# ‘Inner Space’

## The development of repeatable techniques to integrate flameworked inclusions into and onto the sandcast glass form for artists

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**‘Inner Space’ – The development of repeatable techniques to integrate flameworked inclusions into and onto the sandcast glass form for artists**

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## I. Abstract

This practice led research is focused on encapsulating complex flameworked glass components within the interior and on the surface of sandcast glass objects. This research develops new techniques and enhances old methods associated with hot glass inclusion processes to achieve consistent and repeatable results. The practical problems associated with the encapsulation process are smearing, elongation and cracking. Further undesirable effects caused to inclusions whilst casting are misplacement, contamination and breakage.

The technical investigation is built on the methods of two artists, José Chardiet and Paul Stankard. The research concentrates on the adaptation of the pre-heated mould technique and paperweight inclusion techniques. Through mould pre-heating a new process called the ‘transitional’ inclusion has been developed. This technique negates misplacement of inclusions during casting, breakage from exposure to cold or distortion.

Paperweight techniques are utilised for the ‘floating’ inclusion, a historical technique. The ‘floating’ inclusion in conjunction with paperweight encapsulation techniques allowed for the creation of detailed inclusions floating between the glass strata. Paperweight techniques counteracted undesirable encapsulation reactions between the flameworked elements and the negative effects of heat, contamination and the flow of molten glass during the casting process.

A second new technique called the ‘partial’ inclusion is developed using a metal mandrel to create negative holes in the cast during sandcasting. These holes can be used to add flameworked inclusions to the surface of the annealed sandcast with a glass post. This technique negated the need to find compatible glass for casting.

A series of artworks are produced to demonstrate and further develop the new technical processes. The themes behind the artworks are unraveled through three case studies. The inclusion can be used within the body of the sandcast in diverse ways and their relative placement generates potential for a rich new visual language in glass art. These new techniques offer a conceptual opportunity for the artist to articulate the human condition. In conclusion this investigation contributed to new knowledge by generating new encapsulation methods for use in glass industrial design, studio production and to enhance the individual glass artists’ palette.

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## VI Author declaration

According to the regulations I declare that during my registration I was not registered for any other degree. I have not used the material in this thesis for any other academic award.

## VII Acknowledgements

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# 1 Introduction

*This chapter examines the motivation for undertaking research into the fusion of two glass techniques: flameworked inclusions and sandcasting. This emerged from the researcher's twenty year art practice as a flameworker. A short definition of each process is given and the research outlined includes researching further glass techniques such as paperweight making and casting with other glass inclusion types. Other inclusion methods are considered because sandcasting with flameworked inclusions is an unexamined area in academia. Following this, questions, aims and objectives are identified. A suitable methodological approach is explored through the key figures associated with this field Polyani, Kolb and Schön; plus through other practice based PhDs mostly researching glass, ceramics or aesthetics. Finally a summary of the structure of this thesis and a short conclusion complete this chapter.*

## 1.1 Introduction to the research

This thesis begins by introducing a brief history of hot glassmaking to contextualise this research enquiry. Flameworked glass is the oldest form of all hot glassmaking techniques. The first known beads were created in Mesopotamia circa 1'600 BC (Stern & Schlick-Nolte, 1994, p. 13 & 24).The process of working glass at an open fire is most similar to today's flameworking. The first flameworked (dipped) core-formed vessels (see figure 1, p. 2) appeared in Egypt in the reign of Tuthmoses I[1] in the New Kingdom (for a description of the process engaged in using ancient bead furnaces – see appendix 5, p. 266 (Denton J. A., 2015)).

As the centuries move forward, the process of flameworking has barely altered. The essential tools and equipment which include a heat source, a pair of tweezers, a knife and some shears have not changed throughout the millennia's. Although since the invention of closed oil lamps with a spout acting as a wick, the accuracy of flameworking has greatly improved.

[1] Third Pharaoh of the 18th Dynasty, reigned 1506 1493BC

21st century flameworking consists of melting rods of glass with an oxygen/propane burner whilst manipulating that glass by hand using simple tools. Glass objects can be blown on the torch or solid worked. Objects made on the torch are often highly detailed either through form or use of colour. This is mainly due to the improvements made to the burners and changes in fuel type. Flameworking is arguably the most direct form of glassmaking. Results are observable quickly and the relative set-up cost is minimal in comparison with all other hot glass processes. Flameworked glass is frequently intricate, lends itself to the illustrative and is often imbued with some sense of narrative (see figure 11, p. 17). This can be particularly observed in the artworks of Paul Stankard who is a founder of the contemporary flameworking movement. His work can be referred to in sections 2.10 & 2.10.1, pp. 68-76. This tendency towards elaboration often renders flameworked artworks delicate and fragile (see figure 2, p. 3).

Figure 1 Egyptian ‘Amphoriskos’, Twenty-Sixth Dynasty, 7th to 6th Century BC (Stern & Schlick-Nolte, 1994)

This research has been engaged in to establish new innovations in hot cast inclusion techniques and to increase the durability of the flameworked object. However, it was important when beginning this research to retain the detail often associated with the practice of flameworking (see figure 3, p. 5). In the contemporary glass field, flameworking is becoming increasingly popular as can be ascertained in sections 2 - 2.1.2, pp. 35-42. This is due in part to the new trend in smoking '*paraphernalia*'[2] - Utilitarian glass pipes[3] (see figure 12, p. 37). Galleries are becoming increasingly open to flameworked objects both in terms of art and utility. In an interview by Philly.com (an online newspaper covering the Philadelphia area in the United States) Fred Deuschle, an employee of the Primal Glass Gallery is quoted as saying *'They've [functional glassblowers] pushed the limits of pipe making so much that they're now outside of pipes and [have moved] into art. That's changing art's set of rules'* (Vadala, 2014). Due to this recent surge in popularity, flameworking as a technique could become an important player in the glass art field in the future.

Figure 2 'Dragon', 2015 by J A Denton. Flameworked glass; H. 20 cm, W. 15 cm, D. 8 cm. Aquired by Broadfield House Glass Museum, UK for their public collection, photography credit: Kevin Moonan

During this research a survey was undertaken utilising the two most popular glass journals Neues Glas and New Glass Review. This survey examined the popularity of

[2] Any single words in *italics* can be cross referenced in the glossary of terms in Appendix 1 , pp. 213-218
[3] New movement dubbed *'Functional Glassblowing'* in the United States

the glass processes relevant to this research over the last 20 years (see sections 2 - 2.1.2, pp. 35-42). The results showed that flameworking is growing in popularity. This can be corroborated in table 1, p. 36 and table 2, p. 39. Although flameworking is increasing in popularity as an art glass technique, it is still fragile as an object. The initial reason for carrying out this research was to establish practical ways to increase the physical strength of a flameworked object whilst retaining its visual style (see figure 3, p. 5). This research initially focused on finding a suitable hot glass process to combine with flameworking to increase its strength. This combination of processes needed to encompass three primary functions:

i. Be able to retain the essence of a flameworked object.
ii. Act as a catalyst for moving flameworking forward technically and aesthetically.
iii. Permit the development of a range of visual effects suitable for artistic expression and appropriate to the field of flameworking.

In the lead up to undertaking this research, I contemplated which 'other' technique may have the potential to accomplish each of these three roles adequately. After much thought I realised a glass process called sandcasting may be appropriate. I had been exposed to this hot glass process in previous years. I felt sandcasting may adhere to the technical and thematic needs of the research. Sandcasting is a primitive hot glass furnace technique. The process of sandcasting is achieved through ladling molten glass into a mould made from sand. Glass artist Henry Halem (see sections 2.5 & 2.5.1, pp. 55-57) made the observation that *'Although the technique of sand casting is mastered fairly easily, few have defined an aesthetic that goes beyond the crude.'* (Halem, 1996, p. 60).

One could state that casting with flameworked components has previously been achieved in the paperweight. This is true, but paperweights have an entirely different aesthetic impact with added traditional constraints (see section 2.10, pp. 68-71). Paperweight makers are constrained by size and shape of object due to restrictive historical controls. These controls (the collectors market) dictate how a paperweight should appear. Therefore it was not appropriate to research flameworked inclusions using solely paperweight techniques. There has been no formal academic research dedicated to the subject of combining flameworked inclusions within the body of a sandcast. The majority of specialists in the industry believe that flamework combined with sandcasting is too unpredictable. Furthermore in a recorded interview with artist Lachezar Dochev, he says of inclusions within a cast glass form *'Inclusions – I don't do so much because it needs more preparation and better or strong concept in order to use them'* (see appendix 2, p. 250). This suggests that it takes a great deal of time and thematic consideration to yield a successful artwork both on a technical level and an aesthetic level.

Figure 3 Anima Mundi series 'Sacrificial heart' 2015 by J A Denton. Cast in sandmould with flameworked transitionalinclusions; H. 30 cm, W. 21 cm D. 4 cm. Front and back view. Photography credit: Kevin Moonan

In conclusion, this research resulted in a new fusion of glass techniques. The research was driven and informed by the development of a body of new artworks which varied in shape and scale as the research progressed. This research successfully created detailed yet fundamentally strong objects. The sandcast artworks created during this research period could be viewed from at least two sides as can be seen in figure 3 on page 5, and they were often fully three dimensional objects (see Figure 4 below). The new inclusion techniques developed for creating artworks with sandcasting were consistent and repeatable technically. The artworks made during the research period allowed for thematic exploration of the relevance of suspended objects in a transparent yet solid space. Artwork case studies 4.3 & 4.4, pp. 187-206 examined and broke down **some** of the conceptual possibilities these techniques could offer the artist working in glass.

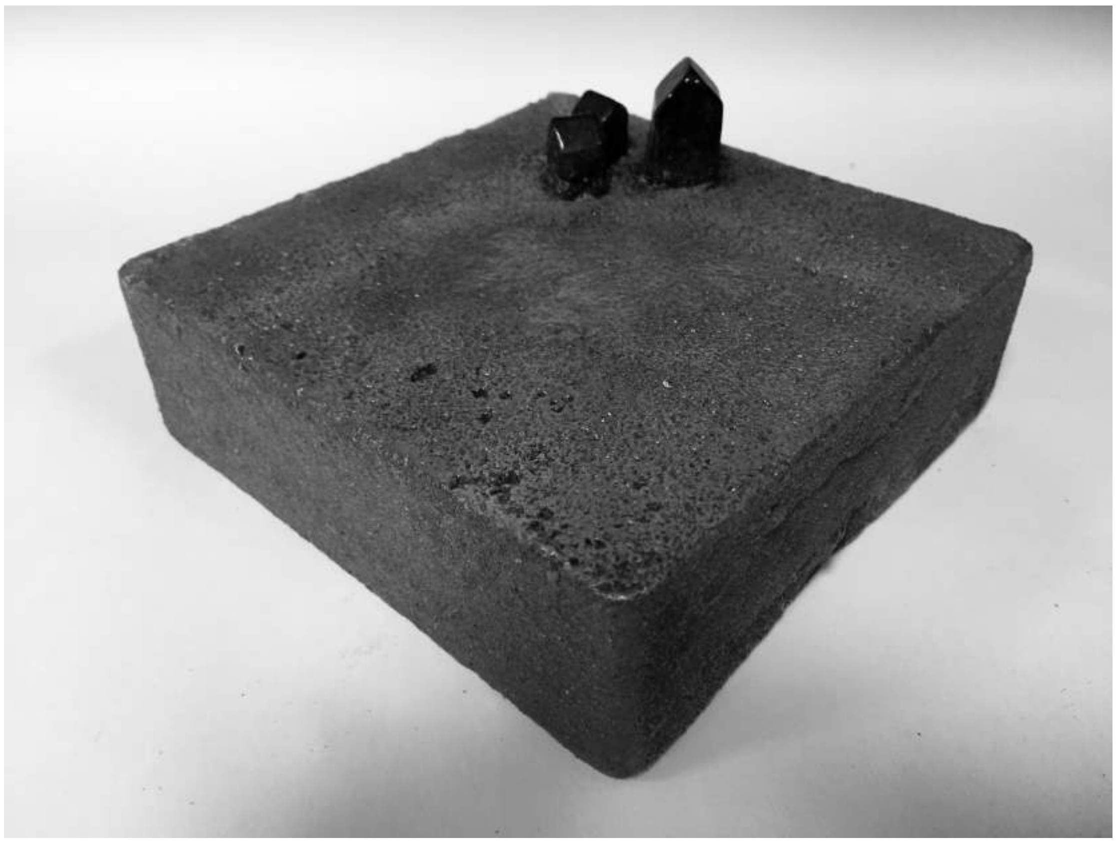


Figure 4 Anima Mundi series 'Home #2' 2013 by J A Denton. Cast in sandmould with flameworked inclusions; H. 15 cm, W. 20 cm D. 4 cm. Photography credit: J A Denton

This research aimed on a technical and aesthetic level to make the combination of flameworking and sandcasting accessible to practicing and developing artists to develop their skillset in a relatively affordable manner.

## 1.2 Outline of the research field

The first manufactured glass objects were made using the technique of flameworking (Kücükerman, 1988, p. 20). This is shown in figure 5 (p. 7) which theoretically illustrates an ancient furnace for flameworking. This diagram is juxtaposed with an actual example of an ancient furnace. This actual furnace was made at the International glass festival in Stourbridge, UK in 2006.

Flameworking consists of the manipulation of glass in a flame to create both solid and blown forms. The output of this technique has been used in the form of beads for trading purposes (Jenkins, 1997, p. 10) or as vessels (see figure 1, p. 2) for both storage and decorative purposes. Since the $17^{th}$ Century flameworking has been used in scientific laboratories, especially chemistry and biology. This is due to the materials inert, transparent and heat resistant qualities (Dunham, 1997, p. 8 & 9). More recently glass has been used as an artistic vehicle of expression transcending its humble origin in the crafts (Hauscke & Weschenfelder, 2014, p. 9).

Figure 5 Left: ‘Furnace diagram’ by Kücükerman. Right: Historic flameworking with Torben Sode in 2006, photography credit: JA Denton

Alternatively sandcasting is an industrial process originally developed for aluminium alloy and bronze casting. This process uses a preformed mould made of sand and bentonite. The mould is then filled with molten alloy. The transition of this technology to creative glass forming was largely pioneered and perfected over a 40 year period by

Bertil Vallien (see sections 2.4 & 2.4.1, pp. 48-55). He works as a designer and glass artist at the Swedish glass factory Kosta Boda. (Halem, 2006, pp. 52 - 71)

Figure 6. Example of mansfield sand with added bentonite, and ladles cooling down after use in the furnace, photography credit: JA Denton 2012

The sandcasting process is transposed over to glass by layering ladles of molten glass into a mould made from *Mansfield sand*[4] (for a visual example of a glass ladle and the sand used see figure 6 above). *Compatible* glass objects can be added in between ladles and are encapsulated between the layered surfaces. These inclusions sit on the viscous surface of the furnace glass beneath. They are captured (made static) by the progressive strata of hot glass ladled over the top. Note that once placed on the glass surface, the preheated inclusions cannot be moved. They are effectively stuck in place which is a reason why specialists in the field state that this technique combination is 'risky' (see p. 16 & p. 163). The liquidity and temperature of the furnace glass can melt and distort any thin glass inclusions causing unnatural distortions like trapped bubbles, elongation or an effect similar to smeared paint (see chapter 3, pp. 87-170). In response to this, artists wishing to encapsulate flameworked components have often

[4] All words in Italics are defined in Appendix 1 : Glossary of terms (pp. 225-240).

restricted the complexity of their inclusions, as shown in figure 7 below, by the Czech glass artist Pavel Molnar.

Figure 7 ‘Disk on stand’ 1986 by Pavel Molinar. Cast in a sandmould; H. 15 cm, W. 20 cm D. 4 cm. Photography credit: Pavel Molinar

In contrast, paperweight makers such as Paul Stankard use highly developed flameworked inclusions within their paperweights. The inclusions are encapsulated in clear glass using a vacuum pump, which pulls the molten glass body around the flameworked forms quickly. The vacuum helps to preserve the three dimensional detail and deter the smearing effect of the flameworked inclusions. This research seeks to build upon paperweight processes and create complex inclusions of equivalent quality in a sandcast. This research will endeavour to discover successful methods to stop inclusions from being misplaced whilst casting. Plus the research will find methods to create inclusions which don’t have inconsistent or unnatural effects caused by the (molten) furnace glass, such as smearing, elongation, trapped bubbles or later, breakage.

Whilst a literature search has not located any completed PhD's written concerning the subject of flameworking combined with sandcasting; a number of PhD's concerning glass, ceramics, and art & design have been compared and contrasted in preparation for the writing of this thesis. The methodological approaches and contextual investigations from selected PhD's such as Petrie (1999), Davies (2012) Flavel (2001), Tani (Tani, 2014), peng (2014), Donghai (2013) and Collier (2011) have been utilised throughout this document but particularly in sections 1.3.1, pp. 18-19; 1.5 pp. 26-30 & 4.1 p. 173.

Although there was no formal academic research on this precise subject, there are a number of articles which have been written about the combination of the processes. For example Bulgarian sandcaster Lachezar Dochev wrote an article concerning procedure for the 3rd International Glass Festival in Luxembourg (Emeringer & Baiza, 2009, pp. 142 - 143). Equally, and on numerous occasions a series of key journals such as The Glass Art Society Journal (USA), New Glass Review (USA) and Neues Glas (DE) deal with the separate subjects of flameworking, sandcasting, paperweights and hot glass casting with inclusions. These articles examine a range of matters relating to each processes technical, aesthetic and philosophical qualities. For example the Curator of the Corning Museum of Glass (USA) Tina Oldknow discusses the ideas behind artist Steffen Dam's work (2013, pp. 96-98). Gunnar Lindqvist (1996, pp. 41-48) deals with the aesthetics of the artwork of Bertil Vallien.

A number of texts in the Glass Art Society journals discuss technical demonstrations in flameworking (Ishida, 2007, p. 107) which have featured heavily in terms of demonstrations of flameworking and neon every year since 2001 up until the present day (2017). Although these articles do include some curatorial critique of theme, I am yet to find an article considering the aesthetic and/or philosophical implications of the use of the inclusion within the cast glass form. This is excepting a short excerpt from an essay in the glass art society journal by Geoffrey Edwards written contextually in terms of Romantic period literature and painting. This article concerned among other things *quiescence*[5], a term referring to one of the qualities of glass – namely the inclusion '*…like the conventional 19th Century exquisite botanical motif concealed and tantalizingly inaccessible within a clear, hemispherical dome of glass. This sense of 'quiescence' – of pristine and hermetic enclosure, of rarefied isolation, of being removed from the anguish and turmoil of daily life – is what we encounter in [the] pictorial glass metaphor'* (2005, p. 25) Here are the beginnings of a commentary concerning what is evoked when apprehending the inclusion within a solid transparent glass mass. For a basic interpretation concerning the concepts of my artworks created prior to this research see Appendix 7 267-272. The artworks considered are mostly flameworked, but the commentary provides a starting point in considering the aesthetic and philosophical qualities one artists artworks made from glass have to offer the glass art movement. The commentary concerning the use of glass as an artistic medium for expression continues throughout this thesis but is intensly investigated in chapter 4, pp. 171-208.

## 1.3 Motivation for the research

Whilst completing a Bachelor in Glass and Philosophy at the University of Wolverhampton, I was privileged to attend Pilchuck, Dale Chihulys'[6] glass school just outside Seattle, USA in 1999. Arguably little was known of flameworking outside of the sciences at that time in the UK. I studied under Muranese glass maestro Emilio Santini, who after I finished my degree chose me as his apprentice in Virginia, USA for nine months in 2001. This was a privileged position because he had never had an apprentice before and he stipulated that he would not have one thereafter. During this period I was able to familiarise myself with the American glass art scene first hand. I achieved this because Emilio taught and exhibited extensively across the east coast of America. I was exposed to a number of glass techniques, and an even greater quantity of professional American glass artists.

[5] Quiescence – One of three definitions attributed by Lord Byron to glass for its metaphorical qualities in literature.
[6] American glass sculptor and entrepreneur

After returning to the Isle of Man and setting up an artist's collective, I travelled regularly to Europe and the USA to teach and assist a number of well-known glass makers such as Lucio Bubacco (IT), Bertil Vallien (SW), Shane Fero (USA), Sally Prasch (USA), Loren Stump (USA) and others. I worked in the most basic studios such as those in Turkey in the early 'noughties', contrasted by 'The studio' at Corning museum of glass which had/s state of the art facilities.

I realised in 2009 that the Isle of Man was limited in terms of creative opportunity, and constrained due to location. I had an affiliation with a glass supplier and educational establishment called Creative Glass in Zurich so I moved there to pursue higher artistic goals. Europe surrounds Switzerland which gave easy access to the Continent. Here I set myself up as a freelance artist and teacher. After changing country, I was immersed by a need to deviate from my direction which up until this point had been the mastery of flameworking. Although flameworking was a direct and expressive medium, it could easily break during transportation. This was a distracting restriction. Therefore I began my search into how I might enable flameworking to transcend its inherent fragility successfully whilst retaining the visual aesthetic associated with the process. Could it be combined with another process to increase the integral physical strength? Could this be achieved whilst still retaining the narrative potential flameworking as a medium had to offer?

I had previously completed a master class with Bertil Vallien (See appendix 4, pp. 262-263) who is considered to be the 'grandfather' of sandcasting. Upon reflection this helped me realise that sandcasting was a possible route to achieving my desired aims with flameworking. In 2011 I embarked on this research degree into the combination of flameworking with sandcasting. I realised it was possible to combine these techniques in a consistent and repeatable way, and I recognised that this research *could* be of use to other artists in the glass field.

The use of flameworked encapsulations in sandcast glass presents benefits for the glass artist. The artist can create finely detailed and delicate assemblages. Delicate assemblages after being cast in the body of a sandcast can be transported or displayed with no risk of breakage to fragile components. Adding flameworked components to a sandcast provides a further dimension of artistic expression for the flameworking artist (see chapter 4, pp. 171-209), because large solid forms cannot be created using flameworking techniques alone.

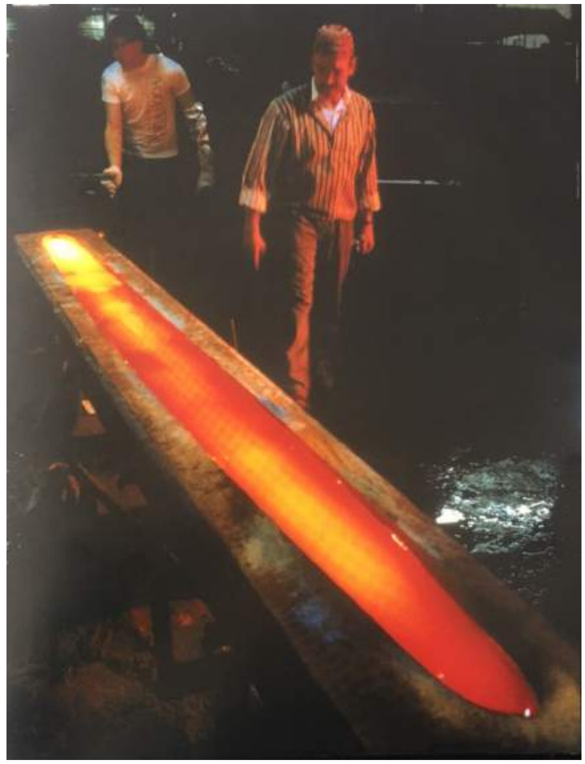


Figure 8 Bertil Vallien casting a large 'Boat' with his team at Kosta Boda in the 1980's, photography credit - Håkan Elofsson. (Lindquist, 1996, p. 25)

The encapsulation method allows flameworking which as a process is known for its delicacy and fragility (as opposed to a process like glassblowing), to increase its scale and mass whilst still retaining its detail. To give an example of scale in terms of sandcasting, artists such as Bertil Vallien make long boats among other things (see figure 8 above). These works at their largest are 4 metres long. Hot glass casting artist Ben Tré (see figure 9, p. 14) creates his works as single piece. The single sandcast pieces are often made in combination with other materials such as concrete, lead or brass. Ben Tré also creates the glass in sections and then cold fuses them afterwards. The largest single sections to date are 45 cm x 62 cm x 122 cm. These artworks are in opposition to flameworking in terms of scale. The largest piece I have made in a single section are filigree vessels (see Figure 101, p. 202) which measure 41 cm x 41 cm x 25 cm. Furthermore the possibility of breakage is a constant issue.

The conceptual possibilities of combining flameworking with sandcasting (explored in chapter 4, pp. 171-209) is an opportunity rich in untapped aesthetic and expressive potential. This potential is only available to the artist working in glass, due to the transparent qualities of the material (see pp. 171-172). Other mediums such as resin could be used as an alternative to glass, but resin is brittle and not as durable as glass. Plus resin does not provide the crisp optical qualities synonymous with the glass object.

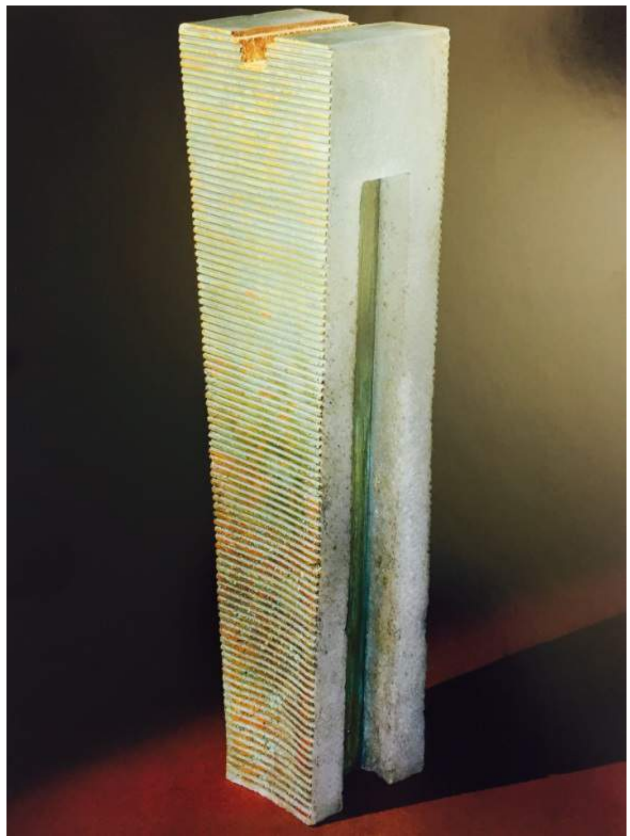


Figure 9 'Dedicant #8', 1987 by Ben Tré. Cast in a sandmould, sandblasted, cut, ground; gilded lead and brass details; H. 121.6 cm, W. 35.9 cm, D. 25.7. (Frantz S. K., 1989, p. 234) Photography credit: Nicolas L. Williams & Raymond F. Errett

As previously explained the combination of flameworking and sandcasting has received little formal exploration or analysis, culminating in a lack of written technical data. This gap in knowledge has driven the focus of this research. Some limited interdisciplinary crossovers between sandcasting and flameworking are evident, and are noted in section 1.2, p. 8. However, Paul Stankard utilises highly developed flameworked inclusions within the form of the paperweight (Also noted on p. 8). Therefore the initial research field suggests that it **is** possible to create complex inclusions within a sandcast form of an equivalent quality to the inclusions in paperweights (see Figure 10 below). It was a key focus of this research to create inclusions in sandcasts with no evidence of smearing, elongation, optical impurity[7] or blurring whilst limiting breakage caused by *CoE* differentials.

Figure 10 Paperweight detail by Paul Stankard

The sandcaster Bertil Vallien almost completely dispenses with paperweight encapsulation techniques when he adds inclusions to a hot glass mass. This

[7] Dirt on the clear inclusion glass either from scratches on the original glass rod surface before melting, or from oil left by fingerprints if glass has not been cleaned with alcohol pre-casting (see section 2.10.1, p. 76 & section 3.5.1, pp. 141-145 for more details)

suggested that there were further alternatives to achieving the same goals, which were to create detailed inclusions combined hot in a sandcast. It was important to the breadth and further dissemination of this research to give the flameworker or caster a series of inclusion options.

Therefore the most important goal of this research was to source commercially available coloured glass which was compatible with the designated furnace glass. Once this goal was achieved through the research enquiry, what other alternatives were available to the flameworker? Vallien paints furnace made compatible *blanks* with high fire enamels (see section 2.4.1, p. 54). He also uses thin machine cut copper inclusions within his casts (see section 2.7, p. 62). This was an alternative. Further alternatives were considered and tested in chapter 3 which led to a new inclusion technique called the partial inclusion (see section 3.5.3, pp. 155-159). Plus a technique was discovered that could force the coloured glass to become compatible with the furnace batch glass dependent on the inclusion technique in use (see section 3.5.2, pp. 150-151).

Sourcing compatible glass was the key element of this research. This was due to the requirement to achieve a paperweight-like quality with sandcasting. This type of visual was only possible with a palette of opaque and transparent colours which *fitted* the furnace glass. Problems with specific colours or brands and solutions are covered in chapter 3.

Another important element of the research was to find (a) new technique(s) which gave consistent repeatable results. In a personal interview with Italian flameworking maestro Lucio Bubacco at the Denizli flameworking festival in Turkey, he exclaimed that '*Flamework combined with sandcasting is a nice technique but too unpredictable… only 20% of pieces are very beautiful!*' (Bubacco, 2013). Figure 11, p. 17 shows a piece created by Bubacco using cast glass and cold sealed flameworked figures. The artwork *'In the garden of the damned'*, and a series others created during this time Bubacco has completely foregone with hot fusing the inclusions. Whilst working with Bubacco in Turkey he told me there is no possibility to sandcast in Murano (Italy), where he lives and works. This lack of facilities could be a reason why he has not created flameworked and sandcast glass. Bertil Vallien creates up to three extra variations when casting large objects, in order to increase his probability of a single beautiful piece (Lindqvist, 1999, pp. 108 - 109)

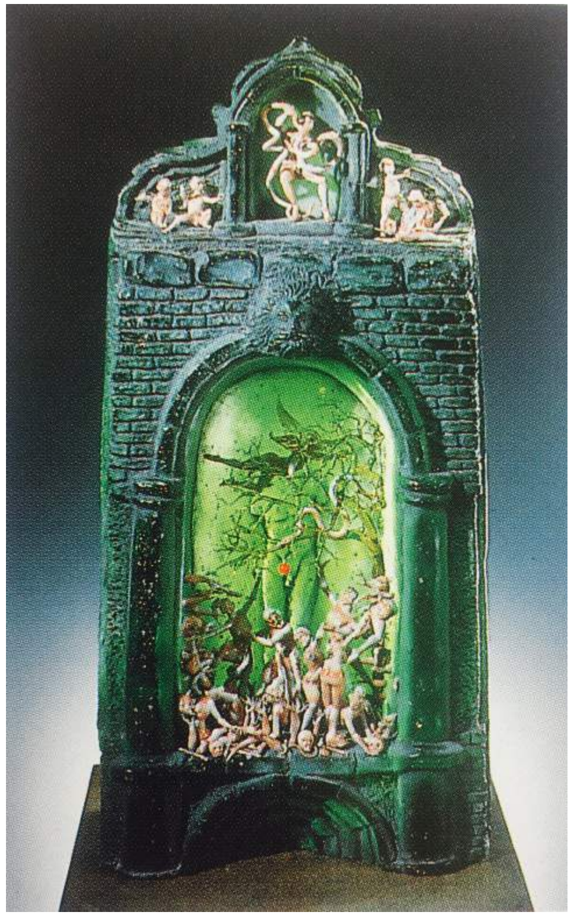


Figure 11 Lucio Bubacco 'In the garden of the damned', 55cm x 27cm x 14cm. Cast and flameworked glass; assembled, 1996. Picture sourced from Neues Glass (Frantz S. K., 1996, p. 81)

This chapter introduces the research field surrounding the combination of sandcasting and flameworking, and the motivations behind this task. Chapter 2 surveys the field and examines current encapsulation techniques used by other artists. The second chapter also breaks down some of the key artists technical processes. Thereafter the artists are compared and contrasted by examining thematic content, choice of techniques and/or exhibition placement, distinguishing themes and who the audience for such works may be. Chapter 3 deconstructs the relevant technical processes researched in chapter 2. This chapter proposes ways in which the known techniques from chapter 2 could be adjusted to increase the success rate of sandcasting combined with flameworking. New technical innovations are discovered and developed partially through the contextual review artists. Other furnaces in Luxembourg and the Netherlands are experimented with and all techniques are classified. Three case studies examining the artworks created during this research period are examined in chapter 4. The case studies critically breakdown the encapsulation techniques used for the creation of the artworks. Plus the case studies explain and examine the themes chosen for the artworks. This examination began to define a conceptual language specifically related to glass as a material and the combination of sandcasting with inclusions. Chapter 5 summarises the thesis and draws conclusions from this research. Consequently potential routes for further research by others are suggested.

In short, the described motivations led to the necessity of ascribing a series of specific questions, aims and objectives to concentrate the research investigation. These questions, aims and objectives were set to lead the practical testing and drive the focus of the written thesis.

### 1.3.1 Research Questions, aims and objectives

Before having chosen an appropriate methodological approach for this practice based research a series of tasks needed to be defined. This was both to set boundaries concerning the investigation and to push the research forward in the appropriate direction. Further this would help define which methodology would most suit this type of research. The following series of questions, aims and objectives were chosen to direct the investigation and the consequent thesis. This helped to anchor the research with a secure starting point and lead the research to its logical end (but not the end of the scope of the research!). This took the form of specific goals particular to each of the subsequent chapters. The following list identifies the necessary practical routes to completion:

**Questions:**

1. Can flameworked glass encapsulations be applied to the sandcasting process, what are the problems associated with the application of these techniques and how may they be controlled to achieve consistent repeatable results?

2. Can flameworked encapsulation techniques previously used in paperweight making be applied to flameworked inclusion encapsulations in the sandcasting process?

3. How might the relative placement of an inclusion change the narrative or the meaning of the conceptual content within the sandcast space?

**Aims:**

1. Analyse key artists using hot encapsulation methods in order to create a series of case studies examining their techniques and artistic themes.

2. Establish new approaches for incorporating flameworked glass components into sandcast glass forms for creative use.

3. Produce a body of artworks in glass that develop and demonstrate the potential of incorporating flameworked glass components into sandcast glass forms from one artist’s perspective as a critical study which others may adapt and build on in the future.

**Objectives:**

1. Construct a glass family tree consisting of known artists working with inclusions in hot glass, and choose three relevant artists as case studies both technically and aesthetically.

2. Examine selected case study artists narratives with a focus on the use of inclusions in a transparent sandcast volume, and the conceptual space (if any) which is being explored.

3. Identify and empirically test all material applications associated with the process of encapsulating flameworked inclusions into sandcast glass in order to gain a full understanding of the process.

4. Design a series of tests based on the work of selected contextual review artists, and adapt their techniques to sandcasting with flameworked inclusions, then refine and improve upon their methods.

5. Experiment with a variety of furnace glasses and encapsulation glasses to unveil compatible combinations and/or alternatives with a concentration on *Philips 3300 batch,* G*lasma* and *Cristallica* furnace glass.

## 1.4 Research approaches introducing methodology

This research concerning the encapsulation of flameworked forms into a larger sandcast mass has been approached primarily from a practical artistic perspective. This research should provide insights which will further develop and advance the use of detailed inclusions within a larger sandcast form for artists. This has been approached via a contextual review surveying the current field and practice based studio testing. The application of this research is mainly for artists wishing to create detailed scenarios in a larger glass body which are not fragile.

This PhD has relied on the application of *tacit* knowledge. The term ‘tacit knowing’ was first given serious attention by the Hungarian theorist Michael Polanyi. In brief, in his book ‘The Tacit Dimension’, Polanyi advocated ‘emergence’[8]. He relied on the assumption that boundary conditions supply degrees of freedom that instead of being random are determined by higher-level realities. The properties of these higher level

[8] The term 'emergence' refers to the claim that there are several levels of reality and of causality.

realities are dependent on but distinct from the lower level from which they emerge. An example of a higher-level reality functioning as a downward causal force is consciousness. *'We can know more than we can tell'.* (Polanyi, 1967, p. 4)

Since Polanyi, others have followed in his wake such as Thomas Kuhn (1922-1996). His theory suggested that learning relates to the acquisition of focused knowledge. Not only this but also, this learnt knowledge matures through observation and repetition which ultimately defy articulation. This is in opposition to explicit knowledge. We can distinguish tacit knowledge further through the PhD dissertation of Ray Flavell who surmises that there is no gap between practice and theory. That rigorous analysis of praxis and the advancement of practical skills give rise to form new creative models (Flavell, 2001, p. 106). Flavell's assertions are interesting, but we know that work and analysis will lead to enlightenment either in cognitive or practical knowledge. How do we take these ideas born of the same origin further?

*'… it requires intelligence not only to discover truths, but also to apply them, and knowing how to apply truths cannot, without setting up an infinite process, be reduced to knowledge of some extra bridge-truths.'* (Ryle, 2009, p. 226)

The process of transforming the 'know how' into 'know that' (Ryle, 1945, p. 1) is known as codification, articulation or specification. 'Know that' is what this thesis has aimed to achieve, especially in chapters three and four. It is important at this juncture to get to the routes of 'exactly' what tacit knowledge is (that which 'cannot' be codified, articulated or specified). Further, why is tacit knowledge something of worth to the authentic practitioner in general, not only in the arts. Tacit knowledge refers to applications which cannot be taught in the same formal way as the explicit knowledge that for example, Bern is the capital city of Switzerland. This can be written down and understood and recalled by an intelligent recipient. However tacit knowledge refers to the 'woolly' acts. Acts like learning a new language, playing an instrument or driving a car. These learned skills require all kinds of knowledge which are not always known explicitly. These skills are often difficult or impossible to transfer in an explicit way to others. The earlier quote by Ryle concerned the acquisition of knowledge and its direct application. Ryle's presidential (1945 to 1946) address to the Aristotelian Society, London sat in direct opposition to the traditional argument that intelligence, is distinct from practical application. Even the Ancient Greeks did not appoint a muse to artists because they felt it did not take intelligence to apply this practical skillset (Cartledge, Hobbs, & Murray, 2016).

In *'The Republic'* written circa 380 BC some of Plato's Socratic dialogue concerned the intellect which according to Plato was divided into three parts – Reason, spirit and appetite. He deduced that the intellect is a special faculty of internal acts of thinking, and that practical activities merit 'intelligence' only when accompanied by internal acts of consideration. At best the act of doing can be attributed to the act of theorising (inner contemplation). This is the summary definition of one component of Plato's classification of the tripartite soul (Plato, 2004, p. Book IV). Ryle successfully argued the case for tacit knowledge[9] encompassing allusions to one of Zeno's paradoxes included in *'The Physics'* (Aristotle, 2008, p. Book VI) which was written circa 350 BC. By utilising a more contemporary version written by Lewis Caroll for the academic journal 'Mind' (Caroll, 1895, pp. 278-280), entitled '*What the tortoise said to Achilles'.* Ryle stated that without causing an infinite regress in logical reason it makes no sense to have a *'shadow act'*[10] which is equally amenable to theory as it is influential over practice. If a practical or intelligent act has to be credited to an intelligently considered regulative presupposition, by its nature this causes a paradox in reason whereby no intelligent, theoretical or practical act could ever begin. Ryle concluded that intelligence is directly applied through action. Intelligence needs no requirement to postulate over a third party faculty reconfiguring the intelligence into an informed act. This is what is known today as tacit knowledge.

The methodological approach was the most essential structural component of this PhD thesis. It was  essential to understand the various methodological approaches concerned with this type of practice based research and choose the most relevant method. The methodological approach was crucial because although knowledge changes over time, the ability to understand how to access knowledge does not. This supposition is succinctly described by Gray and Malins. *'If knowledge keeps as well as fish, today's fact is tomorrow's stinking absurdity. What is important, is knowing how to research.'* (Gray & Malins, 2004, p. 21) There have been countless examples

[9] At that point the term tacit had not been coined.
[10] 'shadow act' in this context refers to a third party – 'A' can communicate with 'B, only if it goes through 'C'

throughout history in which fact has ultimately been proved folly in favour of the next series of ‘facts’, such as the accepted belief that the world was flat, until Aristotle proved with empirical evidence that the World was spherical in circa 330 BC.

This key component of the thesis is equally the most difficult to categorise, as it deals with art practice, tacit knowledge and what sparks creativity. The scientific philosopher Karl Popper believed the empirical sciences couldn’t be proved, but could be falsified. He was quoted as saying in a personal interview for the New Yorker, given shortly before his death entitled, The Porcupine: A Pilgrimage to Popper. *‘It is a myth that the success of science in our time is mainly due to the huge amounts of money that have been spent on big machines. What really makes science grow is new ideas, including false ideas.’* (Gopnik, 2002) Popper advocated scrutiny by decisive experiments and yet maintained that every discovery contains an ‘irrational element’ or a ‘creative intuition’.

A praxis based methodology set the parameters of the creative journey of this research. At times this methodological approach was both crystal clear and directed; whilst at others it posed ever more queries. The practical research period at times encompassed a sense of personal and professional loss when it became clear that a direction took a wrong turn. Then steps needed to be retraced to where ‘it’ was working. But failure has always played an essential role in the making of good art. The artist’s lifelong journey striving for professional clarity is neither simple nor is it easy. Innovation is a key factor, as is adaptability and flexibility in response to numerous constraints, e.g., location, facilities etc... Picasso explained in the most directly perceptible way how the creative act was inspired ‘*The artist is a receptacle for emotions that come from all over the place: from the sky, from the earth, from a scrap of paper, from a passing shape, from a spider's web.’* (Circa 1940) (Walther, 2000, p. 18) Identifying where inspiration may have come from and where (if anywhere) it is heading is a difficult intangible task which can set one up for failure.

In terms of method Donald Schön’s research which was originally directed at professionals in general gave examples of specialised activity. These examples neatly twined with the acquisition of knowledge in the arts. In ‘The Reflective practitioner’ (Schön, 1983, p. 108), Schön endeavoured to examine and explain the relationship between reflection and practice. This was succinctly summed up in 'Planning the journey' from 'Visualising Research', which exemplified an aspect of (the fight against?) reflective practice. I have both identified with this and I have a need to redefine this for the art practitioner, the quote reads accordingly:

*'Schön proposes that much of this activity [problem setting/problem solving] is personal knowledge, learned in practice. In fact he likens it to an intuitive 'art' – 'knowing' is dynamic – knowing **how** rather than knowing what. Schön identifies that the professional's inability or unwillingness to articulate this kind of knowledge has led to a separation of academic and professional practice. This sounds familiar – much of the debate about research in our sector [art] has focused on the fear of losing creativity by speaking about it, and even worse, by writing about it.'* (Gray & Malins, 2004, p. 22)

This excerpt exposes the underlying difficulty of the idea of research in art. This idea is if the hidden element is explained, will the 'genius' simply disappear? This excerpt suggests that the creative person resists discussing their work cognitively, creating a gap between empirical knowledge and intuitive understanding. It begs the question which we are all familiar with, in trying to illuminate the essence of inspiration, is creativity tainted? Does the 'majick' wither into mediocrity when offered a concrete voice? Can art (or any profession utilising creativity/tacit knowledge) be researched in the same manner as the empirical sciences without losing its vitality?

In 2004, Boekman, a Dutch journal concerned with cultural policy, published a special issue concerning the relationship between art and science. Paul Dikker an independent visual artist with a degree in political science from the Netherlands was one of the contributors; here is a small excerpt from his essay in this journal entitled *'Geen doctorsgraad voor kunstenaars*[11]*'* containing the essence of his views associated with research within art. *'Thanks to their formal characteristics, works of art are the personal expression of a theme and thus lay claim to "beauty." A beautiful form can be enjoyed eternally and is therefore "timeless."* Dikker claimed that there can only be one conclusion *'because art and science belong to two completely different paradigms, artists should not preoccupy themselves with all the pressures of social reality and regulations and should above all avoid accepting a "straitjacket" in the hope to obtain*

[11] 'Geen doctorsgraad voor kunstenaars' translates to 'No PhD for Artists'

*one day a PhD in the arts.'* (Dikker, 2004, pp. 189-90). It is difficult to surmise what led Dikker to make such a strong statement, as he himself completed formal art studies at the State Academy of Fine Arts (Rijksacademie van Beeldende Kunsten) in Amsterdam in 1984. Could this suspicion be the Hubris of those uninitiated in the field of research? Could it be fear of the unknown? Or is Dikker suggesting that it is simply wrong to research art in this methodical empirical manner.

Take for instance Leonardo Da Vinci, as cited by Christopher Frayling[12] in *'Artists with PhDs'*. Da Vinci was a visual thinker, a practitioner and an investigator whose passion for knowledge was exemplified in his sketchbooks. The following is an extract from one of Leonardo's notebooks, circa 1500 AD: *'Now, do you not see that the eye embraces the beauty of all the world? The eye is the commander of astronomy; it makes cosmography; it guides and rectifies all the human arts; it conducts man to the various regions of this world; it is the prince of mathematics; it's sciences are most certain; it has measured the height and size of the stars; it has generated architecture, perspective and divine painting. Its excellence places it above all other things created by God.'* (Kemp, 1989, p. 116) Da Vinci's notebooks are arguably one of the first examples of what could be perceived as a visual research methodology. His notebooks display rigorousness and an honest quest for the acquirement of knowledge. In this same book of collected essays concerning Doctoral Degrees in the studio arts, Henk Slager[13] cites Merleau-Ponty. This was in reference to the artistic image, and Slager concluded *'From that [this] perspective, artistic research is also connected with the search for a critical understanding of our existential conditions and the formulation of utopian proposals for improvement… The methodological perspective of artistic research cannot be decided a priori[14], as it can in one-dimensional scientific research. After all, artistic research as an operational process is "open-ended work-in-pre-growth".'* (Elkins, 2009, p. 54)

In conclusion, art cannot be judged in the same way as the sciences, although the accepted framework of the PhD structure should be adhered to so as not to descend

[12] Professor Sir Christopher Frayling - Among many other honours he was the Rector in charge of the Royal College of Art, London 1996 -2009
[13] Henk Slager - Dean of Utrecht Graduate School of Art and Design
[14] A priori – relating to or denoting reasoning or knowledge which comes from theoretical deductions rather than from experience or observation.

into chaos. The immateriality of thought by its nature is difficult to quantify, unlike for example the study of medicine which initially relies on memorising predetermined facts. The art doctorate often depends on a certain amount of qualitative judgement. In this research, chapter 3 is a quantifiable fact finding unit which contributes in a quantifiable way to new knowledge. Chapter four is in part a qualitative enquiry concerning the concepts behind the use of a flameworked inclusion within the form of a sandcast body. This chapter does not contribute to new knowledge directly but acts as an affirmation of the contribution in chapter 3.

## 1.5 Methodology

Initial background research suggested a lack of sources relating specifically to the inclusion of flameworked components into sandcast forms. This was additionally hindered by a protection on the trade which has historically been kept a secret[15] (Kücükerman, 1988, p. 16). These factors necessitated the adoption of a constructivist[16] approach to the research. This approach encourages motivated and independent learning as outlined in *A Bright Spark* (Walker, Gröger, Schülter, & Mosler, 2008, pp. 59-62) from the Journal of Chemical Education. This short document written in Germany outlines Michael Faraday's[17] lectures at the Royal Society in 1860. This concerned the process of what happens when a candle burns. This paper further developed Faraday's ideas and a series of experiments were created. These experiments examined the successful teaching of science. The research was conducted on Primary school and University level students. The paper proposed that the most productive route to learning (science) for all ages was through 'discovering' the process for oneself. This is in opposition to relying on answers given directly by a teacher. In this document Walker, Gröger, Schülter and Mosler have not named the

[15] In 1291 the Venetians moved all their glassmakers to the island of Murano "in case of fire" in 1291. Later in 1295 the government passed a new law forbidding any glassmakers from leaving the city. They softened the blow by awarding every glassmaker a small title of nobility for what it was worth!
[16] Learning is an active, contextualized process of constructing knowledge through experience rather than acquiring it. Constructivism is associated with pedagogic approaches that promote learning by doing.
[17] Michael Faraday 1791 – 1867: English scientist who contributed to the discovery of electromagnetism, and credited with inventing the Bunsen burner.

methodological process, but in essence it is experiential learning as described by Kolb and Flavell.

A praxis methodology puts theoretical knowledge into practice. Within the field of pedagogy it could be described as a cyclical process of experiential learning. This is driven by the development of practical skills and observation. The educational theorist David A. Kolb devised a learning methodology in the 1980's which aptly describes the methodology taken on for the completion of this research. Kolb's method has been reinterpreted to suit this research approach. A diagram describing this can be seen on p. 30. Further Ray Flavell examined Kolbian theory in his PhD which was based on the encasing of glass voids inside a larger glass mass. Here Flavell adjusted Kolbian theory to relate more directly to the practice based PhD in the arts. He devised his own methodological theory which he named the Experiential Learning Model (ELM) (Flavell, 2001, pp. 120-124). This theory applied directly to the studio based artist engaged in academic research. It was composed of four parts which can begin in any one of the four stages listed below:

**concrete experience**

**observation of and reflection on that experience**

**formation of abstract concepts based upon the reflection**

**testing the new concepts**

**(repeat)**

This experientially derived understanding of the research project was the main reason for the chosen methodological approach. By using Kolbian theory as a starting point, and adjusting it together with Flavell's revised version (see diagram 1, p. 28) of Kolbs 'experiential learning cycle' the theory could be modified to suit this research. The further revision I have made can be seen in diagram 2, p. 30. Further, a 'playful' approach to research was advocated by Coffey and Atkinson in their book 'Making sense of qualitative data', and reads *'Analysis is not about adhering to any one correct approach or set of right techniques; it is imaginative, artful, flexible and reflexive. It* *should also be methodical, scholarly and intellectually rigorous'* (Atkinson & Coffey, 1996, p. 10)

Kolb and Flavell's methods were the most direct, and the simplest approach to tackling practice based research in art and design. My method rested on a self-reflective model of continuous questioning, consisting in a mix of curiosity, informed play, discovery, consideration and reinvestigation. This enabled me to regularly define and redefine my academic investigation during specific stages of analysis.

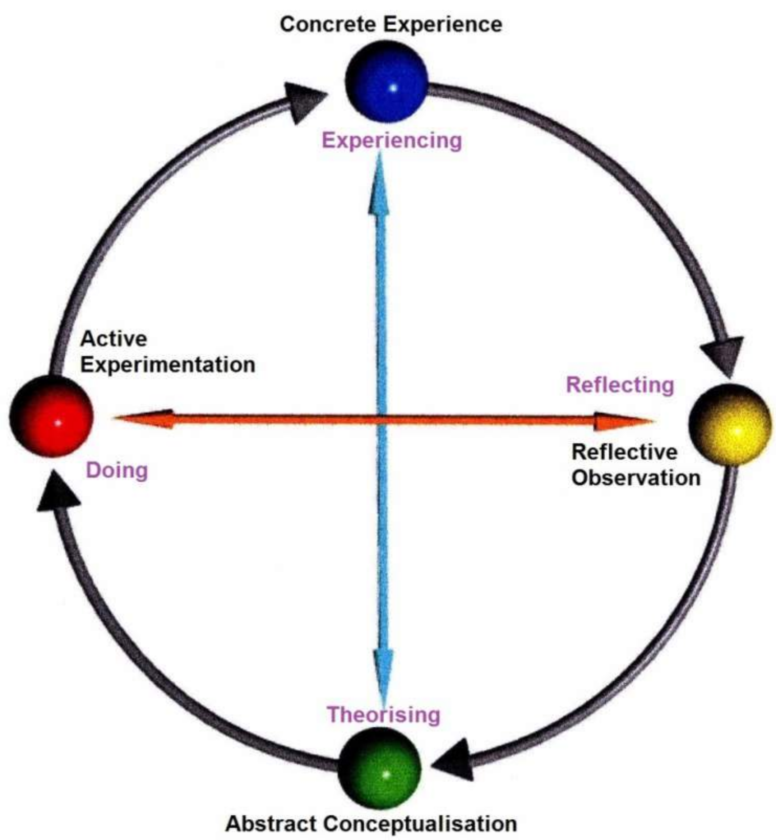



Diagram 1 Ray Flavels diagram (revised) of the Kolbian Experiential Learning Cycle

An investigation of written and visual literature was undertaken in chapter 2. Any gaps in knowledge in the written or visual investigation were researched furthermore by interviewing current relevant practitioners (especially concerning techniques, see appendix 2, pp. 246-254). This enabled a frame of reference to be constructed in relation to the use of glass inclusions in hot casting. Quantitative fact finding took the shape of a survey based on two respected glass journals. This was undertaken to ascertain the popularity of flameworking, paperweights, sandcasting and any other casting techniques which utilised inclusions. These surveys established the relevance of this research to the art glass field, and uncovered further artists who may be useful studies in the contextual review. Thereafter a family tree connecting the important figures in this area of study was drawn up and explained (see section 2.2, pp. 43-47). A contextual review concerned with the collective knowledge in other hot casting techniques linked the artists that were mentioned in the family tree and this made up the majority chapter 2. Finally three artists themes and styles were compared and contrasted to ascertain a firm visual starting point for this research. The research artworks were developed from the critique of other artists chosen themes and were developed in chapter 4. Consequently the research from chapter 2 established the 'gap' of knowledge in the field.

Initially in chapter 3 broad practical testing began. A wide research sweep was undertaken to allow for a sufficient palette of results from which to draw conclusions. This was to ascertain both the viability of the project and in what direction it should be moved forward. Testing out methods already associated with the domain of hot glass encapsulation meant these techniques had to be adjusted to work in combination with flameworked inclusions within the body of a sandcast. By using a Praxis based methodology and reflecting, theorising and improving on the known techniques in this field of research, new techniques were also revealed.

This thesis contains a series of factual investigations which concern the combination of flameworking with hot glass sandcasting both in practice (chapter 3) and in theory (chapter 4). As new techniques were identified in chapter three through standardised tests, chapter four explored and built upon the aesthetic and thematic potential of each step of exploration. Through the creation of a series of new artworks a fuller comprehension of the application potential of the new techniques was possible. Artistic application drove the practical research forward. Further, this qualitative analysis (intellectual craftsmanship) critically developed the conceptual space of the transparent glass object with flameworked encapsulations. This was a rudimentary starting point, but worth further investigation in the future. Consequently the chosen methodology resulted in decision making which was neither static nor fixed, and this left room for further exploration in the artistic 'experiment'.

 Julie Anne Denton

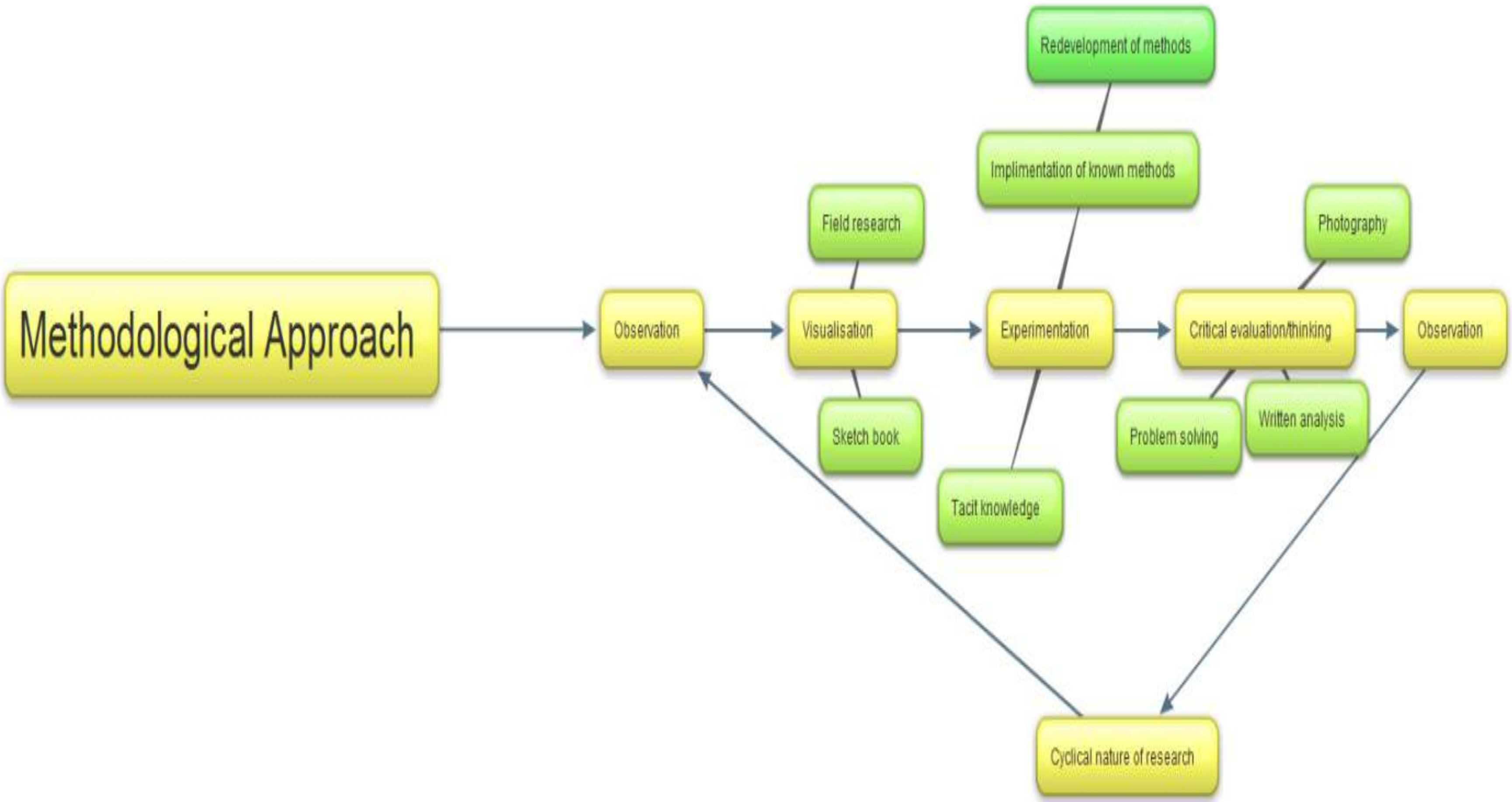



Diagram 2 Methodological approach

## 1.6 Thesis structure summary

This component outlines the narrative of this thesis. Chapter 1 explains why this research is necessary. It outlines the field of research and enquires who if anyone is working with the combination of sandcasting and flameworking. Tacit knowledge is examined and an appropriate methodology is chosen in order to execute this research in the best manner.

Chapter 2 details the popularity of chosen techniques related to the field using two glass journals over a twenty year period. A glass family tree is created to illustrate a visual timeline for artists working with sandcasting and/or hot inclusions of any sort. Key artists are chosen from this family tree and are reviewed in a contextual study surveying the contemporary field. Three of these artists are also reviewed for their technical processes and finally three artists are compared and contrasted in terms of themes and style of artwork.

The contextual review led to practical testing in chapter 3 and the chosen artists whose techniques were most applicable to sandcasting with flameworked inclusions were tested and developed. Subsequently new techniques grew from known methods. This chapter is made up of four components and a final conclusion stating methodological developments and the statement of new knowledge. Whilst the testing commenced, a series of artworks which worked in tandem with this thesis were created and chapter 4 examines the artworks and how these artworks drove the technical investigation in chapter 3. These artworks led the technical direction of the research. As new technical methods were discovered and developed, new artworks could be created to prove or disprove the technical findings. Three case studies looked at three themes making up this PhD research. A narrative for the process of flameworking combined with sandcasting was initially approached particularly in the final case study ‘Heads’. Further, in chapter 4 a tentative investigation was engaged in concerning the visual opportunities glass can offer the artist (pp. 171-174 & 197-201). This conceptual investigation began to unpick and explain how glass specifically, as a transparent material could be utilised as a vehicle for philosophical expression over traditional materials such as bronze or clay. Chapter 4 ends with conclusions comparing and contrasting the artworks created in this thesis with artists chosen at the end of chapter two. This was undertaken in order to place this research in terms of technique, narrative and style within the wider glass art field.

This thesis is concluded with chapter 5 which explains the routes to original new knowledge throughout this thesis and identifies areas for further research. Routes to new knowledge have been defined by Gray and Malins in their book, '*Visualising Research'* (2004, p. appendix 3) and out of 18 clearly defined routes, five applied to this research. A short synopsis of the research followed and further paths for future study directly related to this research were identified. Following the end of this written thesis, a series of appendices concerning annealling cycles, recorded interviews, masterclass notes, published articles and back-up information concerning the created artworks are included. This completed the research.

**Thesis structure summary in brief:**

Chapter 1 – Introduction to the thesis, clarification of techniques researched, research questions, aims and objectives and a discussion concerning the chosen methodology

Chapter 2 – Contextual review examining the popularity of flameworking through respected journals. Selection of relevant artists and practitioners in the field, plus case studies breaking down the most pertinent technical innovations concerned with this research. Finally a debate is undertaken comparing and contrasting the artwork of three selected contextual review artists suggesting thematic and visual starting points for chapter 4.

Chapter 3 – Breakdown in four phases of how the technical research was carried out. A conclusion lists results derived from the technical research and how this contributes to new knowledge.

Chapter 4 – Three case studies of artworks completed during the research period demonstrating techniques, themes and the metaphorical narrative flameworked inclusions can offer to artworks. This was compiled to contextualise the significance of this research.

Chapter 5 – Defines definitions of originality in terms of the PhD, summarises each chapter of this thesis with conclusions and reflections. The conclusions from each chapter are synthesised and areas for further research are developed.

Appendices – Includes a glossary of terms, recorded interview with Lachezar Dochev plus notes on how to make one of his kilncast artworks, notes on Masterclass undertaken with Bertil Vallien, published article, list of exhibitions during this research period, synopsis of contribution of previous artwork and a list of ingredients to make bead release.

## 1.7 Summary of chapter 1 and short synopsis of following chapter

In conclusion this research has been undertaken because sandcasting with flameworked inclusions has not been previously researched in academia. I felt that this research could make a contribution to the glass art field and the industrial area of architectural glass. The questions, aims and objectives clearly state in which direction this research should move forward. The anticipated direction was to investigate other artists who have been using paperweight techniques or hot encapsulation techniques with hot casting.

Chapter 1 establishes for what purpose this research has been undertaken and gives a concise overview of each of the techniques which are to be combined. A suitable methodology was considered in terms of necessity to the investigation and applicability during this type of practical research. A short philosophical discussion was also engaged in to define the need for academic research into the arts and the precise nature of tacit knowledge and it's importance to practice-led[18] research.

The following chapter ascertains the relevance in terms of popularity of each technique concerned with this research. Once established, key artists in the appropriate glass field

[18] Practice-led research leads primarily to new understandings about practice, whereas practice-based research relies on the creative artefact as the basis of the contribution to new knowledge.

are reviewed and in some cases their techniques are broken down in the form of case studies. Finally three artists are compared and contrasted considering their chosen themes and techniques. This is engaged in to establish an initial thematic starting for the artworks created during this research period.

# 2 Contextual review

*This chapter is focused on the artistic practice and the technical methods of individual artists. To develop the context for this research a 'process popularity survey' was undertaken to help establish the scope of the chosen field. A flameworking and sandcasting family tree provides a visual overview of key artists and their connections with one another. Methods of significant artists in terms of this research are chosen and briefly reviewed in relation to their artworks, giving an overview of the field of inquiry. Further, three artists' processes are reviewed in depth in the form of case studies. This component offers a deeper understanding of the individual working practices of these artists, whilst highlighting known techniques and processes particularly relevant to this research. Three further artists are compared and contrasted for theme, style and impact. This chapter establishes where the technical gaps in knowledge lie and indicate a visual starting point for the research.*

## 2.1 Process survey establishing popularity in the field

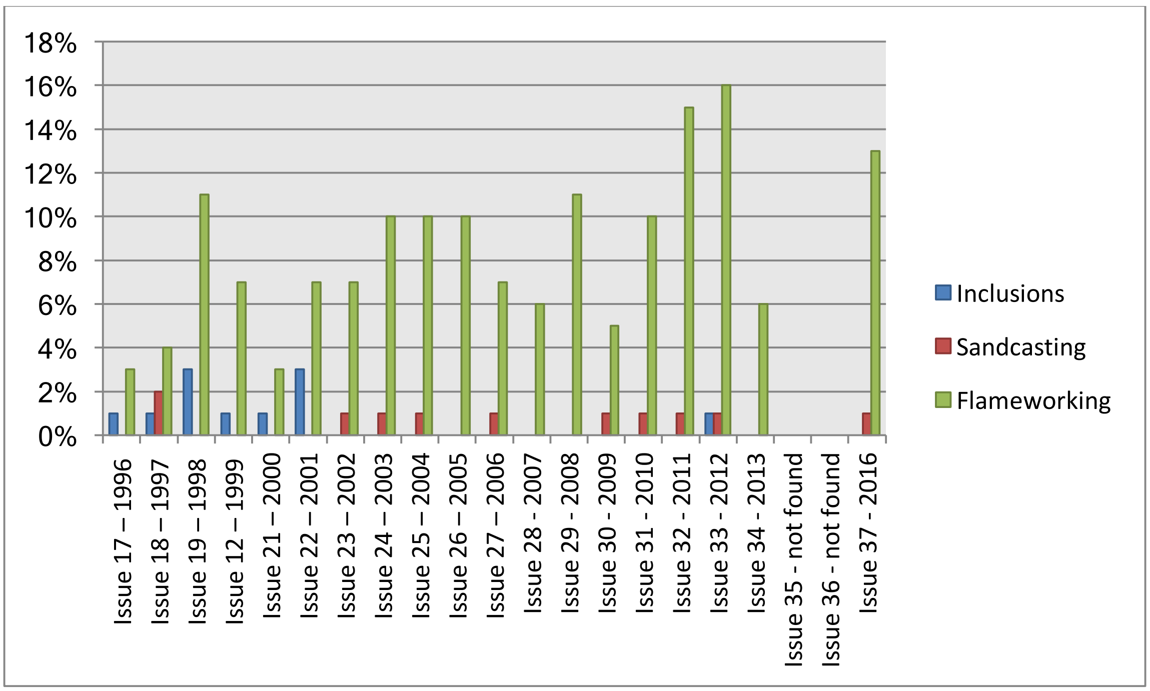
Before beginning the technical investigation concerned with this research, a *significance* survey was conducted. This survey examined two key glass journals *'Neues Glas'* and *'New Glass Review'*. This component of the research was designed to ascertain the popularity of the key techniques associated with this research in relation to the contemporary art glass field over the last 20 years. The goal was to examine if future trends in glass art could be predicted therefore establishing the relevance of this research. This quantitative survey was carried out as an information gathering exercise to further understand the possible implications this research may have on the wider glass community in the future. The main techniques of interest were:

- Flameworking.
- Hot cast inclusions - Mainly inclusions created in hot shop and paperweights.
- Sandcasting.

This survey identified the areas which have gained and/or waned in popularity throughout the 20 year period studied from 1996 - 2016. These publications were chosen because they are the oldest consecutively running and widely respected glass journals. New Glass is based in the USA and Neues Glas is based in Europe which gave a relatively good coverage of the art glass field worldwide.

### 2.1.1 New Glass Review survey

Table 1 New Glass Review survey 1996 -2013




New Glass Review consists of one yearly journal consisting of a juried panel selecting 100 glass objects from submissions from across the world. The included pieces are created by artists (mainly) between October of the previous year and October of the current year of selection. The criterion for this research was to ascertain the popularity of flameworking, sandcasting and the use of inclusions from 1996 until 2016. Note that inclusions were defined as any hot worked glass form encapsulated within a hot or kilncast artwork. The results are shown in table 1 on p. 36 and they show that out of all the areas of research, flameworking was consistently the most popular, spiking in popularity in 2011/2012. The flameworked pieces depicted in *'New Glass Review'* during this time were often in the form of installation works. They consisted of smaller flameworked components which once combined created a larger complete work.

Figure 12 'Munny' 2012 by Coyle Condenser. Flameworked glass; H. 10 cm, W. 6 cm D.3 cm, photography credit: Coyle Condenser

I predict that in the issues from 2017 onwards, a growing trend in 'Functional Glassblowing' (see section 1.1, p. 3 & figure 12 above) will appear in this respected glass journal, confirming the next phase of the genre of artistic flameworking. Robert Mickelson a well-respected flameworker in the USA has been making these type of flameworked pieces for a number of years already, effectively legitimising the genre in advance.

Sandcasting appears less frequently in New Glass Review but spiked in popularity from 1998 to 2001. This thin representation may have been due to a lack of access to sandcasting facilities for artists, or alternatively no artist was making work which was visually successful enough to be included. The rest of the works covered by New Glass Review were either blown, kilncast or kilnformed and each of these techniques were represented in equal measure.

In an interesting turn of events inclusions were more popular from 1996 to 2001, and their peak score was 3 % of the annual review in 1998 and 2001. Since 2001 an inclusion within a cast form has only appeared once in 2012.

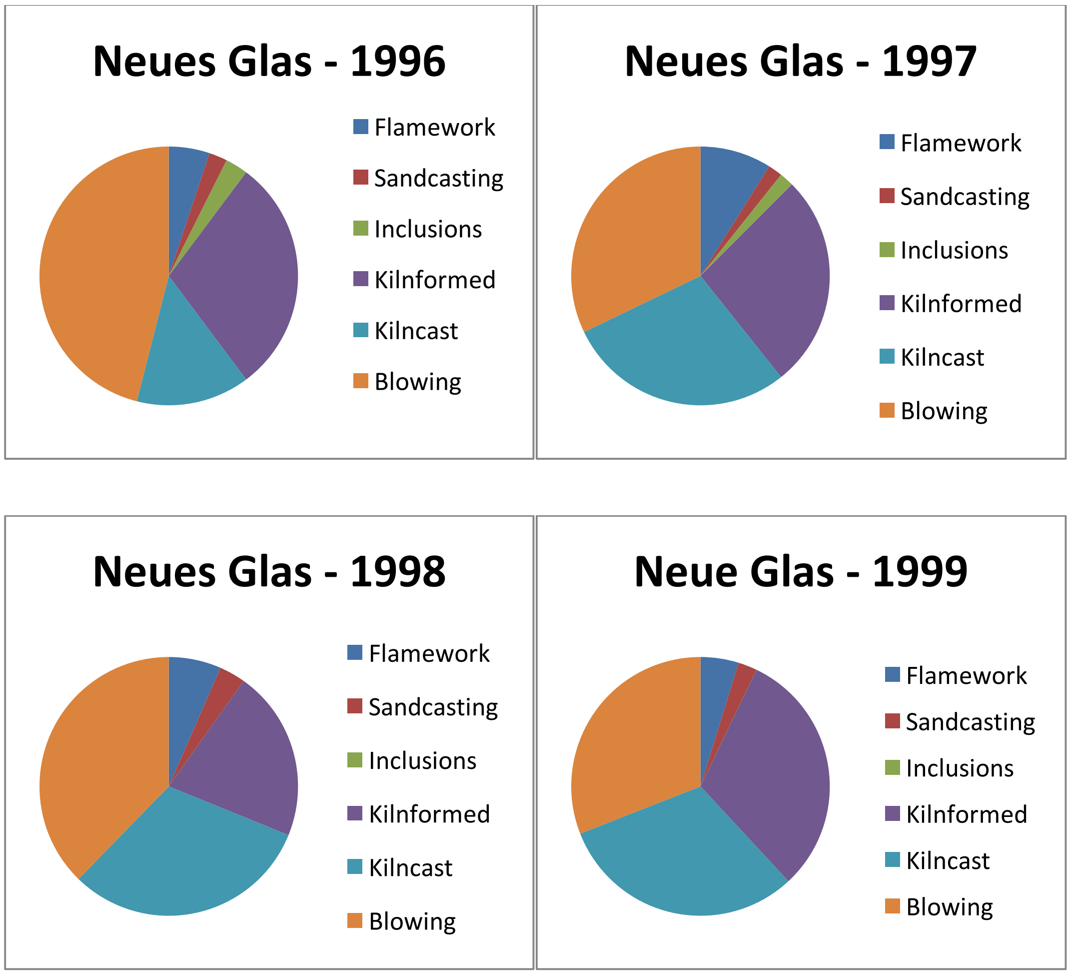
### 2.1.2 Neues Glas survey

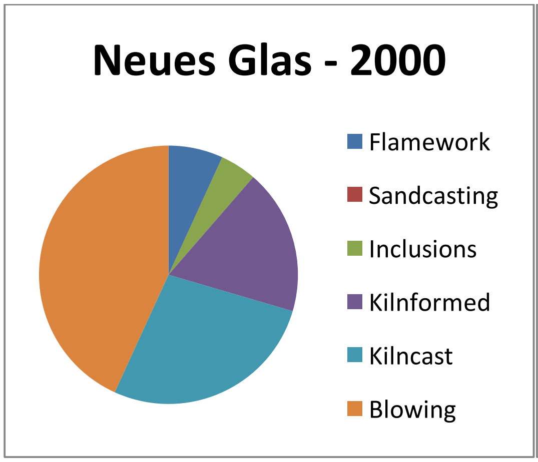
Neues Glas followed a somewhat different format to New Glass Review. It is composed of articles concerning glass artists, current exhibitions at the time and glass prize reviews in the main. This journal comprises of four issues per year. This second survey was undertaken based on both the pictures included within the articles and the articles themselves. Although some articles were three to four pages long, if the article concerned a single artist or group of artists, their individual works only counted as one example for the purposes of this survey. All advertisements for galleries were not not included in the survey.

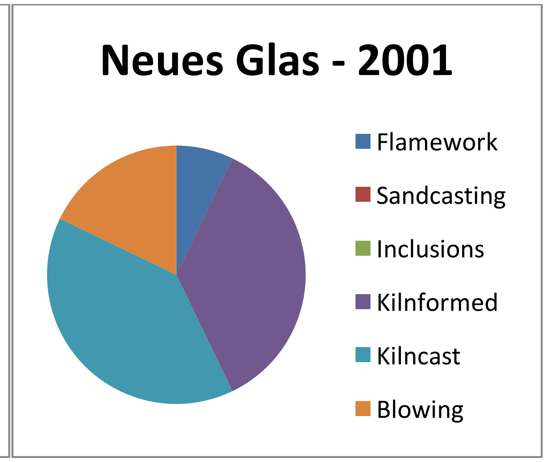
Neues Glas predominantly concerned glass in and around Europe but also included news from other countries such as the USA and Israel. Therefore although there was a European bias it could be considered a relevant source of up-to-date information for the art glass field worldwide. The same time period was chosen for review from 1996 till 2016. This publication proved to be a more comprehensive guide to the current glass art field mainly due to it being published quarterly and including relevant exhibition and competition reviews.

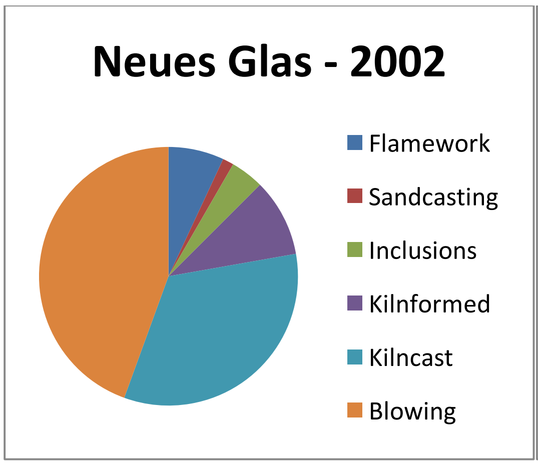
Unlike in the New Glass Review survey, the other glass techniques included in the periodical were also included in the pie charts below in terms of percentage to identify the trends in the techniques used by artists across the board. To avoid confusion, the term kilnformed includes *fusing*, *slumping*, *pate de Verre* and *stained glass*; and the term *Blowing* includes all things made on the end of a *blowing iron* or *punty* including hot formed solid work. Flameworking includes paperweights and neon as well as traditional flameworking. Cold processes such as engraving and sandblasting were not included in this survey. The results are shown in table 2 as follows:

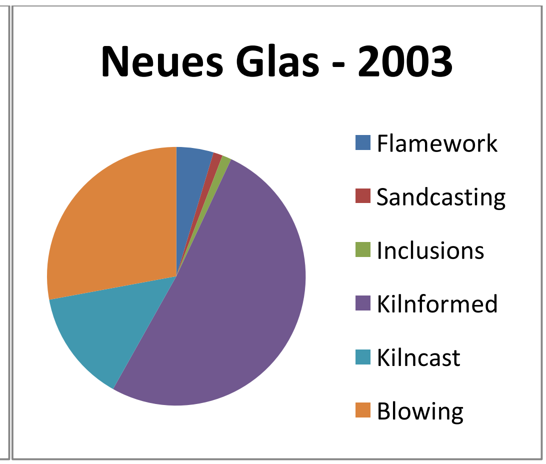
Table 2 Neues Glas Review survey

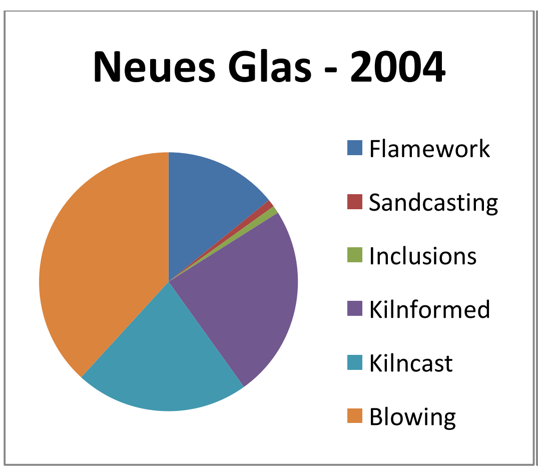



Neues Glas - 2000
Flamework
Sandcasting
Inclusions
Kilnformed
Kilncast
Blowing


Neues Glas - 2001
Flamework
Sandcasting
Inclusions
Kilnformed
Kilncast
Blowing


Neues Glas - 2002
Flamework
Sandcasting
Inclusions
Kilnformed
Kilncast
Blowing


Neues Glas - 2003
Flamework
Sandcasting
Inclusions
Kilnformed
Kilncast
Blowing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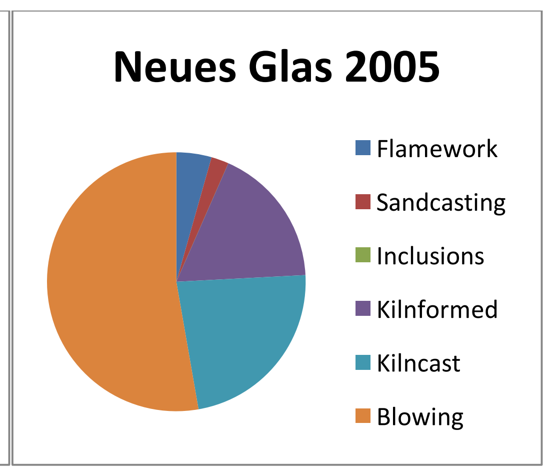
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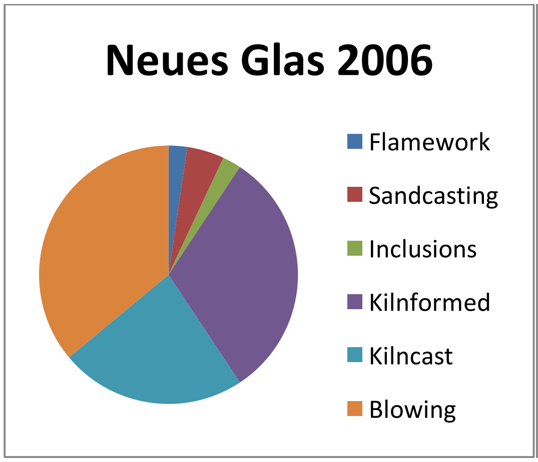
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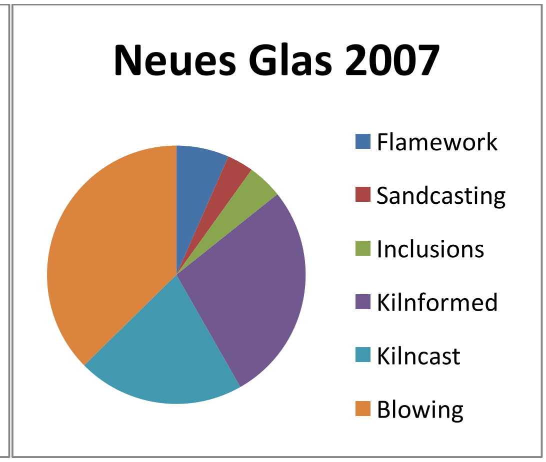
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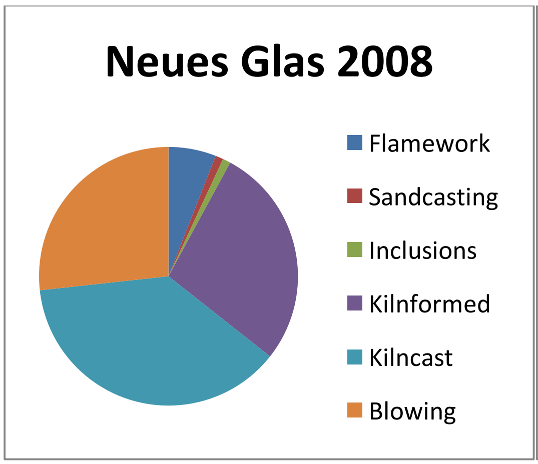
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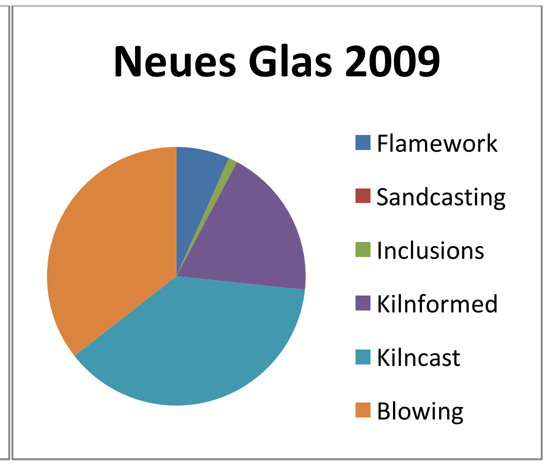
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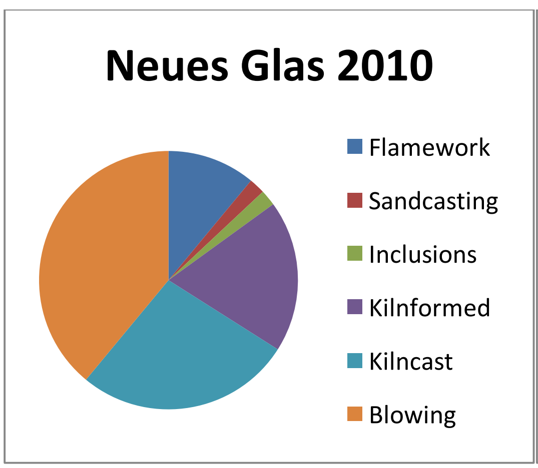
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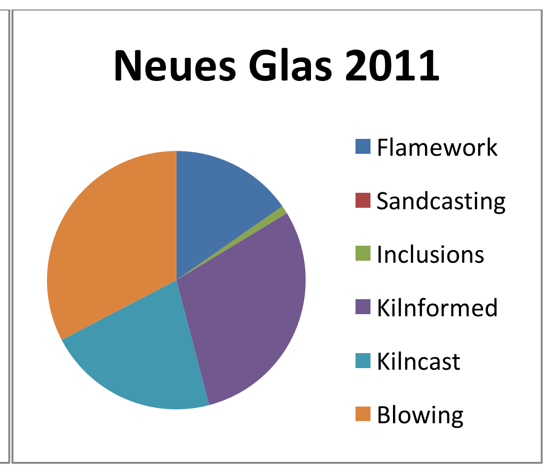
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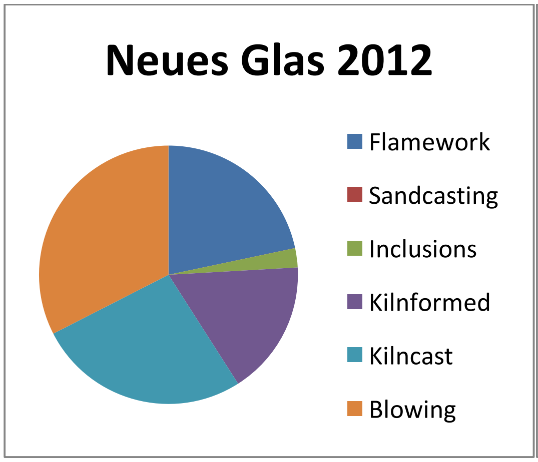


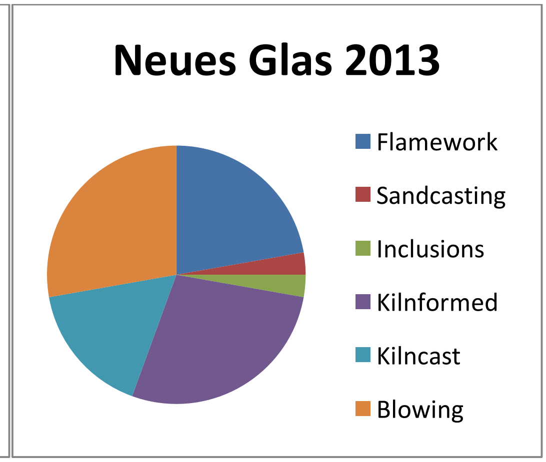


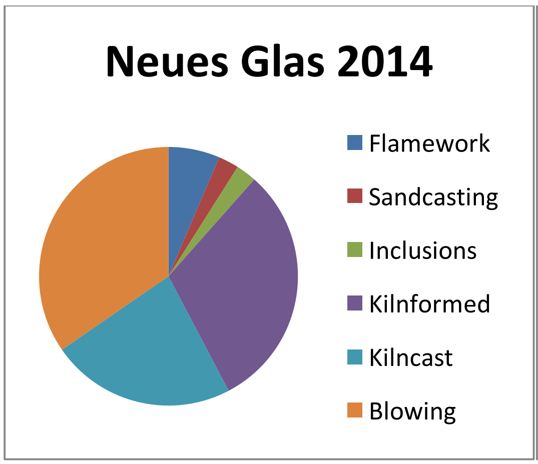


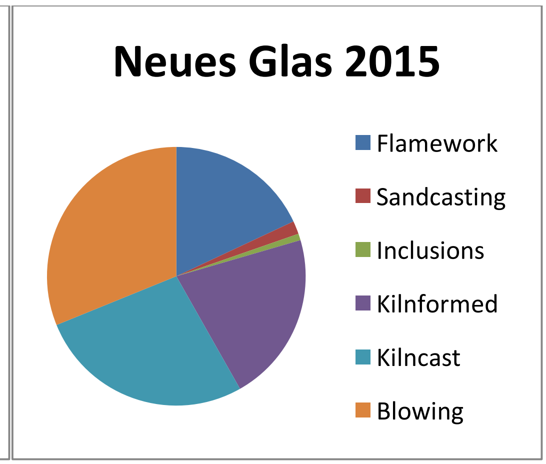


This survey showed simply that while glassblowing and kiln work have remained popular in almost equal rank throughout the researched time period, flameworking has been growing in popularity since 2010 with only a small slump in 2012. This additional survey also confirmed the slim appearance of sandcasting and/or the use of inclusions in the glass form.

These two surveys revealed that flameworking is beginning to establish itself as a serious technique in the field of art glass. It has been stated by Paul Stankard, *'that lampworking is an unexplored process by artists that will have a major impact on contemporary glass.'* (Stankard & Eichhorn, 2007, p. 133). The market rule of supply and demand establishing itself primarily through the *paraphernalia* genre (detailed in section 1.1, p. 3) indicates that flameworking could become as popular in the next 10 years as glassblowing is in 2016.

## 2.2 Flameworking and sandcasting: Family tree

Objective 1 of this research was to *construct a glass family tree consisting of known artists working with inclusions in hot glass, and choose three relevant artists as case studies both technically and aesthetically*. This section partially satisfies that objective and the case studies completing this objective can be found in sections 2.4.1 (pp. 53-55), 2.6.1 (pp. 59-61) & 2.10.1 (pp. 71-76). To give a general overview of how sandcasting and the use of hot cast inclusions have developed over time it was important to distinguish who the pioneers were in this field. How these pioneers might have been connected to one another to allow for idea exchange, or did they work alone? The exact details of this research, such as where artists have shown their work, which artists have worked or exhibited together and which contemporary artist has studied under which historical artist; were difficult to procure. Many of the details were not publically available. Therefore the approach to this research was mainly through reviewing periodic journals such as the two surveyed journals in this chapter, books like *'No green berries or leaves'* (Stankard & Eichhorn, 2007), detailing biographical information of specific artists and curriculum vitae's from exhibition catalogues including 39th Annual International Glass Invitational catalogue from Habatat gallery, USA in order to extract the relevant information.

The facts relevant to this research began with Finn Lyngaard, who wrote '*Glashandbogen'*. Lynggaard is one of the founding fathers of the European glass movement and was best known for establishing the *Glasmuseet* at Ebeltoft in Denmark which now forms one of the finest collections of contemporary glass in the world (Layton, 1996, p. 49 & 81). A contemporary glass artist from Denmark called Steffen Dam (see section 2.9, pp. 65-66) initially found glass through Lyngaards' technical manual. Currently not only is Dam's sandcasting work extremely popular, but equally he has a '*new'* take on the technique of sandcasting. He cuts and polishes his sandcasts and re-fuses these polished multiples together clearly giving him a further element of control over the finished work. In contrast Bertil Vallien (see section 2.3, pp. 48-55) currently creates three versions of each work in order to attain the perfect single piece. Although it was clear that Oiva Toikka from Finland inspired Dam's '*Panels'* with his '*Year Cubes'* (see figure 13 below), Dam has taken the technique to a higher level both artistically and technically.

Figure 13. Left: Oiva Toikka 'Year Cubes' 1977 - 1987, manufactured by Nuutajarvi glassworks & Right: Steffen Dam ‘Specimen Panel’ 2010, photography credit: Steffen Dam

Finnish born artist Oiva Toikka was intrinsically linked with the internationally recognised glass company Nuutajarvi Notsjo which merged in 1988 with ‘Iittala’ both of which were (are) based in Finland. This link to a design company is similar to the link between Bertil Vallien and Koda Boda. As colleagues roughly the same age, both from Scandinavia and working with glass in the Baroque style, they were offered a shared exhibition in Stockholm in 1976. As part of this study Bertil Vallien was the most important figure for this research because he is considered to be the inventor of the sandcasting technique. Henry Halem (USA) added to knowledge exchange, as he introduced Bertil Vallien to the use of sand as a mould material. This in turn led to Vallien’s’ development of the sandcasting technique as it is known today. Further, Henry Halem wrote a key technical manual which included a section on casting glass with sand (see section 2.5.1, p. 57).

A student of Halem, José Chardiet moved sandcasting a step further by creating large three dimensional glass forms using a heated sand mould. This heated mould allowed the glass to flow into long thin negative forms within the sand mould. Halem created a video of a demonstration Chardiet made at Kent State University (see film review in section 2.6.1, pp. 59-61). This recording was incredibly useful to review, as the evidence of his techniques were clear to decipher through the medium of video.

As the aforementioned artists used few inclusions, or only hotcast inclusions, it became important to find an artist working primarily with flameworked inclusions. The most important contemporary glass paperweight maker is Paul Stankard (pp. 68-76). He was chosen to be a case study artist, to see if any of his inclusion techniques could be transposed to sandcasting with flameworked inclusions. This would be developed further in chapters 3 & 4 (pp. 150-154 & pp. 188-189).

Mitchell Gaudet (USA) and his student Lachezar Dochev (BU) were chosen for their novel approaches to sandcasting including the use of many unusual materials both within their sandmoulds and as inclusions. Neither of these artists techniques were scrutinised in the form of a case study, but a personal interview was undertaken with Dochev (see Appendix 2 – Interview with Lachezar Dochev 23.08.2015, pp. 246-254) informing this research of his preferred inclusion techniques, and his artistic vision in section 2.8 (pp. 63-64). This information exchange was built upon further through demonstrating together at the Luxembourg International Festival of Glass 2015 (see figure 22, p. 65). Our demonstration together was examined in terms of furnace glass type in section 3.4.2, pp. 135-137.

This information was compiled in order to create a visual diagram in the form of a glass family tree so as to tie the information together in an understandable written and visual format.

**Key to glass tree**

1. Invited Vallien as guest teacher to Kent State University in ‘74’, Halem taught Vallien to blow glass into moulds made from sand. (Lindqvist, 1999, p. 77)
2. Bertil (Kosta) and Toikka (Nuutajarvi Notsjo) showed together at Nordiska Kompaniet 1967. (Lindqvist, 1999, p. 47)
3. Published article in ‘Glassline’ showing the use sandcasting with flameworked inclusions, directly learnt from Julie Anne Denton.
4. Dam developed themes originally created by Oiva Toikka. (Layton, 1996, pp. 121-122)
5. Dam shown key European glass manual written by Finn Lyngaard. (Oldknow, 2013, pp. 96-98)
6. Finn Lynggard works for Ebeltoft Glass as a designer.
7. Assistant to Steffen Dam in 1988, and since 2000 they have shared an atelier.
8. Assistant to Toikka in 1988/89.
9. Invited Chardiet to give demonstrations at Kent State University.
10. Professor of Sculpture and Glass 1991 – 2000.
11. Student in Mitchel Gaudet hot casting master class at Pilchuck Glass School in 2005 (Dochev, 2009) and consequently assisted him at Pilchuck one year later.
12. Apprentice to Emilio Santini 2001 and studied under Lucio Bubacco in 2003, both flameworking artists have worked with sandcasting and flameworked components.
13. Mainly works with kilncasting but previous works are sandcast. (Walentynowicz, 2014)
14. Teaching assistant to Januz Walentynowicz at Pilchuck Glass School in 2004 for two months. (Dochev, 2009)
15. Studied at Illnois State University. (Walentynowicz, 2014)
16. Studied under Bertil Valien at Northlands in 2003.

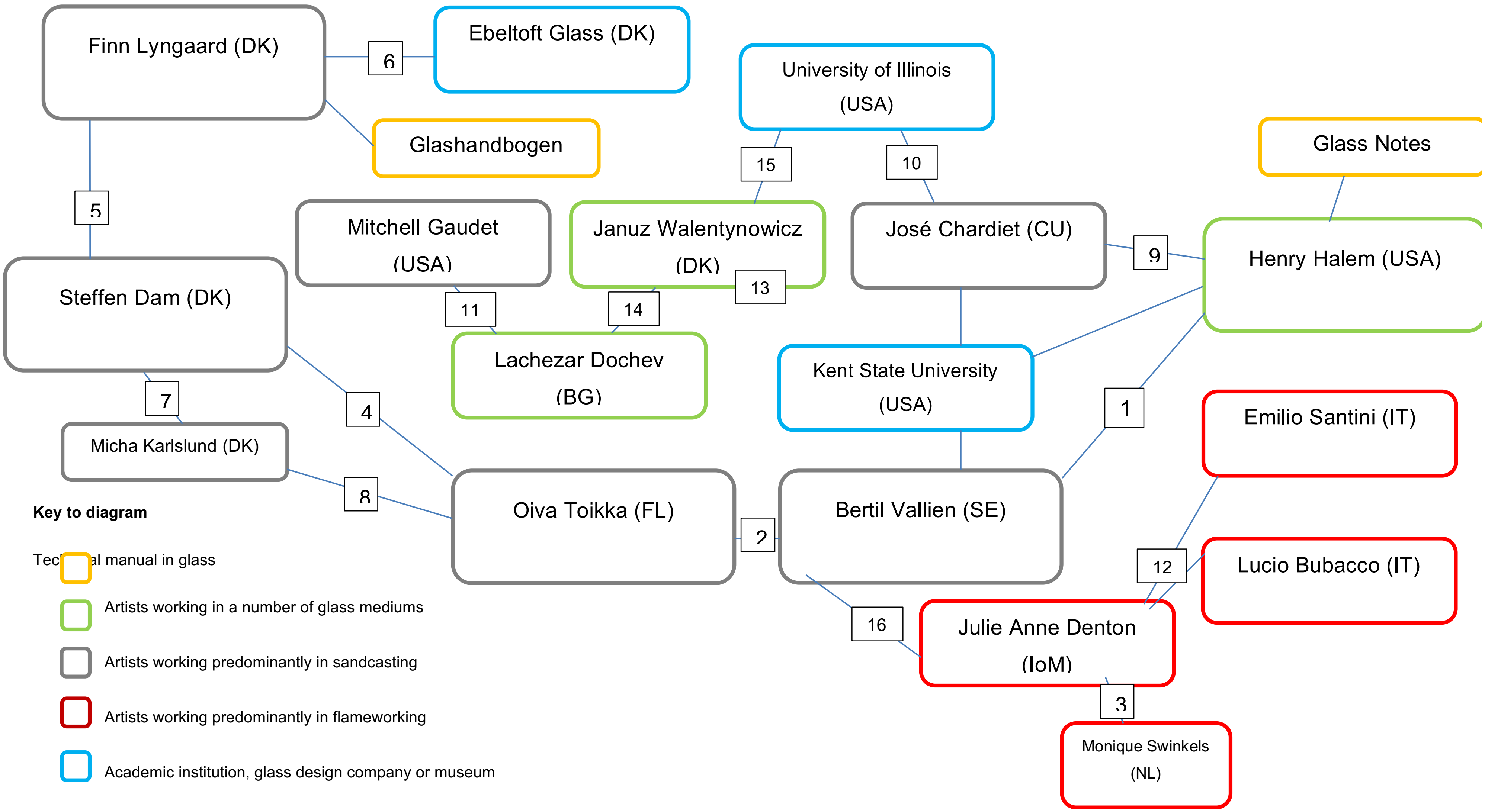


Diagram 3 Glass casting and flameworking family tree

## 2.3 Artists who sandcast, flamework or use inclusions in their work

The following contextual review largely considered the work of the key artists relevant to this research. These artists were Bertil Vallien, Paul Stankard and José Chardiet whose work has been explained through their contribution related to this research. Additional artists were identified from the family tree (pp. 43-47) and the journal surveys conducted with New Glass Review and Neues Glas (pp. 35-42). These additional artists both historical and contemporary were significant to this research for their technical innovations in sandcasting and/or the use of the inclusion within a hot cast glass body. In the following component the key artists have been identified and a brief history has been related. This biographical component of the research was engaged in, in order to place the chosen artists within an understandable timeline. Sections 2.4.1 (pp. 53-55), 2.6.1 (pp. 59-61), 2.10.1 (pp. 71-76) and 2.11 (pp. 76-85) of this chapter satisfy aim 1 of the research which was to *analyse key artists using hot encapsulation methods in order to create a series of case studies examining their techniques and artistic themes.*

## 2.4 Bertil Vallien

Bertil Vallien's work on sandcasting was a key element to this research. Traditionally sandcasting has been used for the metal industry. That is until 1975 when Vallien pioneered the method for casting glass in a sandmould. This was developed further at the Åfors glass factory where he worked as a designer in Sweden. As this was a completely new technical concept (Layton, 1996, p. 121), it opened up fresh roads for both glass production and glass art (see figure 14, p. 49). This new technique in glass was not only embraced by the Åfors factory, but throughout the world ever since. The late Dan Klein corroborates this statement in the book '*Artists in Glass*', by saying *"As an artist his [Vallien's] contribution has been to create a new language in glass that will be used for centuries to come."* (Klein, 2001, p. 206) This 'new language' can be summarised as alluding to universal themes and is unravelled in depth in section 2.11, pp. 76-85.

Figure 14. 'Janus head' by Bertil Vallien. Cast in a sandmould; H. 15 cm, W. 20 cm D. 7 cm. Private collection Mary Anne Sanske, Switzerland. Photography credit: J A Denton

In 1963 Vallien began to work as a designer for the Åfors glass factory in Smaland, Southern Sweden. In 1976 Åfors glass factory merged with Kosta, Johanasfors and Boda, then latterly with Orrefors in 1989 to make what is known in the present day as Kosta Boda AG (Twentieth Century Glass, 2016).

Before Vallien concentrated his efforts on purely sculptural sandcasting, he was employed by Kosta Boda to create utility ware for mainstream public consumption. It is impossible to know how many collections he made during this time, but it is estimated as 600 designed products. Vallien's interest in his higher artistic goals ultimately led him to concentrate on sculptural sandcast glass as a means for expression from 1985 until the present day. Utilitarian items became a subsidiary concern for him.

In Europe it was not unusual at that time for a glass artist to be attached to a factory where they were freely encouraged to develop their own art. Many well-known artists such as the Czech artist Stanislav Libenski and the German artist Erwin Eisch created sculptures under the banner of the factory they designed for. Vallien belonged to this category of artists who held ideals reminiscent of the Renaissance in which technical innovation and work ethic blended intuitively with the artistic personality. Although privileged to be given the opportunity to create his own art, he was also grateful to be a necessary part of a factory team; although they were two separate occupations (Lindqvist, 1999, p. 55).

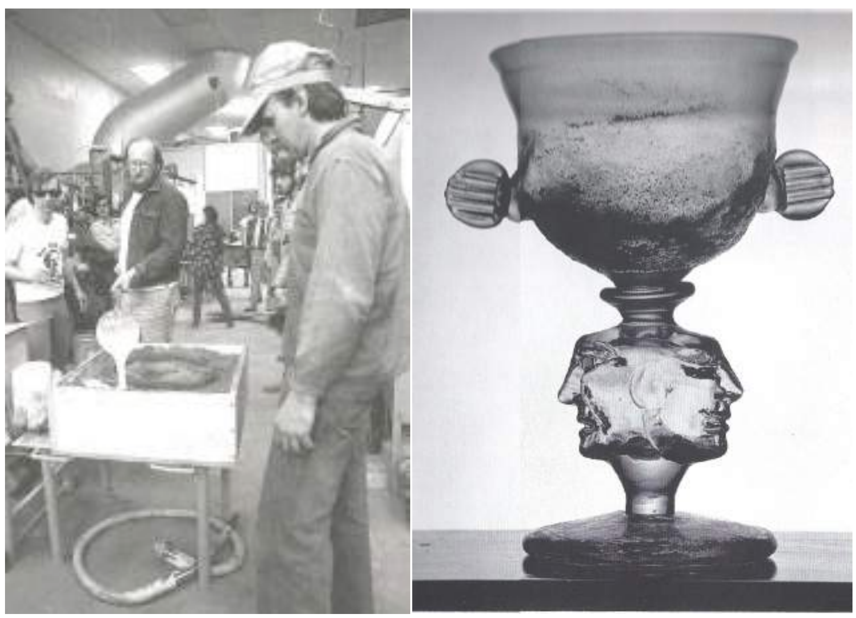

Figure 15 Left: Sandcasting demonstration at GAS conference #5, Toledo Museum of Arts Studio, 1975. Henry Halem to left and Bertil Vallien in foreground, photography credit: Sylvia Vigiletti, GAS Journal Toledo 2012. Right: 'Hand-blown goblet with the head of Janus' by Bertil Vallien, 1978

It is important to note that Vallien in his role as glass designer realised many effects in glass could not be directly translated from his pen in the design room. Vallien spent the majority of his time in the hot shop pursuing his ideas in practice with the trained gaffers. Vallien is quoted as saying *"no other material is so volatile and capricious; it's impossible to capture on paper."* (Lindqvist, 1999, p. 117)

Vallien was first introduced to the use of sand as a mould material for glass, by Henry Halem. Halem taught at Kent State University in the USA and Vallien was invited there as a guest Professor in 1974. Halem imparted to him (Vallien) and the students, the method of blowing vessels into sand forms. This technique Vallien latterly developed further (figure 15, p. 50) and this technique made up a considerable percentage of his output at Kosta Boda in the seventies. Further, blowing vessels into sandmoulds was the precursor technique which led to his sandcast artwork.

Vallien's work is often described as Baroque. Whilst having a joint exhibition with Oiva Toikka (pp. 43-44) in Stockholm in 1976, the art critic Ulf Hard af Segerstad described the work as *'a superbly liberating neo-Baroque'* (Lindqvist, 1999, p. 49). This is a significant aspect of Vallien's work as his sandcast sculptures are defined by the simple yet strong shapes and colour he uses. The sandcast form is a symbolic vehicle for the more detailed inclusion dreamscapes within (see figure 34, p. 77).

In conclusion, throughout his career Vallien has been on the boundary between decorative effect and artistic content hence the reference to his oeuvre as 'Baroque'[19]. This can be compared to the balancing act of his role as designer and artist. Elements of his decorative designs have made their way into his art. It has been known for Vallien to overwork his pieces due to the excitement of a new technical innovation.

However in the 1990's he has and continues to pursue a minimalist approach to his work. Vallien seeks to simplify his forms by creating large scale, single colour blocks of glass (see figure 16, p. 52). Vallien's new works referred to as bridges *"H[h]e has sought to simplify his forms, cognizant of the obligation that the beauty of glass imposes. Remarkably, this potentially dazzling substance is a hindrance to his artistic resolution."* (Lindqvist, 1999, p. 245) At this late stage in his career he has purposefully left out one of the defining aspects of his work. This aspect originally made Vallien's

[19] Baroque definition one: [of] certain stylistic tendencies in 17$^{th}$-18$^{th}$ c. arts, characterized by exuberance and extravagance. Definition two: Grotesque, whimsical. (McMordie & Seidl, 1982, p. 71)

artworks the prototype for sandcast glass throughout the world and specifically associated with him - namely the inclusion.

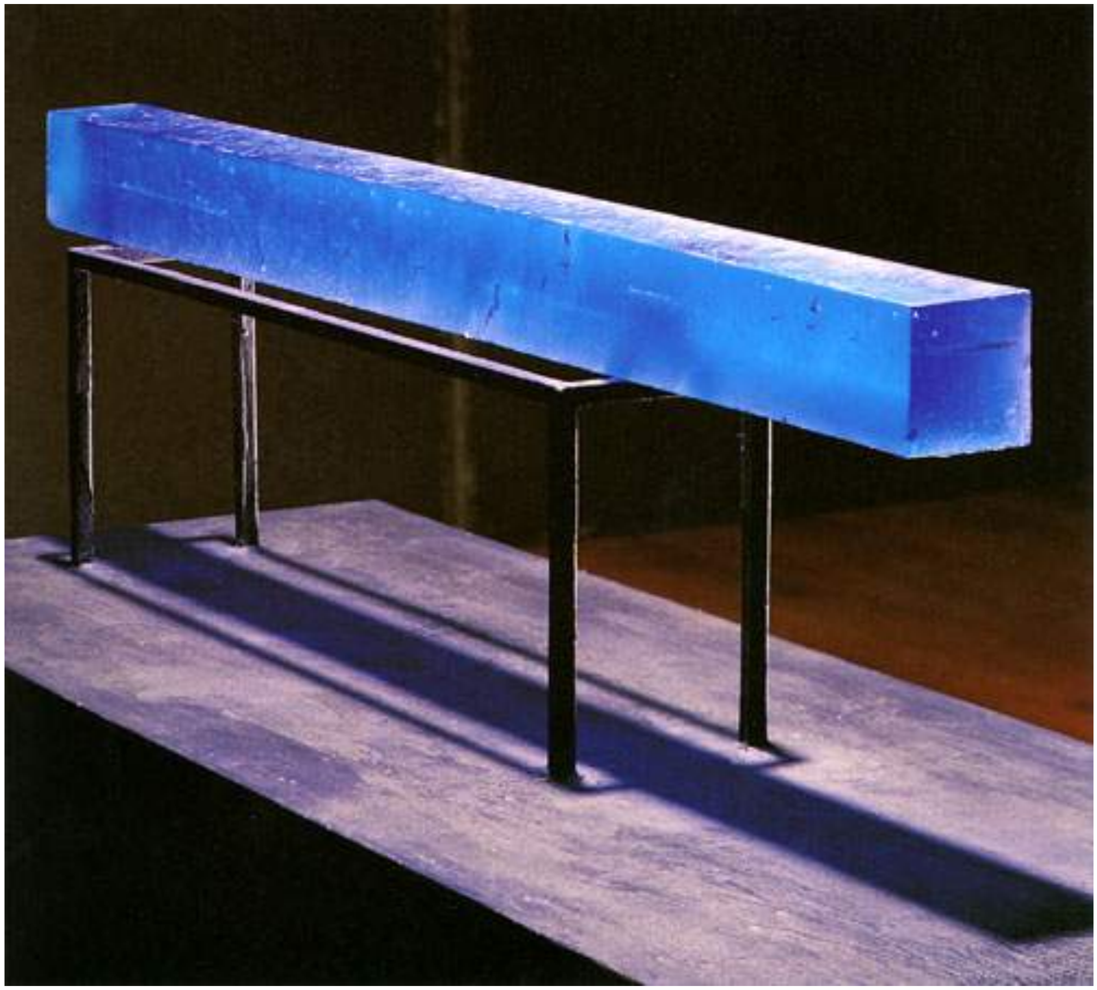

Figure 16 ‘Blue Bar’ 2003 by Bertil Vallien. Cast in a sandmould; H. 8 cm, W. 110 cm D.8 cm (Berengo_studio, 2012, p. 122), photography credit: Anders Qwarnström

In terms of this research Bertil Vallien completely dispenses with paperweight encapsulation techniques when he adds inclusions to a hot glass mass. This suggests that there are further alternatives to achieving the same goal of creating detailed inclusions inside a hot cast. This is explored further in sections 3.1, p. 91; sandblasting - 3.2.3, p. 128; glass powders and high-fire enamels - 3.4, p. 135-137; forcing glass to fit, 3.5.2, pp. 150-151 & negating the need for compatible glass, 3.5.3, pp. 155-158.

Vallien's alternatives utilise only clear furnace glass which has no compatibility issues when used as an inclusion and this makes the combination with the *furnace batch* simple. Inclusions created from furnace glass alone can be coated in glass powders, painted with high fire enamels and/or covered in silver or gold leaf (see figure 14, p. 49). The casting sand can be mixed with resin to harden it and thereafter positive forms can be carved from the hard sand. These forms can later be placed within the cast before filling it with molten glass. This leaves a negative space where the carved sand positive used to be. The aforementioned alternatives are ways of adding inclusions without solid coloured rods. Coloured glass often has compatibility issues with the furnace glass (see section 3.2.3, pp. 102-104). Although these techniques are interesting alternatives, one cannot achieve the realistic depth of colour which is possible with solid colour rods (see figure 10, p. 15 & figure 28, p. 71).

### 2.4.1 Case study 1 – Vallien

This case study is based on insights from a book about Vallien called *'Glass Eats Light'* (Lindqvist, 1999). Further insights are gained from my own personal experiences of attending a five day masterclass at the late Dan Klein's glass school Northlands in Lybster with Vallien in 2003. Finally, further insight was gained from a film excerpt of Vallien at work sourced from the web which is included with this PhD thesis. All three case studies (see also sections 2.6.1, pp. 59-61 & 2.10.1, pp. 71-76) in this chapter are written in the present tense to give the reader the same sense of flow that the glass process offers the artist during creation.

Vallien's process begins when he prepares the contents of his sculptures from existing stock which consist of a variety of pre-made furnace glass inclusion blanks. If he plans for new ideas he will approach the glassblowers at Åfors to create new glass blanks for him to work on. In his studio he prepares tools, templates and seals which are used for adding a relief form or further pattern to the sand wall of the mould. The mould is fashioned using Mansfield sand in a metal box. The form used to create the negative space in the sand is often made from wood.

Vallien spends time carving, sanding and varnishing his wood templates in order to create the perfect form for producing symmetrical negative space in the sand. Over time these forms have become stricter. Vallien often chooses to use a wooden template of uniform shape which he can ‘plough’ back and forth through the sand to alter the shape of the sculpture at will. When cast some of the sand will stick to the surface of the glass to give it a reddish tone but for other colour effects Vallien uses oxides, glass powders and enamels. Once the artwork has been cast the enamels especially will produce a glaze effect on the surface of the glass (see appendix 4, pp. 262-263). Vallien uses his seals for adding relief pattern and/or a knife mark, or fingers to create irregularities in the negative sand form. At this stage (before casting) metal foils or glass threads can be added to the sand mould.

A team of ladlers are utilised to pour Vallien’s casts quickly whilst he adds his pre-warmed inclusions. These inclusions consist of copper figures, glass heads painted with paradise paint and small solid glass forms either painted or decorated in the hotshop whilst being created. These inclusions are added in between pours thus encapsulating them in the body of the glass between the layers (MoBurkhardt, 2012). Once cast the surface of the sculpture is heated with an oxy/propane torch until it flattens into itself with no sign of pour marks. The sculpture is wheeled to the annealing oven whilst still inside the metal mould and placed inside the *lehr*. The cast glass artwork remains in the lehr for a number of days or weeks until the internal stress is relieved (for more information about annealing see section 3.2.4, p. 106).

It is difficult to relieve all of the stress in a large glass mass even with a long and cautious annealing cycle. This difficulty is compounded when adding inclusions to the main glass body (see compatibility section 3.2.3, pp. 102-112) as Vallien uses high fire paints and metal foils on the inclusions which do not have the same *CoE* as the batch furnace glass. Plus the inclusions are placed in between layers at a cooler temperature than the main glass body which causes stress during annealing. Therefore many sculptures especially the larger ones are lost due to cracking and/or the smearing of his inclusions. To combat this high failure rate Vallien casts three variations of the largest pieces. This increases his chances at a single success which has previously been stated in section 2.2, p. 43.

In relation to this research Vallien was important because his themes are accessible to all (see section 2.11, pp. 76-85). They are worthy of further study on an intellectual level. Further, his ground breaking work with sandcasting since the seventies is the fundamental starting point for the technical investigation of the research in chapter 3. In reference to my own artistic ideals I find Vallien inspirational because he has sublimated a technique which was (and often still is) considered primitive. He has kept it simple in terms of little or no cold processing once the sandcast is taken out of the lehr. He has played with the contrast of the textured sand surface which resembles that of ceramics and he has juxtaposed small highly polished elements in key areas creating a contrast. In my view polishing choice areas of the finished sand surface of the glass cast creates a drama bordering on the mysterious. Simultaneously the highly polished 'windows' punctuate the narrative bound within the sandcast in the form of the encapsulations. These encapsulations can be perceived through the windows to give a glimpse into this frozen world of metaphor. His visual language is not only bold, but throughout his lifework his visual palette is tight, expressive, comprehensive, focused and most importantly universal. He tacitly understands the use of glass as a visual means of expression on all levels: through form, placement and in conjunction with light.

## 2.5 Henry Halem

Henry Halem has been involved in the glass movement since 1968. Previous to this he received his BFA in ceramics in 1960 and an MFA in ceramics in 1968. On returning to his studies at the University of Wisconsin, as a Post Graduate in glass form 1968-69 he became the assistant to Harvey Littleton. Littleton was one of the founders of the studio glass movement in America, whose widely quoted aphorism, *'T[t]echnique is cheap'* (Corning Museum of Glass, 2012) urged artists working in glass to concentrate on the artistic integrity of their work over and above their glassmaking skills.

Littleton affected Halem in the personal approach to his own work. He took Littleton's values as his own and he extolled them his students during his 29 year teaching career at Kent State University (since 1969). Littleton's affect was so great that Halem's own quintessential quote reads thus, *‘I try to define my art by content and not material. Art is about ideas; ideas that spring from observation, the persistence of memory and experience.’* (Halem, 2006, p. vii) It is clear that Halem was touched by Littleton’s ideology.

Figure 17 ‘Iraq Memorial’ by Henry Halem on show till 21.10.2012 at Craft Alliance, University City, Missouri.

Halem has taught at highly regarded glass schools throughout the world known for their dissemination of information regarding the practicalities of making glass. Namely Pilchuck, Penland School of Craft in North Carolina, the Nijjima Glass School in Japan and the Studio at Corning Museum of Glass. With the help of Fritz Dreisbach, Mark Peiser, Joel Myers and Marvin Lipovsky; Henry Halem founded the American Glass Art Society (GAS) and was elected its first President in 1993. In 1994 Halem was installed as a Fellow of the American Crafts Council. In 2008 he was presented with the lifetime achievement award at the Annual GAS Conference in Oregon. Figure 17 above is an example of his work.

### 2.5.1 Glass Notes

Arguably Halem's' greatest legacy to the glass movement was his book *'Glass Notes, a reference for the glass artist'* which is a significant practical text acting as a guide to equip and maintain a hot glass studio. The majority of section four of this book is dedicated to basic sandcasting techniques, positive mould form preferences, sand moulds, sodium silica moulds, ladling and the use of inclusions.

Although this text drew its references from terminologies and suppliers within the United States, it was the only published manual found in English dealing technically with the process of sandcasting. It was a key text in relation to this research. Finn Lynggaard's aforementioned (p. 43) '*Glashandbogen*'[20] (1975) was also a published text dealing with the practicalities of setting up a studio. This workbook explains the necessary techniques for forming glass, but it has not been translated into English to date.

Henry Halem invited his ex-student, artist José Chardiet to host a workshop which was filmed for commercial resale and consequently reviewed in Glass Notes. Halem indicated his appreciation of Chardiet's innovative adaptation of the technique Bertil Vallien originally developed. His technique differed from traditional sandcasting in that his pieces were not cast into damp sand, nor cast at room temperature (Halem, 2006, p. 108). For the purposes of this research the workshop hosted by Chardiet in 1992 has been reviewed (see 2.6.1, pp. 59-61)

It is not Henry Halem's artwork which was important to this research, but his output as a glass technician. He created a seminal handbook for the glass artist detailing with a variety of hot glass techniques. In particular the books section detailing the processes concerned with sandcasting was important for this research. A further reason he was important to this research was his recording of a variety of demonstrations since the Nineties. At the time these videos were progressive, and they are now useful both for posterity, and in the case of this research as a tool for further study. Henry Halem's legacy is his aspiration to create future professionals who could master the craft of hot glass making through his written word and visual documentation.

[20] Glass handbook

## 2.6 José Chardiet

José Chardiet emigrated to America from Havana, Cuba in 1960 at the age of four. Chardiet who has lived and worked in Rhode Island since 2001 received his MFA in glass from Kent State University in 1983. In 1991 Chardiet went on to teach glass and sculpture at the University of Illinois for the next ten years. He left this tenured position in 2000 to make sandcast and blown glass fulltime (Chardiet, 2010).

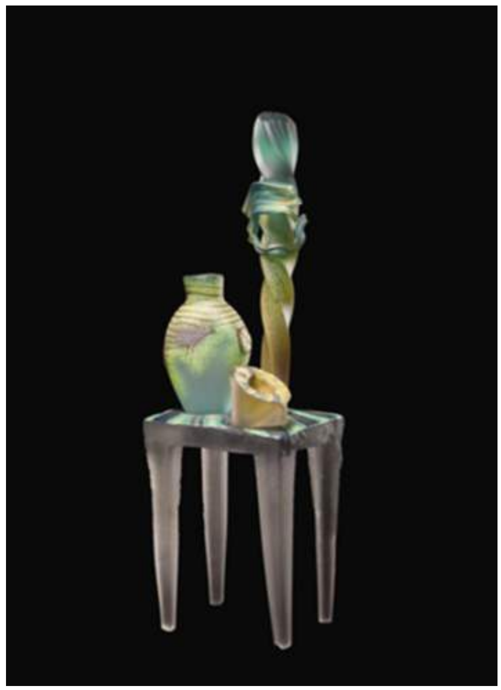

Figure 18. 'Mesa I' (Still Life Series) by José Chardiet, 91 x 27 x 21 cm, 1986

This researches interest in relation to Chardiet was the technique he developed to cast large three dimensional glass objects. These objects have long thin protrusions (see figure 18 above) which could not be made using traditional sandcasting techniques. In order to allow molten glass to flow into the 'legs' of his tables he began to heat the sand mould up pre-casting. This meant that the glass, as it flowed into the leg(s) did not stop half way down the leg due to being chilled by the cold sand mould. Instead the heat radiating from the sand allowed and even enabled the glass to flow to the bottom of the negative sand moulds.

Although Chardiet is a diverse artist experimenting with a variety of seminal strands, he is arguably most highly regarded for his reinvention of the '*table top still life*' (Yood, 1999, pp. 25-27). This series of artworks initially paid homage to the still lives created by painters such as Cezanne and Picasso. He intentionally subverted the pastiche, and created his *still lives* on undersized glass tables. He created an almost human familial feel to the grouping of impractical objects (figure 18, p. 58).

### 2.6.1 Case study 2 - Chardiet

Chardiet demonstrated the technical process of creating his '*still lives'* at Kent State University, and as previously mentioned a DVD of the workshop was produced (Halem, 1992) of this process. In summary, by preheating the sand mould before casting this enabled the glass to freely flow down the `legs` of his casts, this successful technique exponentially increased the potential to create large casts with large thin protrusions, i.e., table legs. Although Chardiet did not actively work with the 'inclusion' his technique could be adapted in a manner which was relevant to this research. By utilising the technique of preheating the sand mould before casting this would theoretically allow for the insertion to the sand mould surface of flameworked components. These flameworked components could be larger and more intricate. Potentially Chardiet's mould heating technique could allow for inclusions which would not break, smear or move during the casting process (see section 3.3, pp. 126 -131).

The demonstration video begins thus: A metal container is placed in a chest kiln, pre-sieved damp builders sand with 4/7% *bentonite* content is shovelled into the container (Mansfield sand is not available in the USA). A shallow form made from foam is placed flush with the sides of the metal box and sand is packed tightly around it. He lightly packs the sand underneath the form to create room in the sand mould for his 'table legs'. This stops the previously created form from distorting. He pushes a cold preformed piece of glass vertically into the sand mould to form a cavity. When satisfied with the depth he removes the positive form, checks the void with torchlight, and moves onto the next *'leg'.*

To create positive forms of his blown vessels, he takes a wedged piece of red clay and pushes the base of his glass form into the clay mass. Once the clay takes the intended shape, he makes it slightly bigger to allow for shrinkage in the cast glass piece once cooled. Plaster is poured into the clay negative, and an arrow is carved on the positive to direct Chardiet upon insertion into the hot cast, how to place his positives. Without the directional arrows for placement it is easy to make a mistake in the ‘heat’ of the moment.

These positive forms are placed in a kiln at 260°C to dry out quickly; they are dry enough when the water vapour ceases to emanate from the plaster surface. Chardiet states *‘Be careful when putting the positive plaster forms in the glass. They cannot be put into the glass as soon as the glass has been cast. It is too hot, and the plaster will release more gas which can damage the cast. Instead the glass must be given time to cool.’* (Halem, 1992)

Chardiet brings the chest kiln up to 593°C, almost 100°C above annealing temperature for soft glass (one cannot be specific here as different glass batches have differing annealing temperatures ±25°C). This hardens the bentonite/sand mix of the negative sand mould, and heats it up to allow the glass to flow into the *‘legs’* freely (Halem, 2006, p. 108). If the mould were cold or heated with a propane torch, the molten glass would set before completely filling the legs which is the reason Chardiet originally developed this technique. Chardiet does not coat the mould with a sand resist like graphite before he heats up the mould therefore Chardiet is required to coldwork his casts once cooled. According to Halem this raises the quality of his work ‘*The elegance of his objects [are] heightened by the many hours of cold working*.’ (Halem, 1996, p. 69)

During the casting process a deep ladle is used to gather glass from the *crucible*. Chardiet’s assistants draw glass from the furnace as Chardiet directs the casters. The casters pour into the mould which is soaking in the chest kiln with the lid open. Once cast, the annealing oven is closed for some minutes to allow the cast to lose heat evenly and slowly. Upon re-opening Chardiet checks the viscosity of the glass with tweezers, and once satisfied he adds his positive plaster forms to the cast surface (see diagram 4 below). Once all three positive forms are in place, time is spent fine tuning their position and depth in the hot glass cast.

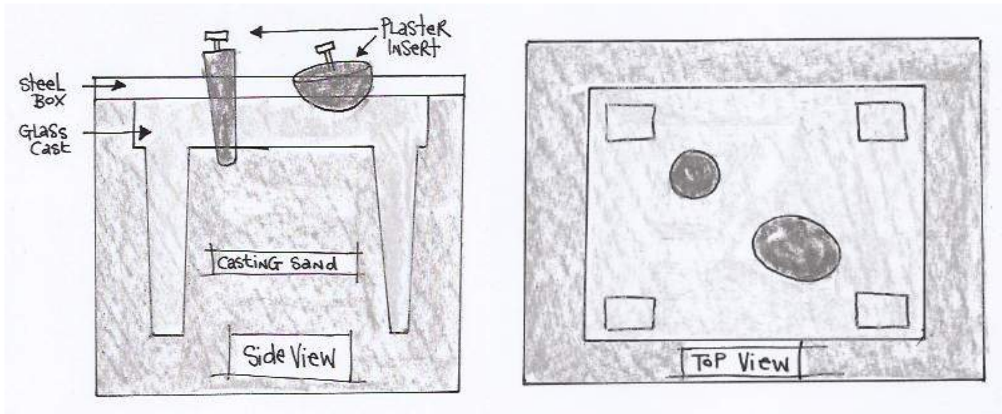


Diagram 4. Side view and aerial view of Chardiet's sand box once cast

For safety reasons the annealer is switched off during the casting process. Judging by Chardiet's reaction at this stage the annealing oven is too cold at 277°C. Due to the temperature drop the annealer is switched on once more and brought to a higher temperature estimated at 850°C. Chardiet checks the positives are still in place and makes final adjustments. At this temperature the glass will flow into any uneven areas disturbed by the initial placement of the positive forms. Later the lid of the chest kiln is opened and the cast looks significantly cooler at 700°C, a 1" fibre blanket is placed gently over the surface of the cast, and the annealer is allowed to run through its cooling cycle. In conclusion, this is an innovative technique worth further exploration in chapter 3 (see section 3.3, p. 126-131).

## 2.7 Mitchel Gaudet

Mitchel Gaudet received an MFA in glass and was another artist using sandcasting processes. He has operated his glass studio since 1991 in New Orleans. The production glass and his personal work display imagery derived from everyday objects and significant events which fascinate him. In a filmed interview of Gaudet (Community Arts Award Recipient 2010) he referred to the inspiration for his work as deriving from the elegance and decadence that made up the patina of New Orleans' rich history, and later described in an online retail gallery '*H[h]e likes to make objects of desire with "a funky historical presence to them."'* (Roger, 2016)

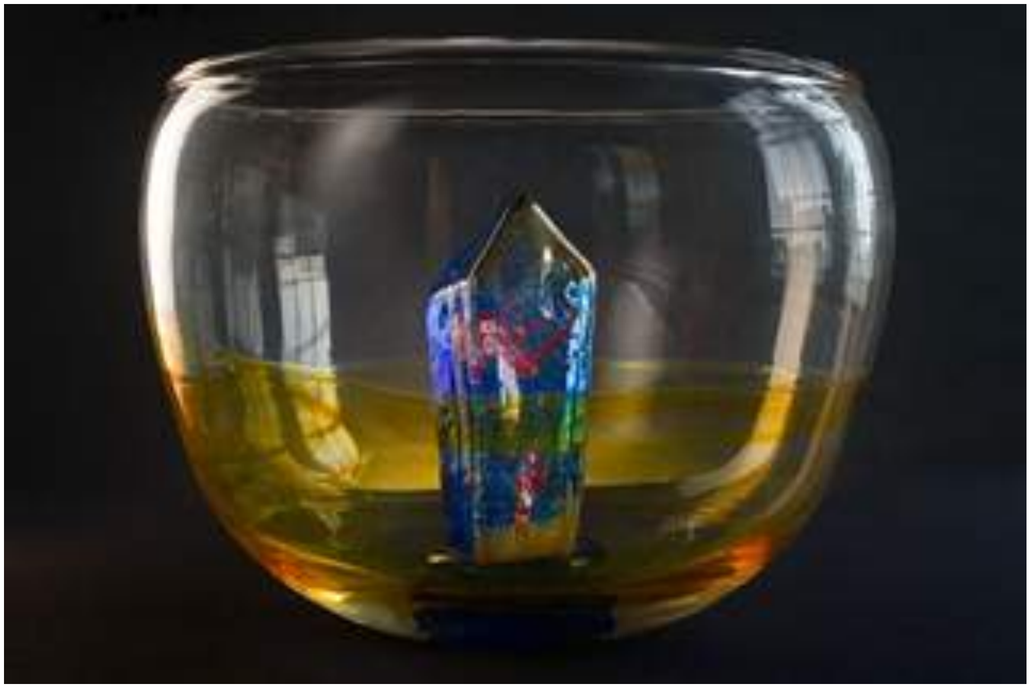

Figure 19 'Watermark #11' by Mitchel Gaudet, 2005

In figure 19 above, Gaudet has combined sandcasting and blowing to create an artwork. The *Hurricane Katrina* series of glass objects are an example of the stylistic influence Vallien has had across the studio glass movement. Gaudet has utilised Vallien's trademark copper figures inside the sandcast form of a house, said form also synonymous with Vallien (see figure 20, p. 63 & figure 34, p. 77). His combination of the sandcast piece inside the blown object is inventive but not new. The combination of blowing with sandcasting was developed earlier by artists such as Michael Rogers (Oldknow, 2007) among others.

Gaudet is known for his use of traditional casting methods such as casting into metal or graphite moulds and casting into sand. His work stands out due to his personal quest for innovation within the boundaries of casting. Gaudet is renowned for experimentation with unusual mould types such as wood, natural materials, plaster bandage and Zircar. These techniques were later adapted by Gaudet's student and later teaching assistant Lachezar Dochev who has assimilated this practice into his own working methods.

Figure 20 'Earth & Champagne' series by Bertil Vallien for Kosta Boda, size: H 95 mm, W 105 mm, and a detail of one of Vallien's encapsulated copper figures

Gaudet is relevant to this research because he has incorporated unusual found materials in/around his casts such as eggshells, to create new and interesting impressions on the surface. He has used lead based pencil to draw on his inclusions which remains on the surface after casting. His focus is to creatively innovate the process of sandcasting.

## 2.8 Lachezar Dochev

Lachezar Dochev is a Bulgarian glass artist who embraces sandcasting in unison with the architectural qualities, textures and themes associated with medieval gothic culture. This can be seen in figure 21 (p. 64). Music, literature, symbolism and legend are recurring themes within his work (Emeringer & Baiza, 2009, pp. 142 - 143).

His process is not concerned with 'clean' forms associated with glassmakers like Paul Stankard (see 2.10, pp. 68-76). Dochev prefers to *'sculpt directly the negative form'* (Emeringer & Baiza, 2009, p. 143). He achieves this by using small found objects and his hands to create a negative mould in the sand. The mould form created is indicative of Dochev's 'style'. Dochev's preference for undercuts reveals his technical preference for the '*freeform'* approach (see 3.2.1, pp. 96-98). *'…Art is where you find it… often there is much more of it in the process than in the finished piece'* (Dochev, 2009) In this citation from Dochevs' website, he expresses an overriding affinity for the process of creating, which is similar to my own practice. In figure 22 (p. 65) Dochev and I can be seen working together creating a dramatic night-sandcasting event at the Luxembourg festival of glass in 2015.

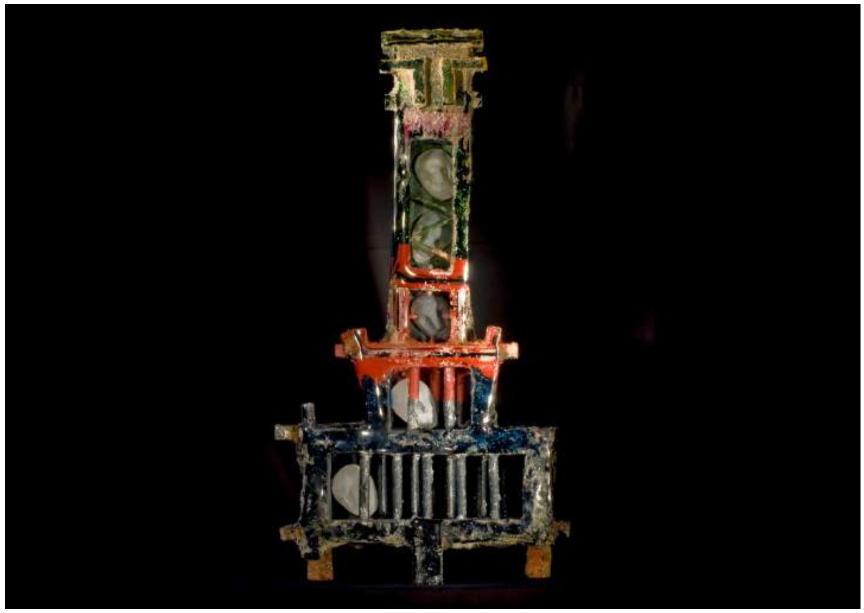

Figure 21 ‘StarlessI’ by Lachezar Dochev, 2009, photography credit: Venzo Danev

Dochev embraces the spontaneity associated with sandcasting. He regards the sandcasting process as a vehicle to melodically express and test his ideas and improvisation techniques. In combination with sand, he merges wood, fabric, orange peel and egg shells within the sand mould form. These techniques were originally associated with Gaudet as he wanted to achieve interesting textures on the glass surface once cast.

Dochev creates works of art as a succession of multiples, by *‘grouping them in a series and using different techniques and contrasts within the same piece… make the composition **move.’*** (Dochev, 2009) He achieves this contrast using a variety of techniques involving the use of bubbles and the hot application of colour. Figure 21 ‘Starless’ (above) shows Dochev’s inventive use of inclusions in the cast glass form. ‘Starless’ was created in a kiln as Dochev does not have a furnace for sandcasting in his studio. The process concerned with the creation of this artwork can be reviewed in appendix 3, pp. 255-261. Dochev’s approach to sandcasting invites a variety of competing variables which technically and visually affect the continuity of his pieces. Although an experienced caster and maker it appears that, like Steffen Dam the next artist to be reviewed: Luck and play are substantial contributors to the artworks during the making process. In relation to this research some of Dochev's decorative techniques made an interesting starting point in the early technical investigations in chapter 3 (see section 3.2.5, pp. 107-116).

Figure 22 Night cast at Luxembourg Festival of Glass, Denton & Dochev, 2015, photography credit – Venzo Danev

## 2.9 Steffen Dam

Dam apprenticed for four years as a technical engineer and on completion in 1982 at the age of 21 he worked as a toolmaker. It was the attention to detail and perfection the profession required which helped him master glass making techniques later on in his career (McFadden, 2009, pp. 6-14). Dam soon tired of making objects for mass production as he wished to find a path which would satisfy his aesthetic needs. He was quoted in the Crafts Council, UK bimonthly magazine 'Craft' as saying *'The moulds [he] worked on were 'highly aesthetic pieces of machinery, delicate and well made', which* *[for him] meant it was all the more heartbreaking that the results were 'crappy products, cheap versions of things'* (Lloyd-Jones, 2011, p. 15)


Figure 23 New Glass Review 34 (2013) featuring 'Flower block' by Steffen Dam on the cover, 2012, photography credit: Steffen Dam

Dam was introduced at a public workshop to Lynngaard's book (Oldknow, 2013, p. 96) 'Glashandbogen'. This book inspired him to dedicate himself to the production of glass. He began with a homemade furnace and a supply of glass cullet from the Holmegaard factory located on the island of Zealand, Denmark, which ceased production in 2009. For the next ten years Dam pursued the mastering of the craft of glass. During this ten year period he created drinking goblets and bowls which were sold from the Arhus studio which he shared with artist Micha Karlslund.

Since that time Dam whose artwork was featured on the cover of ‘New glass review’ in 2013 (see figure 23, p. 66) has developed a sharp narrative style that echoes the study, dissection and analysis of natural things. This is visualised by Dam in the spirit of 18th Century post enlightenment with a subtle undertone of the contemporary hybrid genre ‘Steampunk’ (see figure 24 below). Steampunk is a subgenre of speculative fiction normally set in a futuristic/anachronistic quasi-Victorian alternative history. This fictional future elects steam power as the mainstream energy source over electricity.

Figure 24 Example of Steampunk inspired objects 2012. Photography credit: Anon

To date, Steffen Dam is arguably the most contemporary popular sandcaster who makes use of inclusions. His precision polishing and later re-fusing of glass components is juxtaposed with the playful and seemingly haphazard sandcast inclusions. He is creating an innovative new visual language for the field of sandcasting with hot glass inclusions.

## 2.10 Paul Stankard

Paul Stankard is an American glassmaker from the Millville rose tradition of paperweight making[21]. He is amongst the most esteemed makers in the history of this practice, if not the most regarded in the history of the genre (Klein, 2001, p. 194). Pre-Stankard the paperweight genre was considered to have peaked in 19th Century France (figure 25 below) in the work of Baccarat, Clichy, St. Louis and Cristallerie de Pantin.

Figure 25 'The Houghton Salamander', H: 8.8 cm, Diam (max): 11.5 cm, probably manufactured by Cristallerie de Pantin 1878. Collection: Corning museum of glass

In 1961 Stankard studied at Salem County Vocational Technical Institute for Scientific Glassblowing. During Stankard's time at Salem he was taught and inspired by Francis

[21] The Millville Rose paperweight became known worldwide as the first truly American-style paperweight. This paperweight was produced in Whitall -Tatum, founded in 1806, is now the Ball-Foster Glass Container Corp. and is the oldest continuously operating glass factory in the country. (Pensiero, 1997)

Whittemore. Whittemore was an early pioneer in the renaissance of the paperweight. Whilst working at various industrial scientific glassblowing institutions Stankard set up a small studio in his home and began to experiment and perfect the art of paperweight making (Klein, 2001, p. 195). It wasn't long before he began *`to believe that if Frank Whittemore, Charles Kaziun, Ronald Hansen, and Paul Ysart could be successful, independent paperweight makers then I [he] could be one too`* (Stankard & Eichhorn, 2007, p. 52)

Figure 26 'Swing at Houghton Hall' by Mark Peiser, 1975 (Stankard & Eichhorn, 2007, p. Plate X), photography credit: Anon

The initial and common problems in his early pieces occurred when the flower or other flameworked element lost their 'integrity' by the breakdown of a colour or the development of an unintended shade, but the most common reason for rejecting a piece was either the trapping of an air bubble inside the encasement or an element of the motif detaching from the whole design. Stankard stated '*A(a)lthough they were often seen as part of the floral motif by those who collected American or French* *paperweights, I saw these air bubbles as visual distractions. With my evolving standards I wanted to minimize air bubbles or, "dew drops."'* (Stankard & Eichhorn, 2007, p. 55) Some of these technical problems took him years to conquer.

In 1971 Paul met Reese Palley, an Atlantic City gallery owner who took on his work and mentored him to attain perfection in his field. Palley advised Stankard to scrutinise nature and he introduced him to the world of 'art glass' and the artists associated therein. The sales that followed allowed Stankard to pursue the creation of paperweights full time.

Figure 27 Stankard creating surface design on a blown vessel with Don Friel (Stankard & Eichhorn, 2007, p. Plate XI), photography credit: Anon

This leap into *"glass art"* (Stankard & Eichhorn, 2007, p. 62) allowed him to network with many of founders of the studio glass movement in America and become one of them himself. Harvey Littleton inspired him to push his work into a fine art context. After buying a key piece by Mark Peiser in the late Seventies entitled 'Swing at Horton Hall' (figure 26, p. 69), he was motivated to mimic Peiser's technique during a residency in 1980 at Wheaton Village, New Jersey (figure 27 above), he drew trees and flowers on hot glass forms with a torch and flameworking rods. After one week of experimentation, he realised that Peiser's cross pollination of techniques took as much time to master as his own paperweight making skills.

By 1973 his flameworked flowers began to take on a *Trompe L'oeil* quality (Stankard 2007). Since then Stankard's skills have refined and developed whilst his want to create work in a fine art context has progressively pushed both himself and the genre into the 21st century. During his 50 year career he has gained four assistants, three of which are his children. This would indicate that as he retires his legacy will continue.

### 2.10.1 Case study 3 - Stankard

Figure 28 'Diptych with Gold and Honeybees', 2009 by Paul Stankard, photography credit: Ron Farina

A key example of Stankard's work which moved the paperweight genre forward was his botanical series which can be seen in figure 28 above & figure 37, p. 81 This series of paperweights deviated from the way a paperweight is traditionally viewed which is from above. He spun the paperweight design on its axis so as it could be observed from the front. Plus he adapted its spherical shape into a quadrilateral, perhaps to suggest the form of a picture. This meant that the paperweight could be seen from all sides which was arguably a revolution in the paperweight industry.

*'Diptych with Gold and Honeybees'* (figure 28 above) exemplifies Stankard's technique which shall be broken down here into steps by referencing an article entitled *'A day in the studio'* (Stankard P. J., 2011, pp. 27-32). This article has been cross referenced with two film sources (which are included with this thesis) so as no factual technical detail has been missed. The films are entitled *'Making a glass flower'* (PBS, 2011) and '*Making botanicals in glass'* (PBS, 2009) and were both filmed for Craft in America and aired on PBS:

The first step begins with a detailed drawing of both the botanical flowers and the manner they will be combined in a paperweight (figure 29, p. 72). Step 2 consists of the glass rod preparation: Overlaying various colour combinations over an opaque glass base, this is known as *encasing*. These rods will be used later in the process for creating the botanical specimens. He is using the manufactured soft glass from Murano, Italy called *'effetre'* (104*CoE*), and the optically clear glass he uses for the encapsulation is Schott ophthalmic glass (see appendix 5, p. 264).

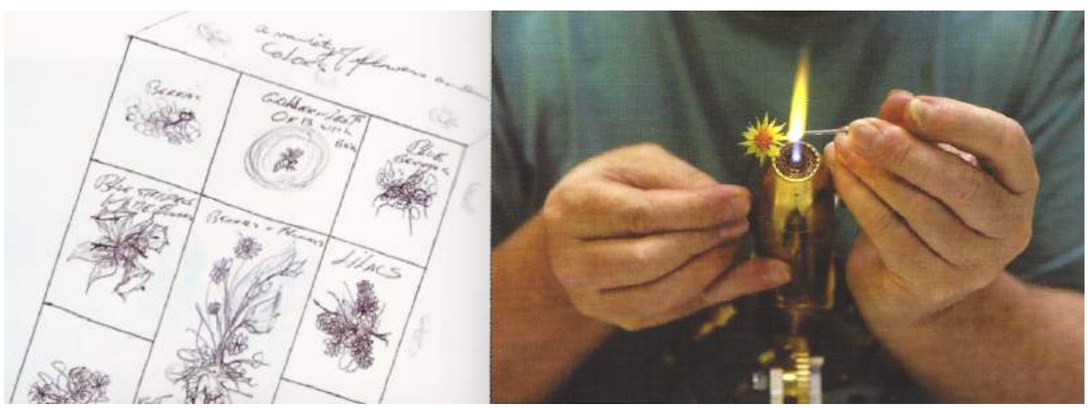

Figure 29 Right: Preliminary sketches and left: Making components with a Carlisle torch, (Stankard & Eichhorn, 2007, p. Plate XVI), photography credits: Anon

In step 3 he encases the 5mm thick opaque white rod with transparent yellow plus a heavy coating of clear. After he pulls out this rod till it is 30-40cm long and 2mm thick, at this stage he is ready to make the petals for a flower. Without getting entrenched in flower details it takes six florets which make up the central flower head and up to 20 petals to create a blossom. Stankard creates more components than he needs in order to select the most appropriate elements for colour, shape and size. He builds this up from the centre and works outwards (PBS, 2011). Once this task is complete he takes the bloom to a holding oven and leaves it to *soak* at 520°C. For all this fine work he uses a Carlisle CC + (see figure 29 above).

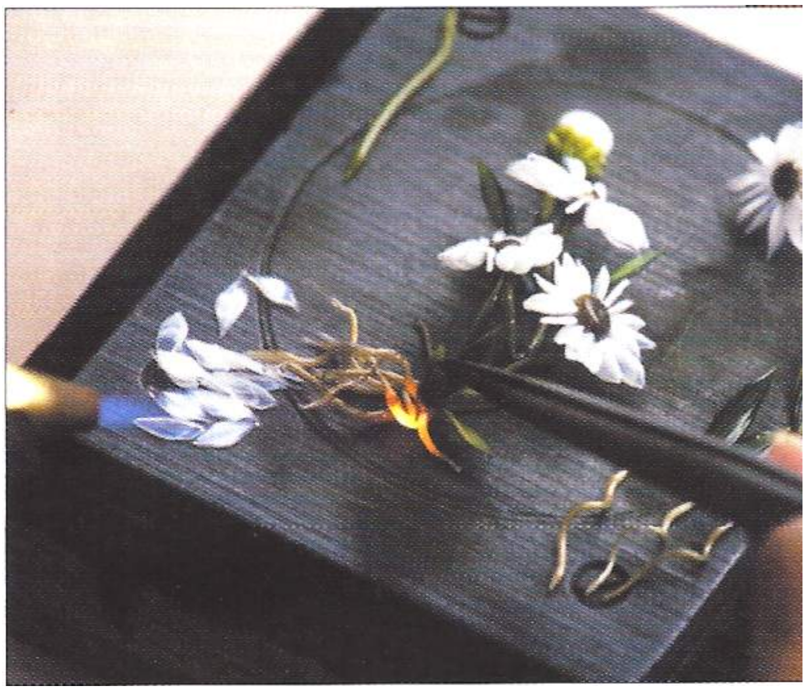

Figure 30 Fusing encapsulation components together, (Stankard & Eichhorn, 2007, p. Plate XVII), photography credit: Anon

Once enough flower, fruit, nut, mask, figure, moss components have been made, which can take anything up to seven hours per paperweight the glory hole is lit. Whilst the glory hole is given time to reach its temperature the flameworked pieces which have been soaking in the oven are ready to be fused together.

Stankard transfers the coloured glass components onto a stainless steel hot plate which is heated above annealing temperature from underneath with a Bunsen burner[22] (PBS, 2009). The Bunsen burner runs off propane/air. They are placed on the hot plate

[22] The Bunsen burner was named after Robert Bunsen, but he based his designs on earlier torches designed by Micheal Faraday (for references in this thesis to Faraday see pp. 25-26).

in order to remain stable whilst he executes the assembly operation (figure 30 above). Stankard wears heat resistant gloves whilst he fuses the components with a 3 a-b national torch. This is a small torch which runs off oxygen and propane. Once assembled to his satisfaction the glass floral arrangement is transferred to the heated vacuum cup in readiness for encapsulation.

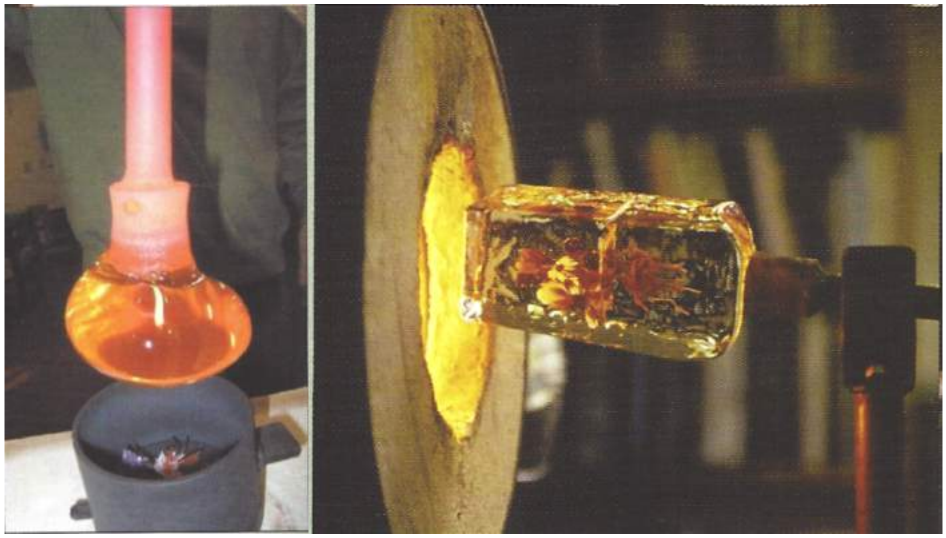

Figure 31 Left: Vacuum sealing components and right: Heating the finished paperweight, (Stankard & Eichhorn, 2007, p. Plate XVII & Plate XVIII), photography credit: Anon

Stankard's assistants prepare the clear glass paperweight blank (*puck*). They take the puck out of a preheated oven with a standard size punty iron used in glassblowing. This puck is heated in the *glory hole* till molten. It is important that the preheated blank is soft (hot) enough to flow around the inclusions easily when dropped into the suction cup (see figure 31, p. 74 left). Although there is no reference to the process of skimming in Stankard's text and short films, the glass blank must have the dirty outside layer taken away to reveal fresh, clean optically clear glass. This is accomplished with tweezers drawing off the dirty outside layer of glass from the puck. The blank is given to Stankard at the appropriate moment and he drops the gather into the suction cup. The glass is drawn around the heated flameworked components by the vacuum underneath the cup. This creates the first half of a paperweight.

Half of the design is now encapsulated; the process is repeated with the second half of the design. Any necessary clear glass ‘fill ins’ applied to the underside of each half of the paperweight are not mentioned but there will be some corrective work engaged in before the two halves are joined. To seal each half of the paperweight, the ends are preheated at the bench with the punty iron resting on a roller. The preheating is done with a GTT Delta Elite torch which produces a wide, specific and evenly hot flame.

Figure 32 Example of a paperweight before and after polishing (Stankard P. , 2017). Photography credit: Paul Stankard

Once the halves are sealed together Stankard spends time reintroducing the integrity of the original form to the paperweight (see figure 31, p. 74 right). He *skims* any edges which may have picked up 'dirt' during the process; once satisfied Stankard knocks the completed paperweight off the punty iron and into the *annealing oven*. Afterwards Stankard sends the paperweight away to be polished (to see the paperweight before and after polishing go to figure 32, p. 75).

It is apparent that Stankard Studio is top draw in the world of paperweight making. An observation as a trained flameworker is that most of Stankard's flameworked components would crack if they were annealed normally and allowed to cool before being preheated once more for encapsulation. Should the whole diorama be allowed to cool after being fused together in readiness for encapsulation, once they reached room temperature they would break into pieces. Using the paperweight as a binder for the encapsulations allows Stankard a great deal of freedom. This freedom is in terms of the joins of his glass components. The dioramas do not have to be perfectly fused together unlike in traditional flameworking.

In conclusion the paperweight technique gives Stankard greater freedom than a normal flameworker to create highly complex scenarios which are later encapsulated within a glass mass. This series of techniques could be transferred to the sandcasting process, and are explored further in phase 4 section 3.5, pp. 138-154.

## 2.11 In depth analysis of processes and themes of three artists

In accordance with objective 2 which was to *examine selected case study artists narratives with a focus on the use of inclusions in a transparent sandcast volume, and the conceptual space (if any) which is being explored.* It was relevant to critically scrutinise selected contemporary artist's themes. This critique was in terms of both their key technical innovations (see sections 2.4.1, pp. 53-55, 2.6.1, pp. 59-61, 2.10.1, pp. 71 -76) and the concepts which have driven their work forward. This component of the contextual review is a critical analysis of the themes of three contemporary artists working with glass inclusions. By analysing selected artists themes and methods I may inform my own starting points for chapters 3 & 4, both in terms of concept and technique.

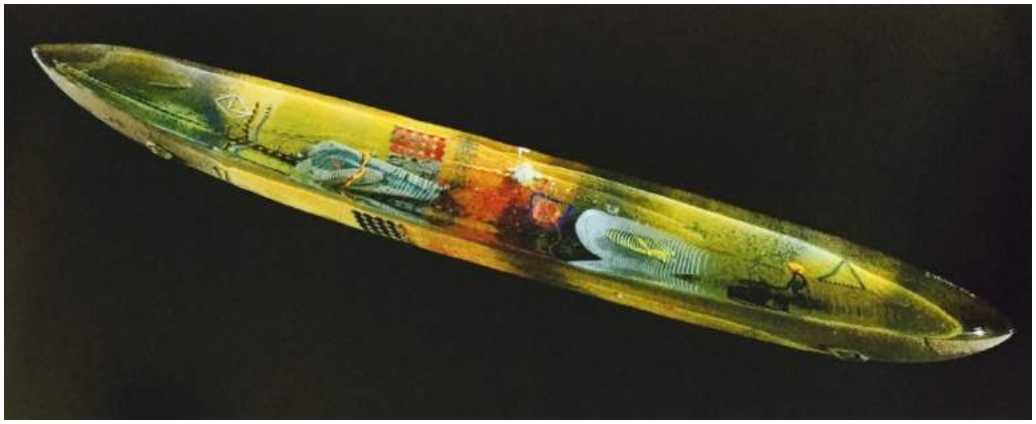

Figure 34 ‘Unknown destination II’, 1986 by Bertil Vallien. Fabricated in the US with assistance of William Morris and Norman Courtney. Cast in a sandmould; copper and hotformed glass inclusions; H. 61 cm, W. 104.5 cm (Frantz S. K., 1989, p. 231), photography credit: Nicolas L. Williams & Raymond F. Errett

Vallien, Dam and Stankard are all artists working in glass who make use of inclusions in their work. Vallien’s inclusions are made using hot glass techniques and manufactured copper inclusions. Stankard works exclusively with *effetre glass* flameworked inclusions. Dam similarly to Vallien uses hot glass fabricated inclusions. Vallien often paints his inclusions with high fire enamels commonly known as *Paradise Paints*. These high fire enamels give a painterly quality to the works immersed in his boats. Contrarily Dam mainly uses glass powders to achieve an organic pastiche reminiscent of flora and fauna viewed under a microscope. Stankard works with a comprehensive palette of solid colours and powders commercially available from effetre in order to create realistic representations of the natural world.

Vallien is debatably most widely known for his creation of glass boats (see figure 34 above). These boats have strong connotations associated with historic Nordic funeral rites which involve laying the deceased in a boat with grave offerings related to their earthly status and/or profession. Vallien’s use of this metaphor speaks on a collective level. It speaks collectively because additional pagan traditions such as Egyptian mythology equally utilises the boat. Egyptian mythology does not utilise the boat as an actual funereal rite of passage (Hart, 1986, p. 182). The boat takes the deceased soul on a spiritual journey to the Underworld (see Diagram 5, p. 78). It was a tradition to bury the dead with sacrificial objects of use or importance to enrich their journey in the afterlife. Similarly this is how Vallien uses the hot glass inclusion within his boats.

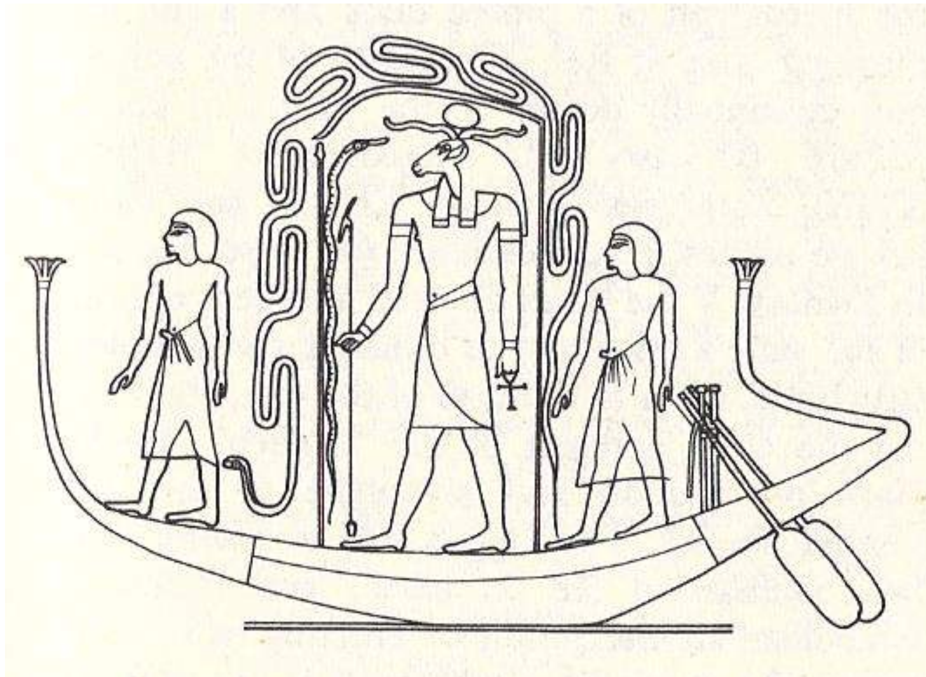

Diagram 5 Re in the Underworld. Tomb of Sety I, Dyn. XIX (Hart, 1986, p. 182)

The idea of flotation, of buoyancy is enigmatic. Vallien’s use of the rawness of the glass surface which comes into contact with the sand (possibly because he was originally a ceramicist) in contrast to the icy (yet still moving) clean surface of the interior space of the boat. The visual contrast between rough and smooth creates a vessel which refers in part to water, both of holding water and of a boat floating. This feeling is paradoxical as the object itself is clearly solid. It is a metaphor referring to the passing of time and to the static timelessness of death. The glass holds the symbolic symbiotic encapsulations to create a feeling of water or weightlessness, time and endlessness.

The floating encapsulations take a variety of forms. Most often copper figures and glass heads as well as ladders, arrows, smaller boats appear. These inclusions have a dreamlike quality and directly reference both Nordic and Egyptian ideology whilst indirectly referencing almost every other faith both new and old. Vallien’s mythology utilises ancient ideas and is concerned with objects travelling with the deceased to accompany them on their journey to the afterlife. These visual references strongly suggest that the inspiration for Vallien's work is derived from the death of his second son Mattias who drowned aged 18 months (Önnerhag, 2013). This family tragedy bestows the glass work created by Vallien with an authenticity which is directly perceptible by the viewer. This authentic quality is noticeable with or without the knowledge of Vallien's personal history.

Figure 35 Example of a horse from the Lascaux Caves, photography credit: Anon

In order to quantify what authenticity means in this context take the Upper Palaeolithic cave paintings in Lascaux, France (see figure 35 above). These cave paintings are an early collection of artworks which are 'directly perceptible' to the viewer. First, one can see the paintings of men hunting game 17,300 years ago. Second, due to the unassuming honesty of these images the viewer can also comprehend how it may have 'felt' to be a hunter-gatherer in Palaeolithic Europe. Vallien's work manages to tap into the subconscious of our psyches with his fundamental themes with the same authenticity of these cave paintings.

Vallien not only uses the dimensions of the glass to express his vision; he is adept at making use of the surrounding ‘installation space’ in which his work is viewed, bestowing yet another layer of depth upon his pieces. A prime example of this is his retrospective exhibition ‘9 rooms’ at the Palazzo Cavalli Franchetti for the 2012 Venice Biennale in which he uses the rooms and the light to enhance his works (Berengo Studio, 2012). This can be observed in figure 36 below where the room has specifically been chosen to match these idols, one of which I create for Bertil Vallien during his masterclass which I attended (see appendix 4, pp. 262-263).

Figure 36 ‘Idols’ 2003 by Bertil Vallien. Cast in a sandmould with metal inclusions; variable dimensions H. 15-22 cm (Berengo_studio, 2012, pp. 62-63), photography credit: Göran  Örtegren

In contrast the artist Paul Stankard uses the clear glass exterior as a vehicle to intensify the intricacies of the encapsulation within, in the same way a child might inspect an ant with a magnifying glass. Stankard’s artwork suggests that his lifetime struggle with severe dyslexia has had a significant effect on the type of work he creates. His dedication to perfection (in part due to his devout Christian beliefs), and use of a craft which is bound by strict traditional constraints signifies a being in need of acceptance by his peers and God. His personal dissatisfaction and frustration (Stankard & Eichhorn, 2007, p. xix) which stemmed from undiagnosed dyslexia drove him to seek out conventionally accepted means of excellence and control (Stankard & Eichhorn, 2007, p. xiii). This search for quality materialised in the form of an appreciation for classical music and poetry. He has used these influences as a motivational tool to inspire his works in the form of masks and root people. He has done this to gently transcend the constraints of the paperweight genre. His self-styled themes are love, sex and death which is evident within the natural world and which he in turn uses as a metaphor for the life of the human animal[23].

Figure 37 'Cloistered Tri-level Botanical with 'Indian Pipe' Flower and Spirits', 1987 by Paul Stankard. Encased flamework; H. 19 cm, W.8.4 cm, D. 7 cm (Frantz S. K., 1989, p. 208), photography credit: Nicolas L. Williams & Raymond F. Errett

Unlike Vallien, Stankard does not use the space outside his 'world' to imbue the work with added symbolism, by the nature of the paperweight the immersed encapsulations within the sphere are the world Stankard wishes to be viewed. By looking at the

[23] Term derived from philosopher John Snow's book 'Straw dogs'

scenario Stankard produces, the viewer's fascination effectively drives them to look deeply and immerse themselves in the unfolding diorama.

His interest in superstitions concerning the Mandrake and root spirits (see figure 37, p. 81) are in direct opposition with his Christian beliefs yet these unseen hidden worlds under the soil like Bertil Vallien's work are enigmatic. Being able to see under and over the surface at the same time derives technically from the need to create the paperweight assembly in two parts. The paperweight is made in two parts so as the flameworked inclusions will be surrounded on all sides by clear glass (see section 2.10.1, pp.74-74). Stankard has to join two paperweights together, therefore it makes logical sense that the junction can be utilised. In Stankard's case the glass join forms the surface of the earth.

Figure 38 'Popular Mechanics', 2011 by Steffen Dam. Sandcast glass with hot cast inclusions and found objects, photography credit: Steffen Dam

Sandcaster Steffen Dam fits aesthetically and technically somewhere between Vallien and Stankard. His encapsulations are not controlled to the degree in which Stankard works his pieces; in fact Dam positively relies on the happenstance of chance within his stylised botanical studies. The way in which Dam shows his mastery of glass is through his precise polishing of his separates and their combination thereafter (see figure 23, p. 66). His compilation technique (see figure 13, p. 44) appears to be directly inspired by fellow Fennoscandian[24] Oiva Toikka (Hom, 2011, pp. 44-45), but Dam has initiated a transcendence of this technique. Dam has combined the tried and tested technique of encapsulation, polishing and fusing with his artistic vision of the natural world. His work includes specimen bottles with creatures floating inside as though trapped in formaldehyde (see figure 38, p. 82) and his exploitation of accidents such as ash and bubbles formed/deposited inside the cast form further enhance the realism of his oeuvre. *'Although his work is related to the history of botanical expressions in glass, it is clearly contemporary in concept and execution.'* (Oldknow, 2013, p. 98)

Dam's work echoes the analysis of natural things in the spirit of post enlightenment. He has added to this mix an undertone of the hybrid subgenre Steampunk (specifically see figure 38 above). Dam's use of 'Steampunk' imagery is perhaps why the curator at Corning, Tina Oldknow refers to his concept as contemporary. It is a key element to Dam's work that the inclusions are trapped inside a clear shell. This clear shell emulates the new view the microscope gave to the Victorians. The fascinating glass slides used to show scientists the micro-world, and consequently the macro key to the Universe.

Dam chooses to work with the microcosm like Stankard but there is a difference between these two artists. The glass surrounding Dam's sandcast 'specimens' makes a contribution to the concept of the pieces unlike Stankard whose glass acts literally as a magnification tool. The clear glass 'slide' metaphorically suggests the use of the microscope as a means to view something normally invisible to the naked eye. Like both of the previous artists his work is enigmatic due to this desire to make the invisible visible (see Jonathon Swift citation, p.171 )

Although the work of Steffen Dam and Paul Stankard are both based on botany Dam's work is more open to interpretation than Stankard's. This is due to Dam's use of abstracted imagery or the essence of the 'specimen'. Contrarily Stankard's decorative intricate inclusions meanings are 'transparent'. This is demonstrated through the function of the botanical illustration which is an in-depth representational study of

[24] The Fennoscandian region within Northern Europe, comprising of Norway, Sweden, Finland, and parts of Russia (mainly Karelia)

plants, flora and fungi for reference. With the help of Reese Palley Stankard strives for accuracy in his floral scenarios (see section 2.10, p.70). Further, Stankard has a limitation set by the field namely the object itself is defined as a 'paperweight' therefore the imitation of nature is key and cords, bubbles or fingerprints are considered a technical flaw (see section 2.10, p. 69 & p. 71). These rules constrain the possibility of abstraction and creativity. Therefore he is restricted by the desire of the collectors in object size and traditionally in subject matter. Collectors require paperweights to include representations of plants and/or animals. Dam on the other hand although also making use of botanical themes has scaled-up his slide specimen interpretations. Dam positively encourages inconsistencies in the glass. These inconsistencies are not noticeable as a 'fault' to the viewer. In the case of Dam, inconsistencies are not seen as a fault because his studies catch the 'spirit' of bacteria or microscopic creatures invisible to the naked eye. This allows Dam's work a greater possibility to transcend itself. His artworks can be opened up to interpretation because of the abstract nature of the theme\, this in turn imbues the artworks with a deeper level of visual and conceptual complexity.

Both Dam and Stankard rely on a specific demographic to gather material for their vision which by definition is a constraint. Contrarily Bertil Vallien's use of cool, stylised Scandinavian design in combination with Nordic mythology and collective mythological themes (see 4.2 for discussion regarding collective mythology, pp. 181-184). These transposable themes work together symbiotically to appeal to a wider audience. Vallien utilises universally recognisable motifs, simplicity of form and generates a visual impact on the viewer with the way he makes and presents his work.

In conclusion storytelling and the notion of enigma and/or mystery has been identified as something which attracts viewers as does technical excellence. Marcel Duchamp said *'All in all, the creative act is not performed by the artist alone; the spectator brings the work in contact with the external world by decipherring and interpreting its inner qualification and thus adds his contribution to the creative act'*[25] (Lebel, 1959, pp. 77-78). This citation indicates that the viewer is integral to the apprehension of an artwork

[25] Duchamp originally presented this paper at the 'Session on the creative act,' convention of the American Federation of the arts, Texas in 1957. The participants were Seitz, Princeton University: Professor Arnheim, Sarah Lawrence College; Gregory Bateson, anthropologist; Marcel Duchamp, mere artist.

and its following success. Therefore artists using more than just the inclusion to tell the 'story' (for example the shape of the sandcast or the environment in which the sandcast has been placed thereafter) imbibe their work with a further level of possibility and comprehension for the viewer. This component of the research fully satisfied objective 2 which was to *examine selected case study artists narratives with a focus on the use of inclusions in a transparent sandcast volume, and the conceptual space (if any) which is being explored.*

In reference to the analysis of the key artists, and in terms of the artworks created (see chapter 4) to drive forward the technical investigation of this research I state that glass is a unique material unlike any other (excepting clear resin). Glass as a material can be seen through allowing the visual artist an opportunity to describe concepts which would otherwise be 'impossible' to demonstrate. The thematic interests of the artworks in chapter 4.3 & 4.4 lie in the visual representation of '*inner'* human emotions. The face that man shows the world, the feelings hidden within 'the man' and finally the subconscious emotions man has no control over. With the use of inclusions inside the body of a clear sandcast not only can the spectator see the outward 'face' of the work, but they can also view what lies behind the façade through the transparent clear layers behind. Considering Marcel Duchamp's view, the artworks created during this research rely on the comprehension of the spectator, their intepretation of the artworks and how they 'the voyeur' relate to the artworks they perceive.

## 2.12 Summary of chapter 2

After creating a contextual review in accordance with aim 1 which was to *analyse key artists using hot encapsulation methods in order to create a series of case studies examining their techniques and artistic themes,* it became clear that the artists who rely heavily on 'play' and 'chance' are producing work which is arguably celebrated on a more localised level. The artists whose work dictates a higher degree of precision are bolstered to a higher level of recognition. This precision is quantifiable in a number of ways including in the polishing process, the use of inclusions, or the tight manner in which it is displayed. This higher level of recognition could perhaps simply be due to a perceivable technical mastery of their process.

In conclusion this chapter indicates through the surveys (pp. 35-42) that flameworking is a popular technique soon to become a major player in the glass art field. It also indicates that the combination of sandcasting and flameworking for at least the last 20 years is not common. The inclusions in sandcasts are used hotformed and often painted. Flameworked inclusions are only in standard use in the field of paperweights. The supposition derived from this chapter is that there is a technical need for this research which will be researched in the following chapter.

Furthermore, it appears that results derived from the journal review indicate that sandcast objects are rarely successful in terms of popularity. This conclusion is derived from the lack of representation of sandcast objects in the journals Neues Glas and New Glass Review. Similarly, the paperweight is also sporadically included in these journals. One can arguably conclude that this is due to the traditional constraints the paperweight must so strictly adhere to. Few paperweights transcend their craft object origins into an artwork which moves beyond its inherent usefulness.

# 3 Routes to encapsulating flamework into sandcasting

*This chapter deals with the technical investigation into the combination of flameworked and sandcast glass. This chapter details four phases of studio testing/practical experimentation and includes conclusions plus a summary of techniques. Phase 1 of the chapter identifies relevant processes and materials in accordance with objectives 3 & 4. Phase 1 examines all relevant technical and decorative techniques from artists featured in the literature review. Phase 2 develops the relevant techniques from phase 1 and develops them further in accordance with aim 2. Heating/annealing processes established by José Chardiet are examined in-depth in this phase satisfying objective 4. These heating/annealing processes developed into a key inclusion placement process in phases 4 & 5. Phase 3 describes field work experimenting with furnaces in Luxembourg and Holland satisfying objective 5. In phase 4 a concentration on inclusion testing led to two new encapsulation methods being effectively developed satisfying questions 1 and 2, plus aim 2. The final component provides a taxonomy identifying the improved and new techniques, the statement of possible new knowledge and how this information could be applied in practice by the wider glass community and the architectural field in the future.*

## 3.1 Introduction to the technical investigation

This chapter focuses on research question 1 and tests if *flameworked glass encapsulations can be applied to the sandcasting process, what are the problems associated with the application of these techniques and how can they be controlled to achieve consistent repeatable results.* Question 1 was this chapters first priority in terms of methodical testing because academically these technique combinations have had little research dedicated to them. The common belief within the community is that this combination of techniques is neither consistent nor repeatable (see section 1.3, p.16). The testing in this chapter begins by examining common materials used whilst creating sandcasts thereby developing objective 3 of the research. Objective 3 was concerned with the *identification and testing of all material applications associated with the process of encapsulating flameworked inclusions into sandcast glass in order to gain a full understanding of the process.* The initial studio tests undertaken in phase one of this chapter (pp. 93-121) were inspired by approaches used by Bertil Vallien, Mitchel Gaudet and Lachezar Dochev (see chapter 2, pp. 35-86 The purpose of these experiments was to ascertain which areas gave potential for new creative work. The first components examined were:

- Resists used to retard the glass from sticking to the sand mould surface.
- Glass powders used to create colour on the surface and in between the layers of the cast. The use of powders led to an alternative colouring method for flameworked inclusions when it proved impossible to source compatible inclusion glass for certain furnace glass batches.
- Brass and stainless steel inclusions as an alternative to copper which has already been pioneered by Bertil Vallien (see section 2.7, p. 62). Little or no research has gone into other types of metal inclusion and this led to an important technique utilising bead mandrel techniques creating voids in the glass cast whilst hot (see section 3.5.3, p. 155 & 3.6.4, p. 166).
- Use of oxides to create colour – Lachezar Dochev (see section 2.8, p. 63) often colours his casts by dropping oxides into a ladle full of molten glass to create colour variations throughout the cast glass body. It was important to see how oxides would affect the sand surface of a cast in order to ascertain whether it was a valid line of enquiry in terms of colouring the cast.
- Selection of inclusion glass for compatibility with furnace glass – Sourcing and testing a variety of inclusion glasses in order to find a compatible glass with a matching *CoE* and *viscosity* to the furnace glass at the University of Sunderland.
- Appropriate annealing cycles and best method for placing finished casts in the lehr.

As a starting point this gave an overall technical view of combining flamework with sandcasting. This broad perspective facilitated the opportunity to pinpoint areas in need of further investigation in relation to this research. The initial tests began to hone aesthetic expectations plus highlight common problems associated with the encapsulation of flameworked components into a larger glass mass. These technical problems are listed as follows:

- Compatibility issues between the furnace batch glass and the encapsulation glass. This is caused by differing properties in the glass centring on CoE and viscosity differentials.
- Distortion or breakage before, during and after annealing (figure 39 below).
- Accidental movement, smearing or elongation of flameworked components during casting. This is due either to accidental misplacement whilst adding the inclusion to a hot cast or due to overheating of flameworked components whilst the next pour is ladled onto the cast surface.

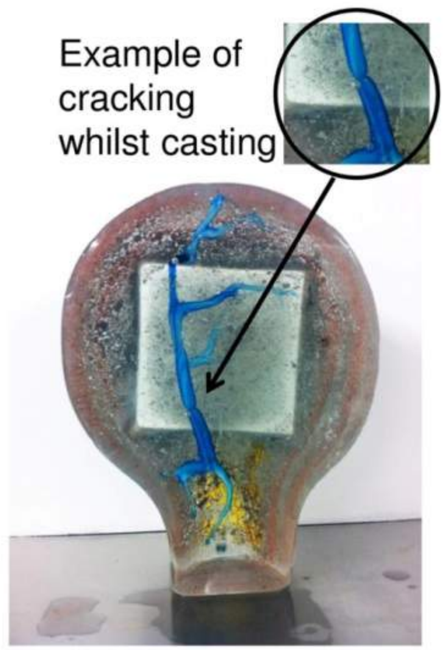


Figure 39 Floating inclusion cracking due to the shock of being transferred into hot sandcast with cold metal tool, 2013. Photography credit: J A Denton

As the issues were identified and tested in this phase, this allowed for regular re-evaluation of methods and processes. For example when a test did not give the anticipated results (see section 3.2.6, pp. 116-121), further tests had to be created. The further tests were needed to ascertain one of two things: First inquiry - Why was the result unexpected? Could it be retested? Second inquiry - Could an alternative route be explored?

In phase two (pp. 121-131) the criterion for testing started to refine as some applications in phase one were either resolved, worth further exploration or dismissed. Further, it became necessary to consider and test specific techniques developed by key artists examined in the contextual review in accordance with objective 4 which was to *design a series of tests based on the work of selected contextual review artists, and adapt their techniques to sandcasting with flameworked inclusions, then refine and improve upon their methods.* Testing other artists techniques was necessary to this research because some of the techniques artists used in their own practice could be relevant to this line of inquiry.

As this research is an unexplored area (especially in academia) none of the chosen artist's techniques were directly related to combining sandcasting with flameworked inclusions. Artists techniques had to be adapted to suit this research. José Chardiet was the first artist examined and his approach was the first to be tested. Chardiet was chosen firstly because he had worked with preheated moulds. The preheated mould technique was significant because Chardiet makes large scale work in three dimensions which does not deform during casting. For an explanation of Chardiet's glass control during sandcasting see section 2.6.1, p. 59-61. Mould pre-heating relates to this research because of issues experienced in phase one of the testing. The issues in phase 1 included a lack of time for precision inclusion placement during casting and the breaking of casts in the lehr. These cast breakages in the lehr were due to CoE and heat problems with the inclusions (too cold and too hot) and the furnace glass. Chardiet's preheated mould technique alleviated these issues and fortuitously led to the discovery of a new encapsulation technique (see section 3.3.2 - 3.3.4, pp. 126-131) which for the purposes of this research is called the 'transitional' inclusion (see figure 3, p. 5). The development of this line of enquiry allowed the flameworker full control of inclusion placement and stopped the inclusions from being smeared due to overheating during the casting process, i.e., a hot ladle of glass being poured directly on top of an already hot inclusion would cause the inclusion to smear. This new technique addressed and answered research question 1.

Phase three (pp. 131-137) focused on objective 5 which was to *experiment with a variety of furnace glasses and encapsulation glasses to unveil compatible combinations and/or alternatives with a concentration on philips 3300* batch, glasma and *cristallica* furnace glass. Objective 5 was developed out of the responsibility of this research to be applicable to the wider glass community. This phase concerned the use of flameworked encapsulations within a sandcast glass mass using different furnace *batch* glasses across europe. It was essential to examine other glass types so as this research could be applied to other artists with differing furnace glass types. This was achieved by making site visits to two hotshops: One in Holland and the other in Luxembourg. The issues being observed and tested in this phase were:

- How other sandcasting artists were using their furnaces and what were their alternatives should they have no furnace available?
- What type of furnace glass were other glass artists using and was it possible to source compatible inclusion glass?
- If no suitable matching inclusion glass could be found what were the alternative methods of encapsulating flameworked inclusions into a sandcast body, if any?

The resultant findings gave ample alternatives in terms of inclusion possibilities. These possibilities were created with both compatible glass and alternative computations. The alternatives involved using the ‘designated’ clear furnace glass pulled into rod form. This rod could then be flameworked on the torch and combined with powders in a hot process or with high fire enamels (akin to Vallien) in a cold process. Similarly clear flameworked inclusions (furnace batch glass) could be sandblasted to create a ghostly veil perceivable to the naked eye after casting.

In phase four (pp. 138-158) of the research more specific testing was engaged in. The causes of ‘blurring’, ‘smearing’, ‘elongation’ and ‘trapped bubbles’ caused to inclusions whilst casting were critically examined and tested. In this phase the ‘transitional’ inclusion (previously identified in phase two of the research) was developed further. It consisted of heating inclusions within the sand mould surface pre-casting. Fortuitously 'transitional inclusion' testing led to a breakthrough in this research: Not only could soft glass flameworked inclusions be embedded in the sand surface retarding movement and blurring but inclusions could also be created in component form to create a larger focal area in the cast. This greatly increased the size potential of the inclusions and consequently if desired the size of the cast. The work was no longer reliant on a single inclusion dictating the size of the cast. The component aspect of the 'transitional' inclusion technique (see figure 85, p. 175) was inspired (and developed in this phase) by Paul Stankard's method of creating elements for his paperweight flower scenes (See section 2.10.1, pp. 71-76). The use of components answered question 2 of the research which enquired whether *flameworked encapsulation techniques previously used in paperweight making could be applied to flameworked inclusion encapsulations in the sandcasting process?*

Discovering the 'transitional' inclusion for use on the surface of a cast led to testing the tolerances of this inclusion type. This was to ascertain how far these inclusion types could be pushed out of the surface of the cast before breaking. What technical difficulties may be related to this technique? Plus what were the alternatives, if any? These tests led to the unexpected development of the '3D transitional' inclusion (see Figure 81, p. 162). This inclusion development furthered the scope and diversity of the flameworked inclusion within a sandcast form.

The alternative to counteract 'transitional' inclusions which broke after casting stemmed from a discovery concerning the usage of bead *mandrels*. Originally the mandrels were used to create voids inside the sandcast so as metal bolts could be slotted in place after casting in order to mount and display the artwork. During phase four (pp. 138-158) the use of a metal mandrel was developed further and became the 'partial' inclusion technique. This technique consisted of a separate glass element which fitted into the surface of the sandcast using a glass post, similar to a *dowel joint* in carpentry (see figure 78, p. 158). This technique bypassed the material constraints of joining transitional elements in hot form; once again dramatically increasing the size potential of a cast should there be a need.

The penultimate component of this chapter consisted of conclusions and a summary of the methodological developments which led to new knowledge (pp. 159-167). This section classified the techniques by identifying each inclusion type whether previously known or established during this research period. This summary further considered how these techniques may be used for industry in an architectural glass context or in a studio glass environment. The final component consisted of the statement of new knowledge (pp. 169-170).

## 3.2 Phase One – What techniques to take forward?

Phase one was designed to test which processes and materials were of importance to the research field in accordance with objective 3. This initial phase began by identifying relevant types of relief mould. Issues to consider were initially material choices available for the creation of moulds: Did they need to be durable and strong or could they be weak and perishable? Mould shapes equally needed to be identified to test specific criteria relevant to this research such as inclusion glass compatibility.

The next features to test were the types of sand resist available as sand adhesion negatively impacts the visual aesthetic of the sandcast. Which resists would attest to be the ideal solution for coating the sand moulds? What resist proved superior in its capacity to retard the molten furnace glass from fusing with the counter-relief sand mould?

It was clear that the research hinged on finding a furnace glass with a suitable commercially available flameworking counterpart in order to achieve a *trompe l'oeil* effect with the inclusions. In order to create a three dimensionality observed particularly in the work of the paperweight maker Paul Standard, opaque inclusion glass must be overlaid with transparent glass (for an example of this see figure 52, p. 117). Desired colour variations of this magnitude could only be found commercially and it was a necessity to the wider impact of this research to find a compatible match with the furnace batch glass.

Figure 40 Example of use of powders and metal, plus use of cold inclusions on surface of cast leading to eventual discovery of the transitional inclusion technique, 2012. Photography credit: J A Denton

This was a difficult task which particularly concerned *CoE* (which will be explained in full in sections 3.2.3, p. 102-104 & 3.2.6, pp. 116-120). This original constraint split into a number of variant computations including the use of glass from other furnaces (see section 3.4, pp. 131-137) and a change on two occasions of the furnace glass at the University of Sunderland (see section 3.5.1, pp. 142-149). The latter variant required research on a number of separate occasions in phases 1, 3 & 4 because it considerably affected the testing.

Thereafter it was unclear if the use of oxides similar to techniques used by Lachezar Dochev (see section 2.8, pp. 63-64) would become an important factor in the colouration of glass casts. Therefore oxides were tested. Oxide testing naturally led to testing the compatibility of a series of glass powders, frits and *enamels* and later their subsequent combinations (see figure 40, p. 94). Whilst testing the decorative techniques (and due to most sandcasting artists using copper inclusions) it was relevant to this research to test the use of metals on the surface and in between layers of the sandcast body.

Figure 41 Example of two mould forms in a metal box almost ready to be placed in Lehr and after casting pieces annealing in the Lehr, 2012. Photography credit: Left: Anon. Right: J A Denton

Copper was not tested because it has previously been proven compatible with glass and has been pioneered in sandcasting by Bertil Vallien (see section 2.7, p. 62). The compatibility of metals testing led to an important hole creation technique. This hole technique consisted of the use of metal mandrels with a self-made release agent. This technique was developed further in phase four (see sections 3.5.3, pp. 155-159 & 3.6.4, pp. 166-167) of the research and led to a new inclusion type called for the purposes of this research the ‘partial’ inclusion.

During testing a question arose concerning the importance of the boxes one uses to cast into. Was it better to use large wooden receptacles and once cast dig out the casts and place them into the annealer? Or was it more viable in reference to space in the *lehr* versus the cost of box fabrication to cast pieces one at a time in metal containers (see figure 41, p. 95) The use of metal boxes led to two important findings:

- The use of metal boxes cut casting time down by two thirds due to not having to wait on each cast to cool enough to be dug out of the sand. Plus glass casts could be moved to the lehr without deformation or cracking, as they would stay in the metal box during this process.
- Using the metal boxes led to the use of José Chardiet's technique of pre-heating moulds in the lehr pre-casting. This motivated the development of the 'transitional' inclusion initially developed in phase two (see section 3.3.2, pp. 126-131).

These questions were posed and tested in order to ascertain which technical and decorative techniques were expendable, and which materials and processes warranted further exploration in phase two.

### 3.2.1 Proposed mould forms

As previously stated in the literature review (see sections 2.6.1, p. 59 & appendix 4, p. 263) it is a prerequisite that the Mansfield sand is sieved and dampened before casting (see figure 42, p. 97). This is important because the sand should be strong enough (damp) to hold the shape of a pre-made relief mould form and be light enough (sieved) to pick up the fine detail on said relief mould. The mould must not contain undercuts as upon withdrawal from the sand, an undercut would drag parts of the sand mould surface with it. This would destroy the desired concave form which was initially required to cast into. Porous mould materials such as plaster, foam or wood are easier to carve. Obviously wood is the most hard wearing of all the above mould materials, but it takes longer to carve the form. Plaster is also strong but chips easily and it is heavy – If moulds are being transported to different venues the weight can pose a logistical problem. Foam is the easiest to carve but it is also the weakest type of mould material. For the purpose of this research all mould materials were used. Foam coated in a layer of plaster tended to be the fastest to make and simplest to transport.

Figure 42 Preparing the Mansfield sand for casting, 2012. Photography credit: Anon

Once a mould has been made from any of the above materials it must be coated with varnish. The varnish creates a protective non-porous layer on the mould surface. This non-porous layer prevents sand adhering to the surface of the mould whilst creating the negative in the prepared Mansfield sand. In order to identify easily which problems were being tested, specific mould forms were assigned to particular types of experiment. The mould forms were the arch, the cuboid and freeform:

- Arch - Designed to work purely with the encapsulated flameworked arrangement without the use of powdered colours or any other inclusions such as metals (see figure 43 below). It was useful not to use any other decorative effects when examining compatibility issues under a *Polariscope* because there were no visual distractions from other test items in the glass body. Decorative effects included coloured powders, metal inclusions or oxides. These effects would visually impair the reading of results ascertained with the polariscope.

- Cuboid - Designed to test the use of powdered colour, enamel, frit, metals and oxides in unison with flameworked inclusions (see figure 40, p. 94). The use of this shape was to make it easily identifiable from the arch form which was concerned with the singular technique of testing inclusions for compatibility, smearing, breaking and deformation.
- Freeform – In phase three of the research the freeform mould was used to create more complex artworks with undercuts (see figure 61, p. 135).

Figure 43 Example of plaster relief mould in the arch form placed on sand precasting. Photography credit: J A Denton

### 3.2.2 Sand resists

During the glass casting process, the sand mould surface bonded to the hot glass as it was poured. This sand bonding made the casts appear primitive. It is visually negative if the sand bonds to the glass surface unless the pieces are *cold processed* or *sandblasted* afterwards. Chardiet cold processes his sandcasts once they have been annealed (see section 2.6.1, p. 60). To minimise the extent to which glass and sand bonded a resist coating the negative mould was a necessity. The visual difference between casts with and without a sand resist can be seen in figure 44 below.

Figure 44 Visual difference between sandcasts made without a resist (left) and with a resist (right), 2015. Photography credit: J A Denton

Tests were carried out to establish which resist was the most appropriate considering the following four factors: ease of use, effect on health, mould coverage and effectiveness against bonding. The tested resists were chosen because I have used each of these resists at different stages in my varied glass career.

The most commonly used resists are as follows:

- **Mica** (Introduced to this resist in UK by Bertil Vallien).
- **Graphite** (Introduced to this resist in the UK by Colin Rennie).
- **Molasses** (Introduced to this resist in Turkey by Mitchell Gaudet).
- **Corn flour** (Introduced to this resist in the USA).
- **Acetylene** (Introduced to this resist in Turkey).

Certain resists were considered unsuitable after a single test for the following reasons:

- **Molasses** is a sticky natural substance which when mixed with water to form a liquid can be sprayed from a pump action bottle. The viscous molasses tends to quickly block the nozzle of the spray gun used to coat the surface of the sand mould. This method was dismissed because it was not easy to use.
- **Corn flour** was a good resist but must be added to the sand body before creating the concave mould in the sand. The corn flour weakens the bonding capabilities of the bentonite naturally found in the Mansfield sand. The cornflour causes the sand to lose its ability to bind tightly to the relief mould – the mould is liable to cave in on itself. Therefore this was also dismissed because it was not easy to use.
- **Acetylene** was an excellent resist which bonded to every part of the negative sand mould surface but the excess carbon from the flame was dirty and became airborne immediately. This method was dismissed due to potential negative effects on health through inhalation and adhesion to skin.

**Graphite** and **mica** gave the best initial results. Further test results indicated that graphite resisted the bond between glass and sand adequately but could often only be found in powdered form. The powder prohibited coverage of angles of 90° or less (acute). The adhesion to only part of the mould surface was a negative aspect and graphite was dismissed as unfit for purpose.

When combined with alcohol and applied with a small airgun mica covered negative moulds evenly. An iridescent layer of colour was deposited on the surface of the cast post-annealing. The iridescent deposit mica left on the cast surface was especially prevalent in casts utilising exterior powdered colour which could pose a visual problem for some users. When used with only clear casting glass the mica resist proved to be less effective than the powdered graphite as the sand bonded to the glass more than when using graphite.

Figure 45 'Moon cast', 2013 by J A Denton. Cast in a sand and graphite mould, flameworked glass inclusions: H. 12 cm, W. 12 cm, D. 5 cm, photography credit: J A Denton

All sand moulds were coated with 20% mica & 80% surgical spirit resist. The airbrush coated both the flat surface and the 90° walls evenly. The surgical spirit was benign and simply evaporated once sprayed over the mould surface. In future if one wished to see the iridescence of the mica on the finished cast it would be advisable to increase the percentage of mica to 70%, and 30% alcohol whilst spraying a thicker layer over the sand surface.

As mica was a less satisfactory resist than graphite and powdered graphite could not cover side walls of the mould form a different experiment was conceived of. The new experiment used a four sided graphite mould form. The graphite mould was placed on a bed of Mansfield sand covered with graphite powder, powdered glass colour and a pre-heated inclusion (see figure 45, p. 101). The results were satisfactory and the sides of the mould were free of sand but this technique rendered the process time consuming. The graphite mould could not be placed in the annealer as the heat would break down the graphite. Plus the cast needed an extended time to cool before placement in the annealing oven. The extra time needed to cool own the glass cast was due to both the insulating nature of the graphite mould and a lack of escape routes for the heat emanating from the freshly poured cast. Normally the heat dissipates through the sand mould and from the glass surface of the cast which is exposed to the air. In this instance the four side walls were insulated by the graphite mould therefore heat loss was slow. Heat dispersal could only occur through the floor of the cast where the glass made contact with the sand and on the face of the cast where the glass made contact with the air.

Towards the end of phase one of the research large cans of spray graphite were sourced and this was a perfect resist. Spray graphite fulfilled all testing criteria as long as it was sprayed in a room with extraction and the user wore a respirator for safety. Sand deposits on the sandcast surfaces were minimal and mould coverage from the spray graphite including angled or vertical surfaces was 100%.

### 3.2.3 Compatibility

All glass makers have to consider the *coefficient of thermal expansion* (COE or $\alpha$) of different glass types and their combination. CoE is generally considered to be the rate at which any material expands and contracts when heat is applied. Coefficient differentials must be considered in this research because when glass types do not match, the finished artworks are likely to break after annealing. This aspect of the chapter will briefly explain what a CoE is (also represented by the Greek letter α) and why this research is concerned with it. The CoE is important in reference to inclusion use and/or surface colour/embellishment. Furthermore this part of the chapter will demonstrate why the technical investigation hinges on resolving constraints derived from coefficient differentials in relation to the combination of furnace glasses with other types of glass or metal.

When a substance is heated the kinetic energy of its molecules increases and the heated molecules move more. Movement of molecules usually maintains a greater average separation when generated by heat thereby expanding the material. Glass and other typical coefficients of a given material are measured in 0.1 parts per million per *Kelvin* ($10^{-7}$/K). Zero Kelvin is the temperature at which all thermal motion ceases. Glass is measured in linear expansion and the degree of expansion divided by the change in temperature is called the coefficient of thermal expansion. CoE is measured by the rate a material expands when heated. Materials with a higher melting point have a lower thermal expansion thus the thermal expansion of α90 soft glass (silicate) is higher when compared to α5.8 quartz (crystal) for example.

| Type of glass | Coeff. of Exp. | Strain point | Anneal Point | Soften Point |
|---|---|---|---|---|
| Soda Lime | 89 x $10^{-7}$/K | 511°C | 545°C | 724°C |
| Lead crystal | 94 x $10^{-7}$/K | 457 | 492 | 639 |
| Borosilicate | 32.5 x $10^{-7}$/K | 510°C | 560°C | 821°C |
| Quartz | 5.5 x $10^{-7}$/K | 1120°C | 1215°C | 1683°C |

Table 3 Comparison of expansion rates/heating temperatures of different glasses in common use

When combining two different glasses they must have the same CoE, or within 2 to 3 α points, i.e., If a stiff black rod of *Effetre* glass which in full written form is α = 104 x $10^{-7}$/K, and the soft opaque ivory *Effetre* is α106 they will fuse together in a hot process and stay fused without cracking. Alternatively if fusing *Spectrum 96* glass (α96) with *borosilicate* glass (α32) tests show that pieces will break away from each other immediately upon cooling due to α differentials (see figure 47, p. 110). Therefore it is vital to the success of the research especially in relation to question 1 to perform compatibility tests with commercially available flameworking glass.

The inclusion glass was tested in combination with several different furnace *batch* glasses. This was in accordance with objective 5 of the research which was to *experiment with a variety of furnace glasses and encapsulation glasses to unveil compatible combinations with a concentration on Philips 3300 batch, Glasma and Cristallica furnace glass.* It was essential to the satisfaction of this research to undertake tests with different batch glasses so as this research could be applied to the wider glass field in the future. **If** a commercial glass with a broad colour palette could not be found to fit with one/any of the chosen furnace glasses, what were the alternatives?

Table 3 on page 103 gives a basic comparison of key glasses used in industry: Note that soda lime glass is for use in most hotshop furnaces.Once finding a suitable flameworking glass with the same α as the furnace glass, the two different glass types may **still** not be compatible if the *viscosity* of each glass  differs. Viscosity describes a materials internal resistance to flow (stiffness) and can be thought of as a measurement of fluid friction. Viscosities are expressed in units called poises[26]. The term poise is named after Jean Léonard Marie Poiseuille a French physicist and physiologist active in the 19th Century.

Water has a low viscosity and is described as “Thin” whilst glass when heated has a high viscosity like honey, and is described as “Thick”. To give two examples of viscosity in terms of poise; at 25°C the viscosity of water is approximately 0.001 poise, honey has a viscosity of approximately 100 poises and the viscosities of any glass will obviously change when measured at different temperatures.

[26] The poise is often used with the metric prefix *centi-*. A centipoise is one hundredth of a poise, equal to one millipascal-second (mPa·s) in SI units.

Viscoelasticy refers to the viscous and elastic qualities of the material during deformation (heating). Glass has elastic qualities which are due to the bond stretching across its crystalline structure and glass has viscous qualities as a result of the diffusion of molecules inside the amorphous material, thus making it a *Kelvin-Voigt material* which encompasses both of these material qualities. Viscoelastic materials have elements of both viscous and elastic properties and therefore exhibit time-dependent strain. It was beyond the remit of this PhD to strategically test the viscosity of any given type or brand of glass because this research has been designed for the glass art community who may neither have time nor equipment to carry out this further testing. Should a practitioner wish to carry out a basic test it would revolve the dispersion test as utilised in the petroleum industry quantifying viscosity. Given that the CoE of two glasses from different companies with the same CoE are being tested. It is a given that different colours are made by combining different oxides and the CoE differential in any one brand is $\pm\alpha 2^{7}$ of the CoE stated by the manufacturer. These two test glasses could be cut into the same shape and size e.g., a 2 cm x 2 cm x2 cm cube. The cubes could be placed in the kiln under the same conditions and taken up to high melt (1150$^{o}$C). Once cooled the resultant samples which would have melted flat can be measured across their length. If the samples have the same measurement then they have the same viscosity. If the sames differ in size then the viscosity is different and these two glasses will have to be combined using the methods discussed further in phase 4 of this chapter.

Although testing viscosity was not part of this research it is sufficient to say that not testing the viscosity of all brands of encapsulation and furnace glasses effected the results of the practical testing negatively (the only untested factor) and a number of sandcasts with incusions broke after annealing. Alternative routes to successful encapsulation of commercially available flameworking glass were discovered and researched in phases two (sandblasting, p. 128), three (glass powders and high-fire enamels - p.135) and four (forcing glass to fit, pp. 150-151 & negating the need for compatible glass, pp. 155-158).

### 3.2.4 A technical note on annealing

Glass and ceramics in terms of thermal expansion are considered to be brittle materials which are sensitive to uneven heat which in turn can lead to uneven expansion. In '*Chemistry of glass'* (Vogel, 1985, p. 295) an explanation of why glass needs to be annealed reads as follows:

'*When heated, a glass body expands, whether more or less being dependent on the thermal coefficient of expansion. On relatively rapid subsequent cooling it shrinks and contracts. Because of the relatively low thermal conductivity of the glass in the exterior, a structure corresponding to a higher temperature is fixed, whereas the interior continues to contract, assuming a denser structure. Because of these differences in density, strain [and birefringence] will result.'*

The thermally conditioned strain can be described by the following expression:

$$S = \frac{\alpha \cdot \Delta T \cdot E}{2(1 - \nu)}$$

Where $S$ = strain, $\alpha$ = linear thermal coefficient of expansion, $\Delta T$ = temperature difference, $E$ = modulus of elasticity, $v$= Poisson's constant'[27]

It is important to technically understand why it is necessary to anneal glass at all. Plus the equation above will help to provide answers to issues of compatibility. A small explaination of the symbol *v* is necessary here. *v* refers to Poisson's ratio which is a

[27] Poisson's constant tends to be referred to as Poisson's ratio and the symbol it is represented by the 13th letter of the Greek alphabet Nu = *v* (Uppercase N, lowercase v)

measure of the Poisson effect and consists of the ratio of transverse contraction strain to longitudinal extension strain in the direction of the stretching force. Utilising the example of an elastic band in way of explaination, when rubber is stretched on one axis it becomes thinner on the other axis, and contrarily if a material is compressed in one direction, it usually tends to expand in the other direction perpendicular to the direction of compression. This phenomenon is called the Poisson effect and Poisson's ratio is the measure of this effect. A material with no resistance to stress is known as an 'ideal form' such as cork, which shows little lateral expansion when compressed and is measured close to 0 poise. The Poisson ratio is the fraction (or percent) of expansion divided by the fraction (or percent) of compression and is represented by the symbol $\nu$ used above. The above equation describes the strain a poor conductor like glass is put under when heated and why slow cooling is essential to creating an artwork which does not crack. In terms of this technical investigation good annealing practice is essential due to the differing viscoelasticity and thermal expansion between the various furnace and inclusion glasses which were used during this investigation.

### 3.2.5 Powders, metal inclusions and oxides

Sandcasts are often made in combination with a thin layer of powdered colour and/or metal inclusions both on the surface and inside the cast (see figure 48, p. 111). This aspect of the testing examined powders in combination with the furnace batch glass. Quantitative testing included establishing the tolerance differentials possible between furnace glass and the commercially available powders before the CoE's became too extreme and the effects produced were negative (cracking and/or crazed surface cohesion). Powders such as α96 Kuglar often used in combination with batch glass in the hot shop and powders often used by flameworkers called α104 Thompson enamels were tested among others. The results of some tests were readable with the naked eye such as the combination of α96 furnace glass with borosilicate powder α32 (see figure 47, p. 110), but for tests which were not obvious a polariscope was used to assertain the amount of stress between the two glasses or between the glass and metal.


Figure 46 Example of a polariscope

Throughout this technical investigation a polariscope was used to test quantitatively for the extent of stress between powders, metals or inclusions when results could not be assertained with the naked eye. A polariscope is a simple piece of equipment which uses polarised plates to determine the optic character of glass (stress levels) and/or gems (isotropic or anisotropic type) and is used in a similar way to a microscope. As can be seen in Figure 46 above a polariscope has two polarised filters, one on the top (analyser) and one on the bottom (polariser) of the instrument which have their own vibrational planes. When the vibrational plane of the polariser is at right angles to the vibrational direction of the analyser, the field between them remains dark. This position is known as the ‘crossed position’ and in this position no light will travel through the polariscope. When the light source is added from underneath the polariscope and the glass to be examined is placed between the filters, refracted light can travel through the directional plane of the filters and be seen. When the glass being tested is turned in the polariscope rainbow coloured straations observed between the powder/inclusion/metal and the furnace glass means that the glass is producing an anomalous double refraction. ADR indicates that there is residual stress and strain within the glass being observed and it is up to the individual to interpret this qualitatively. The glass must be transparent or translucence because light cannot pass through a fully opaque glass and therefore ADR cannot be tested in this way. This testing used both qualitative and quantitative analysis because the polariscope quantively demonstrated the strain levels in the glass but it was up to the individual to interpret the results in a quantitative tacit (see section 1.4, pp. 20-22) manner.

In terms of powdered colours added to the sandcast surface it was important to find out at what point the CoE of any glass powder would produce *stress* on the outer surface of the sandcast glass. This was significant to the research because it indicated what degree of 'freedom' the glass artist could have over the surface 'decoration' of a cast. These experiments with surface colour showed the CoE ranges the glass artist can work within when using powdered glass colour in a thin layer with furnace glass.

List of powders which were tested:

- Thompson enamel α104 – Combined successfully with furnace glass.
- Kuglar powder α96 – Combined successfully with furnace glass.
- Mica powder α unknown – Combined successfully with furnace glass.
- Brown bottle reclaimed glass[28] α85 – α87 – Combined successfully with furnace glass.
- Borosilicate powder α32 – Did not combine successfully with furnace glass.

During testing there were no issues with the Kuglar powders and the same was true of the α104 Thompson enamels. The higher CoE powders if combined with Kuglar powder for example created surface decoration with a satin finish. Normally the finish on a sandcast with a powder of a similar CoE is matt. This set of experiments showed that

[28] Reclaimed powdered bottle glass powdered has a COE of between α83-α90, but it is generally accepted that this glass is between α85-α87

there is at least a ±α10 flexibility margin between powders and any soda-lime furnace glass.

Figure 47 Incompatibility results when combining *α*32 borosilicate powder with *α*96 furnace glass, 2016, photography credit: J A Denton

Additionally borosilicate powder (see figure 47 above) was completely incompatible when combined hot with the furnace glass. A thin layer of borosilicate powder once cast in combination with furnace glass could not even survive the annealing process before breaking. This demonstrated that powders over a ±α10 would be incompatible with any furnace batch glass. Powders within the ±α10 added as a thin layer on one side of the cast caused minimal stress throughout the glass artwork. Any stress caused to the sandcast due to the use of glass powders was inconsequential because a thin layer of powder on one plain could not damage the glass artwork. On the other hand a three dimensional inclusion trapped between glass strata was more problematic (this aspect of the research is developed further in sections 3.2.6, pp. 116-121 & 3.5, pp. 138-155). The Thompson enamels lowered the melting point of the Kuglar powders which gave the cast a smoother satin finish as opposed to a matt coarse surface texture. Contrarily the recycled bottle glass created a rougher surface due to its lower (more heat resistant) α.

| Metals used during testing | Thickness tolerances |
|---|---|
| Gold leaf | 0.08 μm[29] / 0.00008 mm |
| Silver leaf | 0.125 μm / 0.000125 mm |
| Silver foil | 7 μm / 0.007 mm |
| Aluminium foil | 16 μm / 0.016 mm |
| Copper foil | 25.4 μm / 0.0254 mm |
| Copper sheet metal | 127 μm / 0.127 mm |
| Mild Steel washers | 510 μm / 0.51 mm |
| Brass clock components | 728 μm / 0.728 mm |

Table 4 Gauges in mm & μm of metals used during this research

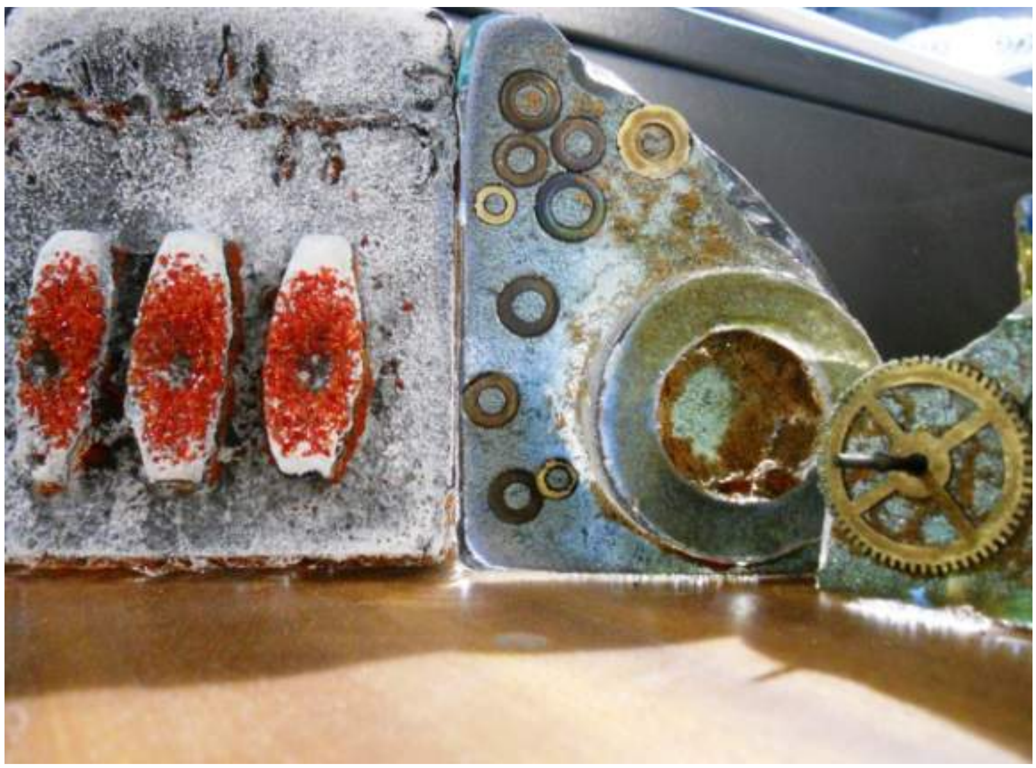

Figure 48 Test with powdered colour and a variety of thin (0.51 mm – 1mm) metal ready-mades, 2011, photography credit: J A Denton

[29] Standardised unit of measurement symbol for micrometre which is 1 millionth of a metre

Testing the capacities of metals in conjunction with the furnace glass was researched because it is another form of inclusion. As previously stated Bertil Vallien has worked with copper on the surface of and inside his sandcasts. Tests were designed to affirm that copper foil and sheet were compatible and to check if any other possibilities had been missed. The copper experiments led to other metals being tested such as brass and stainless steel. These metals were tested in the form of thin sheets or as found objects such as small pre-fabricated watch and clock components or metal washers (see figure 48 above). There was a high chance that thick metal inclusions would cause too much stress due to the $\alpha$ differential in relation to amount of foreign material used. Should any of the aforementioned combinations fail what were the other possibilities? Were there alternative ways to combine other thin/thick metals within or on the surface of a hot cast?

Philips batch furnace glass was compatible with copper wire, tubing, foil and sheet. The copper kept its copper colour when cast on the face of the sand mould. If the copper sheet was sandwiched in between glass pours it transformed to a red colour and this was due to the heightened core temperature of the copper (see figure 51, p.115). The only variant in this group of tests was copper mesh which needed to be preheated with a torch to stay red in the sandcast after casting. The copper wire matrix needed to be further heated because the wire naturally lost heat because of the surface area to volume ratio (see figure 49, p. 113). If not preheated with a torch the matrix struggled to retain any heat even when encapsulated at 1200°C. In relation to the Philips batch glass there was **some** compatibility with metal inclusions other than copper such as brass or steel. The Philips batch glass was uncompromising when using alloy components in any amount, this was not the case with other furnace glasses (see section 3.4, pp. 131-137)

Figure 49. Example of copper mesh after casting, 2011, photography credit: J A Denton

Further experimentation with metal components was undertaken. This was because these incompatible elements had a parallel to the glass inclusions. As an example, thick flameworked inclusions made in a different glass type from the furnace glass often broke once annealed. This was the same for an inclusion made of thick copper even though it **is** compatible with the furnace glass. What alternatives were available to elicit the combination of thick copper with glass? Perhaps coating any metal components with a *release agent* so they didn't adhere to the glass surface post-casting? This was tested and worked well with small metal components. With very large metal components this did not work (see figure 50, p. 114). The metal was so large that it drew the heat from the glass cast as it annealed. Post annealing there were many areas which had small cracks due to the metal inclusion on the outside of the cast. The release agent was successful though. Therefore further alternatives using a ceramic release agent were investigated in section 3.5.3, pp. 155-159

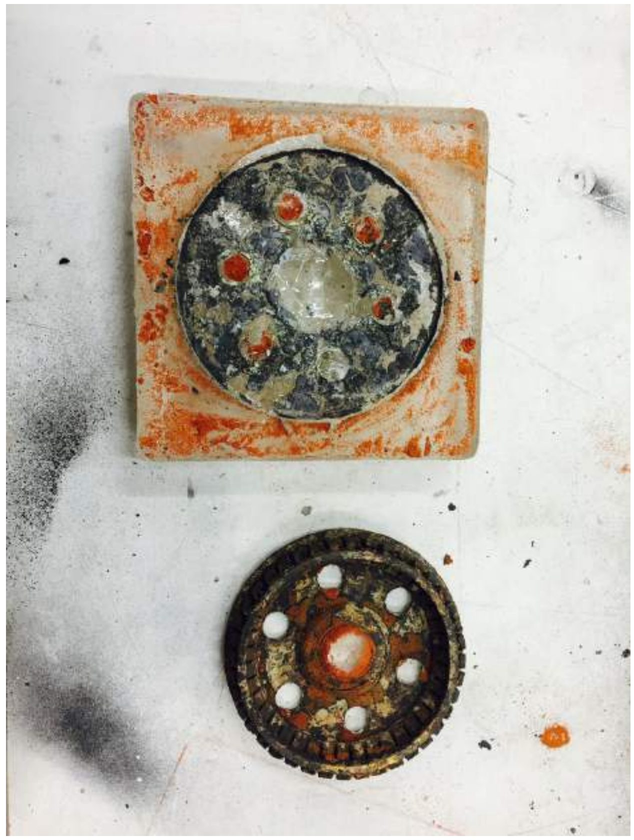

Figure 50 Large brass inclusion coated with ceramic release agent pre-casting and cast on the outside of the body of the sandcast like a transitional inclusion, 2016, photography credit: J A Denton

In batch production, glass is coloured with a variety of oxides and in some cases precious metals (gold = rose colour). Artist Lachezar Dochev (see section 2.8 , pp. 63-64) uses oxides to help colour his transparent casts during the casting process. This is an interesting idea as most furnaces contain clear batch glass only. Therefore it is possible to introduce colour to the complete cast by embracing this technique. As oxides are mixed in the ladle immediately before casting there is a tendency for many bubbles to form which are then trapped within the cast. Dochev stated in a personal interview conducted in Luxembourg, (see appendix 2 , pp. 246-254) that he actively encourages the bubbles which are formed from the use of oxides in his casts. As part of this research oxides were tested to confirm that bubbles formed when oxides were administered to the surface of the cast.

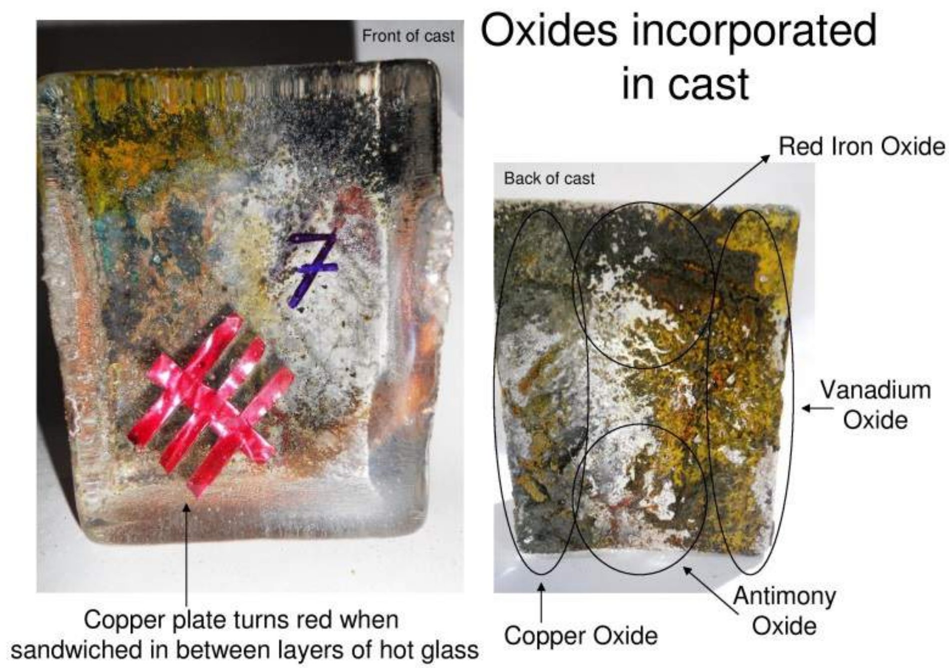


Figure 51 Oxides and sheet copper incorporated in a sandcast, 2011, photography credit: J A Denton

As can be seen in figure 51 above, the oxides used on the surface of the cast were red iron, vanadium, copper and antimony. The expected outcome was that oxides would create many bubbles throughout the cast as previously seen in Dochev's work, but this was not the case. The raw materials used in industry as a colorant for glass, gave off few bubbles whilst producing many earthy colourations when viewed through the clear surface of the cast. On the anterior side of the cast, the texture of the oxides was rough. On page 116 a table listing some of the chromopores and their resultantant colouration for use in ionically coloured glasses is shown for reference.

In conclusion virtually all glass powders, enamels, metal foil inclusions and oxides form a compatible bond with sandcast glass as long as the powder COE differentials are

±$10^7$ in relation to the batch glass. The volume of the sandcast is exponentially bigger in mass than the surface area covered by a powder or foil and this greater surface area renders the stress minimal throughout the cast piece.

| Raw material | Effective chromophore | Usual colouration |
|---|---|---|
| Iron oxide - $Fe_2O_3$ | $Fe_2O_3$ | Yellow brown |
| Cobalt oxide - $Co_2O_3$ | CoO | Blue |
| Copper oxide - CuO | CuO | Blue |
| Copper sulphate $CuSo_4$ - 5 $H_2O$ | $Cu_2O$ | Red |
| Manganese dioxide - $MnO_2$ | MnO | Faint yellow |

Table 5 Effective Chromophores and their resultant colour range in glass.

### 3.2.6 Inclusion glass - Compatibility colour tests

This research hinged on finding a commercially available flameworking glass which had both the same coefficient of expansion as the furnace glass and the same viscosity. The colours used for glass blowing come in the form of a Ø4 cm x 40 cm colour bar. This colour bar is chopped into segments of approximately 4 cm in length. The colour bar is heated and placed on the end of the blowing iron and the colour is then *gathered* over with clear furnace glass. Once enough furnace batch glass has been gathered over the colour it is blown and shaped to form a hollow vessel.

The intension of this short introduction into beginning glassblowing is to draw attention to the fact that pure glass colour from another company is used for blowing. The colour is added to the blowing iron as a thick mass of colour and ends up as a thin layer of colour surrounding a greater clear glass mass when blown. Therefore α problems with colour in blowing are less frequently an issue because the colour is simply a thin coating, hence the clear glass dominates the thin colour and the small CoE differentials are rarely an issue. This works in much the same way as a powder works on the surface of a sandcast. Unless the α of the powder is more than ±$\alpha 10^7$ points difference[30] there will be no stress in the glass piece as was shown in section 3.2.5, pp. 107-116.

Figure 52. Example of a floating inclusion made with sourced flameworking glass rod, photography credit: Kevin Moonan

It is important to note that the colour palette of any commercially available brand of glass is prone to α variations of up to ±3[7] depending on the colour. Blacks and transparent colours tend to be stiffer (lower α). Reds, creams and opalescent glasses tend to be softer (higher α). This α difference could have an impact on the stress levels in casts caused by flameworked inclusions. A series of tests were conducted to firstly identify any problematic colours in conjunction with Phillips3300 furnace glass (see also section 3.5, pp. 138-158). The logical starting point was to make glass compatibility tests with a known method of encapsulation. The technique often used by Bertil Vallien

[30] This result was in accordance with testing thus far. Where it part of the research remit, powders with much higher and much lower α could have been sourced to test what the exact capacity the sandcast/powder combination would stretch to in terms of α

called the *floating inclusion* (see figure 52, p. 117) was most appropriate. Two manufactures of premade flameworking rods were initially tested by combining them within the *Philips 3300/3301* furnace glass body. The companies were *System 96* (α96) and *Kuglar* (α97).

The basic colour compatibility tests used glass sample shorts of various colours and sandwiched them between strata of furnace glass. This initial experiment was to investigate whether any coloured glass of Ø0.5 cm x 5 cm (other than the furnace glass itself) would fit with Phillips 3300 batch, and if so which colours? These primary tests were essential to the investigation. The tests were necessary because if all commercially available glass types were unsuitable then alternatives would need to be found. These alternative starting points would use either high fire enamels or powders administered to the surface of the flameworked inclusions. The inclusions would have to be made from the furnace batch glass. This alternative investigation would have satisfied question 1 but the results would have been arguably less visually satisfying.

Figure 53. System 96 sheet glass cut to make flameworking cane, 2012, photography credit: J A Denton

The above mentioned inclusion alternatives are a suitable compromise if other artists in the wider glass field cannot source a compatible flameworking glass for their furnace batch. Perhaps they lack the time or the means to source a compatible inclusion glass and need to take an alternate route. These alternatives create the opportunity to make inclusions with colour from either a hot powder application or a cold high fire enamel application and achieve results without α problems. Further alternatives are explored further in sections 3.1, introduction, p. 91 / 3.2.3, sandblasting, p. 128 / 3.4, glass powders and highfire enamels, p. 135-137 / 3.5.2, forcing glass to fit, pp. 150-151 & 3.5.3, negating the need for compatible glass, pp. 155-158.

The colour tests included the complete colour range of both opaque and transparent flameworking rod with α 96 currently available on the market. The specification sheet for System 96 (see figure 53, p. 118) confirms that their colours are also compatible with Spruce pine, Gaffer 96, East Bay Special and Seattle Batch. This brand made up four of the six colour test pieces. Twelve different hues of Gaffa colour bar (used primarily in the hotshop) were used in the other two compatibility test pieces.

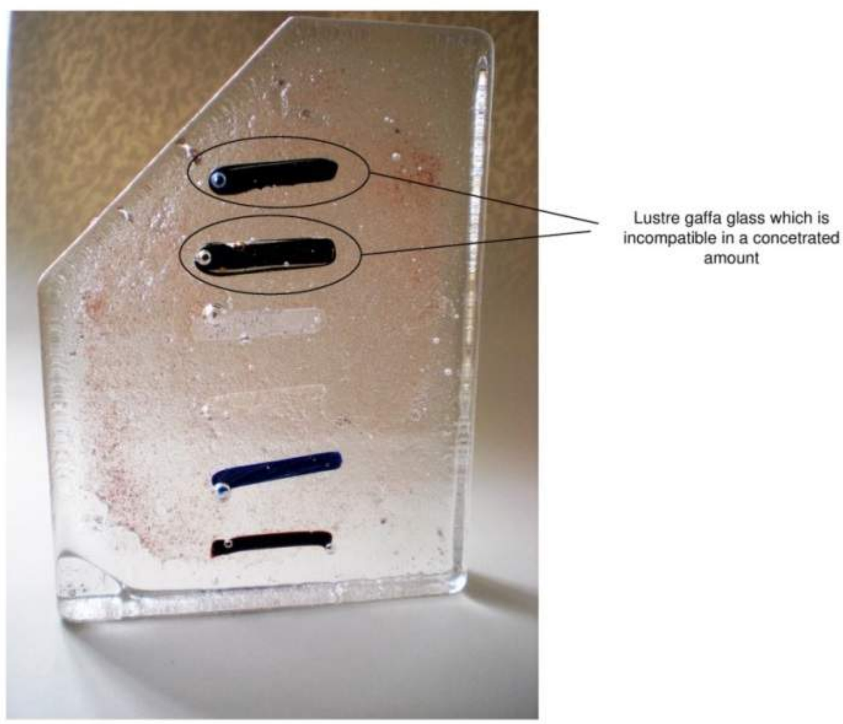


Figure 54 Gaffa lustre colour compatibility test, 2012, photography credit: J A Denton

The ‘floating’ inclusion colour tests worked with minimal compatibility issues when viewed under a polariscope. The colour tests worked excepting two of the five lustred

Gaffa colours which showed signs of strain. There were no signs of strain with any of the yellows, oranges and reds which are known problem colours (higher α) in reference to compatibility. The furnace glass at the university as previously stated was Phillips at this point in the research. Pellets 3300/3301 furnace glass has a α 96 and according to the specification sheet was compatible with the complete gaffer blowing colour range. Gaffer Glass also employs the trident seal test on all its glass melts to ensure compatibility to within ± 0.5 x $10^{-7}$ of all its blowing colour range plus its master clear glasses. The clear master glasses for glass blowers are manufactured by Philips and are offered as pelletised Gaffer Batch; Code #3300 or #4433. It appears that when used as a solid inclusion, some of the Gaffa colours were not compatible with Philips batch (see figure 54, p. 119).

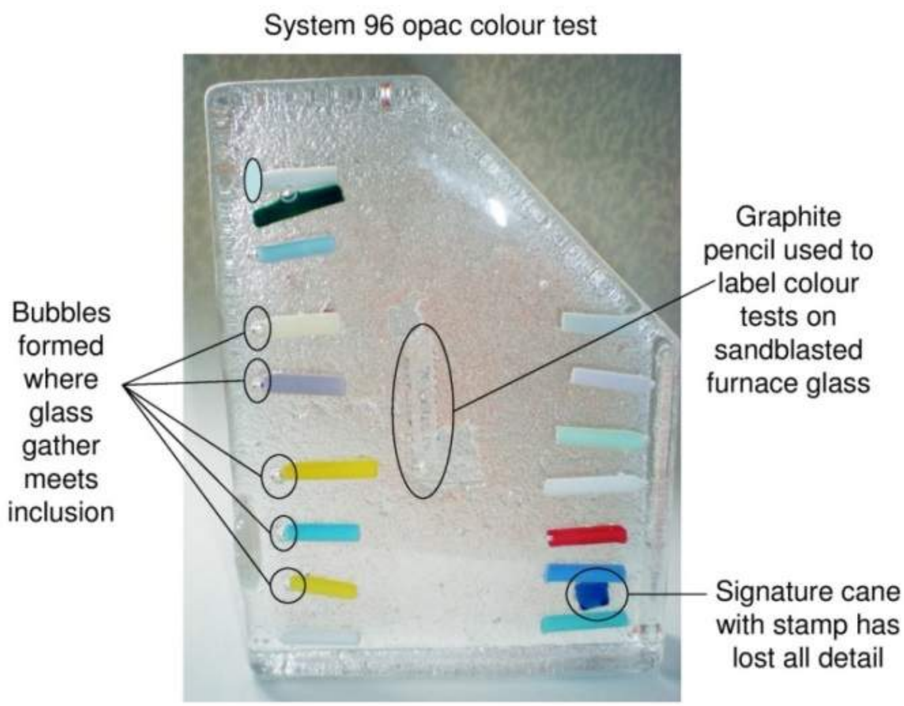


Figure 55 System 96 opaque colour compatibility test, 2012, photography credit: J A Denton

Whilst the test casts were poured noticeable large bubbles formed from the cut edges of the inclusions (see figure 55 above). This was where the second glass pour primarily touched the first pre-poured gather. This ‘fault’ was due to the furnace glass being unable to completely cover the sharp edge of the cut cane and consequently trapping air bubbles. In this context the erroneous air bubbles could be avoided using option 2 (p. 121).

It quickly became clear that using a ladle to pour casts was dangerous to the integrity of the delicate flameworked components. Smearing and distortion occurred once the preheated inclusions had been positioned. This was due to the second glass pour moving across the cast surface in a single direction. The following possibilities were examined to find ways to avoid or minimise this problem:

1. Using a ball iron to cast around the inclusions and *capping* them in place, this would restrict inclusion movement.
2. As components are placed in the cast, pushing them into the surface of the molten glass rather than placing them on the surface. This would act as a type of capping technique by the person in charge of placement rather than relying on the dexterity of the pourer.
3. Devise a new technique to keep inclusions in place irrelevant of how the sandcast is poured or pieces are placed during the casting process.

Although options 1 & 2 (p. 121) worked, it still did not satisfy the responsibility of question 1 which was to devise a way of casting which ensured *consistent and repeatable results*. New methods needed to be devised to keep inclusions in place irrelevant of how the sandcast was poured, or pieces were placed during the casting process. (See sections 3.3, pp. 121-131 & 3.5.3, pp. 155-158)

## 3.3 Phase Two – Adapting other artists techniques

This phase of the research concentrated on refining the applicable results from the first series of tests in accordance with research aim 2. This aim was devised to *establish new approaches for incorporating flameworked glass components into sandcast glass* *forms for creative use*. Devising new approaches involved the development of a casting method used by José Chardiet. This new method would incorporate flameworked glass components pre-casting in the sand moulds.

In this phase the Chardiet technique was developed. Previously Chardiet had simply pre-warmed the sand moulds to 540° in a kiln. This research involved incorporating the flameworked components within the surface of the sand mould before being heated in the kiln. This experimental focus formed the body of this phase and here the development of the '**transitional'** inclusion began (see sections 3.6.2 & 0 / pp. 162-158 / 4.2.1, pp. 174-179 / 4.3.2, pp. 189-180 & 4.4.3, pp. 201-191). The 'transitional' inclusion later became one of the two routes to new knowledge. This next series of tests began to investigate option 3 on p.121.

### 3.3.1 Sand mould options and annealing

An accepted method in sandcast mould making is to create the negative sand moulds in a wooden box. These boxes are cast into and after the positive glass form is dug out from the sand. In order to dig out the new cast one must wait till it is cool enough to be moved without deforming and thereafter the cast is transfered into the *lehr* to anneal. Often, excess sand is still attached to the surface of the cast to help insulate the hot glass artwork from the cold air during transfer.

Whilst carrying out the initial tests the use of a wooden box rendered the casting process lengthy. The process became drawn-out because only one cast could be poured at a time and a ten minute (approximately) time lag ensued waiting for the work to cool enough to transfer into the lehr. The waiting time was necessary because of the risks involved to the glass artwork. If the cast was transferred too early there was a high risk of distortion because it was too hot. If the artwork was transferred too late to the lehr one risked cracking the glass because it was too cold.

Casting the next artwork directly after casting the first put the original piece in jeopardy as it may cool before the team was finished casting the second piece. Furthermore, there was a risk of breakage to casts which were too close to the front of the lehr, as the lehr lost heat when the door was opened to accept a new cast[31]. Therefore the lehr door being opened and closed on a number of occasions caused heat loss and potential/actual damage to finished casts.

Due to the above concerns, an alternative needed to be found. This came in the form of metal moulds. These moulds could be placed directly into the lehr once all pieces had been cast, negating the necessity to wait for individual casts to cool enough to be transferred. The next tests consisted of three to four mould forms per metal sand box which were cast together. Once the casting of each box was complete, the metal sand box was placed in the lehr for annealing.

Whilst conducting the practical tests on this aspect of the research the first casts which consisted of four moulds per box cooled too quickly. These casts came out of the lehr broken. One of the arched casts (see p. 96) had cracking which was attributed to exposure to cold air due to the pattern of the cracking on the surface of the cast. Evidence in the form of the box's placement in the kiln suggested this occurred when the lehr door was opened to add the other sand boxes for annealing.

These heavy metal boxes filled with compacted sand and glass put a lot of pressure on the caster who had to lift these substantial moulds into the lehr once they were cast. A number of options below were tested to find the most fluent way to prevent these problems occurring in the future and ensuring a smooth casting session, either:

1. Cover the top of each metal sand box with high-fire fibre board once in the lehr. Covering with heat resistant fibre would significantly decrease the chance of cracking from air exposure. The problem with fibre board is that it would increase the need for a slower annealing cycle due to the increased insulation of the glass on all sides. Further, the probability of loose material from the fibre falling onto the surface of the hot cast

[31] A casting session generally consists of pouring multiple pieces

was high. Contamination of this type would mean extra time spent in cold processing to polish out the flaws.

2. Dig the cast out of the sand before putting it in the lehr. This would reduce the need for lengthy annealing cycles, but it would increase the time it took to cast a series of pieces in the hotshop. If casts were taken out too early there was a chance for casts to distort, and if casts were left at the front of the annealer there was a chance of cracking due to exposure to cold air. This option negates the need of a metal box as this was the initial technique used with wooden boxes.
3. Use a forklift to transfer moulds into the lehr once cast. This takes the pressure off the caster's physical strength.
4. Give each cast their own metal box.
5. Utilise the Jose Chardiet method of casting and leave the moulds in the lehr while casting.
6. Install a casting truck kiln with rollers so as casts can be pre-warmed in the kiln, rolled out for casting and rolled back in for annealing (see figure 56 below).

Figure 56 Example of a casting truck kiln with rollers, photography credit: Anon

Trying option 2 on page 121 for a second time became a struggle once the test pieces had been cast. Removing the hot casts from the sand mould without disturbing either the integrity of the other uncast moulds or dropping stray sand in them was difficult. Removing the first cast was especially difficult as the sand at that point was unbroken. The whole process was time consuming and awkward.

The next set of tests had only four test pieces per receptacle to give more room around the casts. A piece of steel or kiln shelf was inserted between each mould form in order to shield the other moulds from caving in during casting when taking out the cast from the sand. The cast divider also protected the other negative forms from errant sand whilst creating other forms in the sand pre-casting (see figure 57 below). This was a suitable alternative but still time consuming and difficult to dig casts out of the sand due to the sand being compacted. Compacted sand was essential to the integrity of the moulds so this was not a variable it was a constant.

Figure 57 Negative forms separated by kiln shelf (or metal plate) pre-casting, 2014, photography credit: J A Denton

Once all test variables had been completed it was obvious that at this stage and with the facilities at hand option 4 (see p. 124) was best practice. Utilising this option meant there was no possibility for the piece to get too cold before being placed in the lehr as a single cast in a metal box could be placed in the lehr immediately after casting. Both box and sand insulated the glass from any heat seepage which may have occurred when the lehr door was opened. There was less chance of loose material falling onto casts[32] rendering option 4 a superior route to option 1. The pieces were of a medium size at this stage so their size or weight gave the caster less physical difficulty whilst transferring the metal casting box into the lehr.

### 3.3.2 José Chardiet - Hot casting technique

In accordance with objective 4 which was to *design a series of tests based on the work of two contextual review artists, and adapt their techniques to sandcasting with flameworked inclusions, then refine and improve upon their methods* this section examined José Chardiet's technique of pre-warming moulds in a kiln to 560$^{o}$C and casting glass directly into the kiln. It was hoped that the following would be achieved using this technique.

- A preheated mould would disguise the lines created at the sides of the glass cast from the ladle pours because the sand mould was much hotter during casting.
- Caster would not have to handle heavy moulds because they are casting directly into the kiln. This was another potential solution to the mould problem as described in option 5 (p. 124) in section 3.3.1.
- New inclusion technique: Flameworked 'transitional' inclusions could be added to the surface of the mould prior to casting.

In this series of tests sand moulds had some inclusions placed in the surface of the sand when cold. After placement the inclusions were gradually heated in the mould until they were hot enough to be cast over. These initial tests later developed into the 'transitional' inclusion investigation (see sections 3.5.1, pp. 142-148 & 3.6.2 - 0, pp. 162-166). The moulds were made in a metal box and placed low in the kiln during the

[32] During the whole research period this continued to be a factor of contention, as flecks of rust continued to be loosened from metal kiln shelves when a new cast was placed in the lehr. These rust flecks either attached to the surface of the freshly cast piece or on the mould surface of the uncast works which were being preheated in the lehr.

first round of experimentation. This made it difficult for the caster to cast into. It was equally challenging to place any preheated 'floating' inclusions (see sections 3.6.1, p. 160-162 & 4.3.1, p. 188-189) into the cast between pours. It was difficult to place pre-heated inclusions because the kiln emitted a great deal of transient heat and this was too hot to work around accurately. In later tests the moulds were placed closer to the top of the kiln which helped the casters accuracy. If 'floating' inclusions were added to the artworks in a pre-heated kiln it was still difficult to place them with precision because of the heat given off by the kiln which was holding at 560°C and 540°C later in the experiments. Accurate placement of inclusions was virtually impossible. In later experiments and to gain fuller control over the process the moulds were taken out of the lehr and cast in the hotshop on a *marver*. Once the mould was filled with glass, the added weight increased the difficulty for the caster to transfer the mould back into the lehr once cast. When the sand box was too heavy a forklift (see Figure 87, p. 178) was used to transfer moulds in and out of the lehr.

It was necessary to add 5% bentonite to the Mansfield sand mould. The extra bentonite was added so as the sand would form a hard unbreakable shell instead of crumbling in on itself in the heat of the kiln. Once the firing was complete and pieces annealed the extra bentonite made the sand tough to chip away from the finished cast. In retrospect it may have been unnecessary to add bentonite to simple shapes. The next tests did not use bentonite, sides of moulds did not crumble when preheated in the kiln, and sand came off the finished sandcasts easier. This method should only be used for casts with a complicated shape or casts where the sand cannot be packed tightly.

During these tests there was an issue with chilled glass from the ladle used for casting falling into the moulds during a pour. This problem became apparent in phase one when every third ladle pour, a chilled blob of glass fell into the cast. The only way to avoid this was to cast with a larger ladle and only pour half of the glass from it. This avoided the possibility of the chilled glass pouring into the cast, but was wasteful. The other alternative was to cast with a ball iron which prohibited chilled glass to work its way into a cast and poured with more control. During this phase of the research investigation the glass ladle was preheated and this resolved the chilled glass issue.

### 3.3.3 Case study 1 - Ogham Night Cast

For the purposes of this thesis the following sandcast examples are referred to as ‘day’ and ‘night’ so as to easily distinguish one test from the other for the reader. These casts were chosen as technical case studies as they utilise most of the techniques of interest from phases 1 & 2.

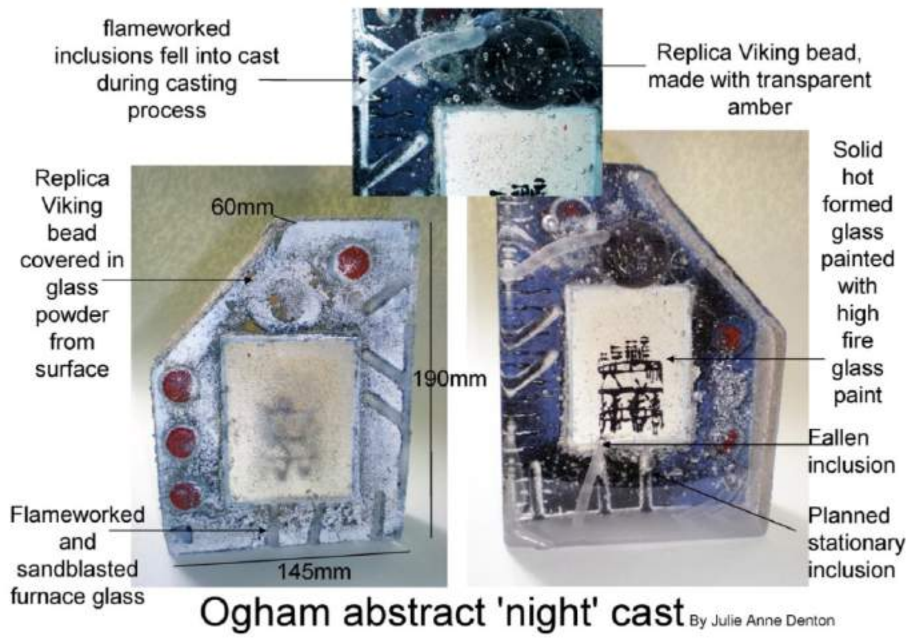


Figure 58 ‘Ogham Night’ cast using José Chardiet technique, 2012 by J A Denton. Cast in sand with flameworked inclusions; H. 19 cm, W. 14.5 cm, D. 5 cm, photography credit: J A Denton

One of the flameworked inclusions incorporated in the surface of the sand mould before it was preheated was a three dimensional representation of a medieval alphabet called *Ogham.* This alphabet is often seen on gravestones in the Isle of Man and Ireland from $4^{th}$ to $9^{th}$ Century AD. This inclusion was crafted to fit along the sand surface of the negative mould and across two of the four sides of the cast at a 90° angle. This flameworked inclusion was made from clear furnace glass and later sandblasted. The sandblasted surface can be observed in figure 58 above & figure 59 (p. 130).

The sandblasted inclusion once cast took the form of a subtle translucent veiling trapped between strata. If a commercial glass brand could not be found for a particular furnace batch glass this sandblasting technique would make a suitable alternative. The sandblasted ‘oghams’ placed at the sides of the sandcast fell into the mould after the first gather due to the intensity of the heat from the freshly ladled pour, but fortuitously they acquired a new ephemeral ‘chance art’ quality which was worth further exploration. ‘Chance art’ was not explored further but is referenced in section 5.4, p. 225. Contrarily sandblasting furnace glass inclusions was explored further, see section 4.4.3. p. 201.

The powdered colour had a visual effect on the inclusions which were placed in the cast when cold before being heated in the kiln. The Viking bead which was pushed into the cast after it had been decorated with black powder looked interesting on both sides of the sandcast. The inclusions which had powdered colour sieved across their surface after placement in the cold sand mould did not work well. The coloured powder on the surface of the inclusions disturbed the *trompe l'oeil* effect of the inclusion. Later a brush was used to take off excess colour powder from inclusions which preserved their visual integrity.

The *striped* cane inlaid before preheating was preserved from the glass side as one looks into the cast body. On the sand side of the sandcast the cane took up too much of the sand mould surface texture during the pre-firing in the kiln therfore its physical integrity was compromised. This was not erroneous per se, and was a variable worth exploring when creating preheated casts in the future (to see an example of where this worked to the benefit of the glass artwork see figure 90, p. 182). The top temperature of the heat cycle pre-casting needed to be adjusted from 560$^{o}$C to 540$^{o}$C to control and/or deter this effect in future casts.

The Viking bead inclusions laid on the surface of the cast before pre-heating were made with burnt out bicarbonate of soda on their surface. This bead aging technique was previously developed for a live project for national heritage (Denton J. A., 2016, pp. 20-22) to reproduce a fifty two bead Viking necklace (see appendix 6 to view a copy of fully published article, p. 266). Once the Viking beads were covered with hot furnace glass the bicarbonate within the beads reacted with the furnace glass. The bicarbonate created a number of small bubbles on the surface of the bead where the inclusion bisected the cast. With further development this could have been a highly effective inclusion technique. The effect created by bicarbonate was similar to the effect achieved with a sandblasted inclusion (See sections 3.3.3, pp. 128-125 & 4.4.3, pp. 201-203).

### 3.3.4 Case study 2 - Ogham Day Cast

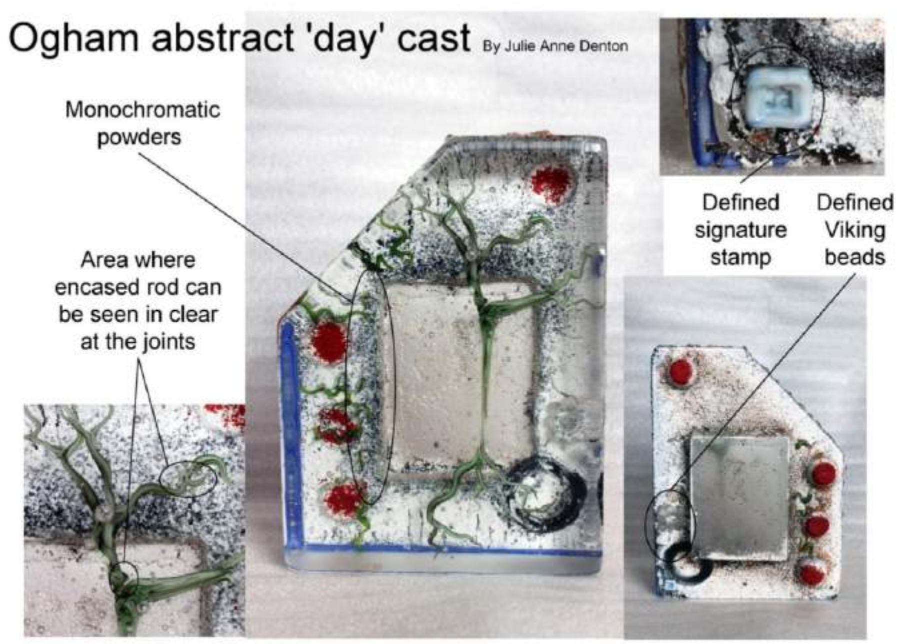


Figure 59 Ogham Day' cast using José Chardiet technique, 2012 by J A Denton. Cast in sand with flameworked inclusions; H. 19 cm, W. 14.5 cm, D. 5 cm, photography credit: J A Denton

As shown in Figure 59 above, the Viking beads on the sand surface had barely any distortion, due to these inclusions being pushed further into the sand surface, and therefore further away from the heat source of either the preheated lehr or of the molten glass. The *filigrana cane* was added to the sides of the cast after the powdered colour was added, which meant the cane was hidden from the eye on the sand side of the cast.

The sides and surface of this cast did not distort as much as the ‘Night’ cast, which was due to firmer compacting of the sand when the mould was initially created. On the glass side the main flameworked inclusion was lost visually due to the colour and ‘busyness’ of the cast itself. The filigrana cane was too dark for such a light cast and the white powder was too white on the edges but as it began to mix with the black underneath close to the window it looked visually effective.

The flameworked figure fashioned in the style of a tree was encased in clear glass (a common paperweight makers technique – see section 2.10.1, p. 71) to hinder distortion, which worked well. There were a few areas at the joints of branches where it could be noticed that the join initially began as clear glass. With a little practice this paperweight technique could easily be developed for use with sandcast inclusions (for a variant on this theme see section 4.3.1, pp. 188-189 ).

## 3.4 Phase Three - Other furnaces

Field work was undertaken in 2012 & 2015 to satisfy research objective 5 which involved *experimentation with a variety of furnace glasses and encapsulation glasses to unveil compatible combinations*. Two different furnace and inclusion glasses were experimented with at Stipglas, NL in 2012 plus a performance involving the process of sandcasting was filmed and later edited and exhibited for use in combination with this PhD and for dissemination of the process to the wider public.

At the Atelier d’art du Verre, LU a lead based glass was used for sandcasting outdoors as part of the International glass symposium 2015. During this symposium I delivered a paper concerning my research undertaken at the University of Sunderland. Thereafter a joint sandcasting performance with Lachezar Dochev (see section 2.8, p. 63-64) demonstrated to the public some of the techniques discussed in the delivered paper. Afterwards an interview was conducted with Lachezar Dochev (for transcript of interview see appendix 2 , pp. 246-254).

Freeform casting as described in section 3.2.1 (p. 98) was demonstrated as part of the performances for the public. Due to time constraints and distance the possibility of finding a suitable inclusion glass to match the furnace glass was impossible. This presented an opportunity to devise, examine and test alternative techniques such as high fire enamels and glass powders to colour clear lead glass inclusions. Traditionally powders and enamels are simply a part of the surface decoration on a sandcast, but they can also function as an additional method of colouring the encapsulation glass if a compatible flameworking brand cannot be found.

### 3.4.1 Stipglas masterclass, NL

As part of the dissemination of this PhD research an art performance was created and filmed combining the techniques of sandcasting and flameworking. This occurred whilst teaching a flameworking masterclass at Stipglas in the Netherlands in 2012. The founder JanHein Van Stipout and I planned to disseminate the combination of flameworking and sandcasting to the students, and later to a wider audience.

Objective 5 of this research stated a need to *experiment with a number of other furnace glasses and encapsulation glasses* in order to make this research relevant to the wider glass community. Van Stipout possessed *cullet* samples from two different German firms in α 96 and α 104 whose exact origins were unknown. The use of two types of cullet presented a reasonable opportunity for sourcing a compatible inclusion glass to match at least one of the new batches. This was undertaken to open the scope of this research so as it would apply to the whole glass field instead of glass artists only working with Glasma, Phillips or Cristallica batch glass.

There was no furnace at Stipglas to heat up the cullet. When this occurs it is standard practice to fill small ceramic crucibles with cullet, place these crucibles in a kiln and bring them up to 1200$^{o}$C. Once up to temperature the crucible is removed from the kiln with large metal tongs (see figure 61, p. 135) which act in the same way as the ladle does in the normal hotshop setup then the molten glass is poured into the sand mould.

Figure 60 Example of compatibility between α104 inclusion glass and brass with furnace glass in the Netherlands, 2012, photography credit: J A Denton

The filmed performance of this process was conceived of in advance with a scant narrative. It consisted of a speaker introducing the story whilst the two protagonists acted out their comic parts. Flameworking in combination with sandcasting was the basis of the story and consequent presentation. Humour played an important role in making this an enjoyable experience for the informed public who were watching the live show. Later it would be a novel way for further dissemination to the general public in exhibition spaces. We decided that an avant-garde ‘universal humour’ of slapstick/pantomime comedy was the most directly perceptible (see section 2.11, p. 80 for clarification) way to engage the audience in the performance.

Prior to the performance, inclusions were created from powdered colour and Ø 0.5 cm cane which were *fused* in a kiln. Flameworking rods from *Effetre* (α 104) and *Kuglar* (α 96) were used to create the inclusions. These inclusions were preheated in a kiln and added to the sandcast as ‘floating’ inclusions which is the technique Bertil Vallien uses to cast his inclusions (see section 2.4.1, pp. 53-55). During the videoed performance for the public casting directly from the crucible was no more or less haphazard than casting in the hotshop, although there were a number of additional variables introduced to the process using this pouring technique. Variables included trying to retrieve the crucible out of the kiln without incident and led to unnecessary unexpected delays during casting. Using with a crucible was ultimately a negative in terms of the satisfaction of this research. Pouring with a crucible was undesirable because question 1 of this research called for *controlled and consistent repeatable results.* Subsequently after filming the video footage was edited by Philip Tscheimer and a voiceover was prepared and transcribed to what became a 45 minute docufilm called ‘We love Edward Leibowitz’. This was created as a compliment to this PhD and a novel way to disseminate information to the wider public.

The pieces created during the performance were mostly broken due to the performative aspect of the casting session, which means the performance took precedence over the glass output. The breakages were due to the extra variables involved in the making of the performance, e.g., humour, acting, crowd pleasing. The α96 glass cullet was not compatible with the α 96 kuglar flameworking rod. Interestingly the α104 cullet had no issues with full colour (not using clear furnace glass on the inside of the rod to even out the CoE variables, for further information regarding this go to section 3.5.2, pp. 150-151) effetre flameworking rods. Plus the α104 cullet had no compatibility issues with brass found objects included on the mould surface (see figure 60, p. 133).

In reference to compatibility Glasma furnace glass used at the University of Sunderland only accepted copper sheet, thin stainless steel and metal foils in a hot process (See section 3.2.5, p. 107-116). In phase 4 of this chapter (section 3.5, pp. 138-158) when using the university standard batch glass (Glasma), compromises had to be made, which included encasing clear furnace glass with the colour encapsulation glass to make sure the inclusions were compatible (pp. 150-151)). This was necessary to ensure the encapsulation glass would be compatible with the batch glass due to there being only a thin layer of 'foreign' glass in the cast. Only very small inclusions could be forged in full colour, and larger inclusions had to be formed by encasing clear furnace glass with spectrum 96 colour on the surface. This posed no visual or technical problems but made the flameworking process more time consuming.

### 3.4.2 6th International Glass symposium Luxembourg

Figure 61 Freeform mould being cast in Luxembourg, 2015, photography credit: Venzo Danev

This bi-annual event takes place in Asselborn. It consists of an international exhibition (over 20 countries) on the extensive premises of Atelier d'art du Verre, a series of demonstrations in all glass mediums plus lectures on a variety of glass ideas and technical innovations. In 2015 I was awarded a travel grant to take part in this event. Here I gave a talk concerning the combination of sandcasting and flameworking, interviewed Lachezar Dochev (see section 2.8, pp. 63-64 and appendix 2 , pp. 246-254) and gave a demonstration to the public using the lead based furnace glass at Atelier d'art du verre. Similar to Stipglas there was no furnace at this event and the glass was melted in a crucible in the kiln and poured into the mould with 'forceps' holding the hot crucible. This can be be seen in figure 61, p. 135.

Figure 62 Flameworked inclusions painted with high fire enamels pre-heating before inclusion in freeform cast, 2015, photography credit: J A Denton

There was no time to source a compatible inclusion glass before the event. Therefore the only alternative to create compatible glass inclusions was to pre-pull canes from the clear furnace glass and colour that cane with glass powders and/or when cooled paint with paradise paint (figure 62, p. 136). The glass was lead based which made it difficult to flamework with because not only was it very soft to work with whilst molten, but it also *reduced* in the flame very easily due to the high lead content. This reaction turned the clear glass a dull grey colour. During casting the inclusions had no compatibility issues. It was essential to deter the glass from reducing whilst flameworking it. To hinder the reduction effect on the lead glass the glass needed to be worked with a highly oxygenated flame. This was important because the reduction effect could be noticed through the enamel and/or the powder coating once cast and annealed.

The research paper concerning the process of sandcasting with flameworked inclusions was delivered to an audience of professionals, interested amateurs and collectors during the symposium. Directly after the research paper was delivered a sandcasting demonstration of some of the techniques discussed was presented with the help of artists Lachezar Dochev and Torsten Rötzsch (DE) (see figure 63 below). This was undertaken in order to further disseminate this research to the public. As Lachezar Dochev is one of the literature review artists an interview was conducted and taped, then later transcribed. This interview examined Dochev's techniques, education and his artistic vision and can be viewed in appendix 2 , pp. 246-254.

Figure 63 Freeform sandcasting with flameworked inclusions - demonstration for the public in Luxembourg, 2015. Left to right: Torsten Rötzsch and JA Denton, photography credit: Venzo Danev

## 3.5 Phase 4 - Systematic testing

This phase was devoted to furnace work and mould making. It comprised of creating practical tests primarily describing the ways in which flameworked inclusions could smear, elongate, blur and break during and after the casting process (see figure 64 below, plus figure 65, p. 139). In this testing phase a series of irregularities concerning the *fit* between the glass types came to light. The ‘transitional’ and ‘floating’ inclusions within the sandcast body developed a series of consistent compatibility issues which needed to be re-tested, considered and solved. New compatibility tests also had to be arranged due to a change in the furnace glass at the university from Philips batch to Glasma and then later to Cristalica[33]


Figure 64 CoE problems between flameworked inclusions and furnace glass led to cracking, 2012, photography credit: J A Denton

All compatibility issues concerned with the ‘floating’ and ‘transitional’ inclusions were tested in the following component of this thesis. After these further tests an analysis of the results was discussed whilst highlighting further necessary tests. During this testing phase it was possible to test how far the ‘transitional’ inclusions could be taken out of the sandcast body before breaking. The results from this component and in conjunction

33 Each new batch glass had a CoE of 96, but had to be re-tested because of the viscosity. All batch glasses were not compatible with each other.

with the use of glass beadmakers *mandrels* within the body of the sandcast inspired the development of a new combination technique called the 'partial' inclusion (see figure 84, p. 166).

Latterly the testing phase shifted to experiment with the preheated mould technique. This gradually evolved through a process of testing out and problem solving into the use of inclusions on the surface of the sand mould. After further experimentation singular flameworked surface inclusions were developed and utilised in multiple element form (see figure 66, p. 140). The preheated mould solved the problems posed by smearing succinctly. Ways in which an inclusion can be smeared can be observed in figure 65 below.

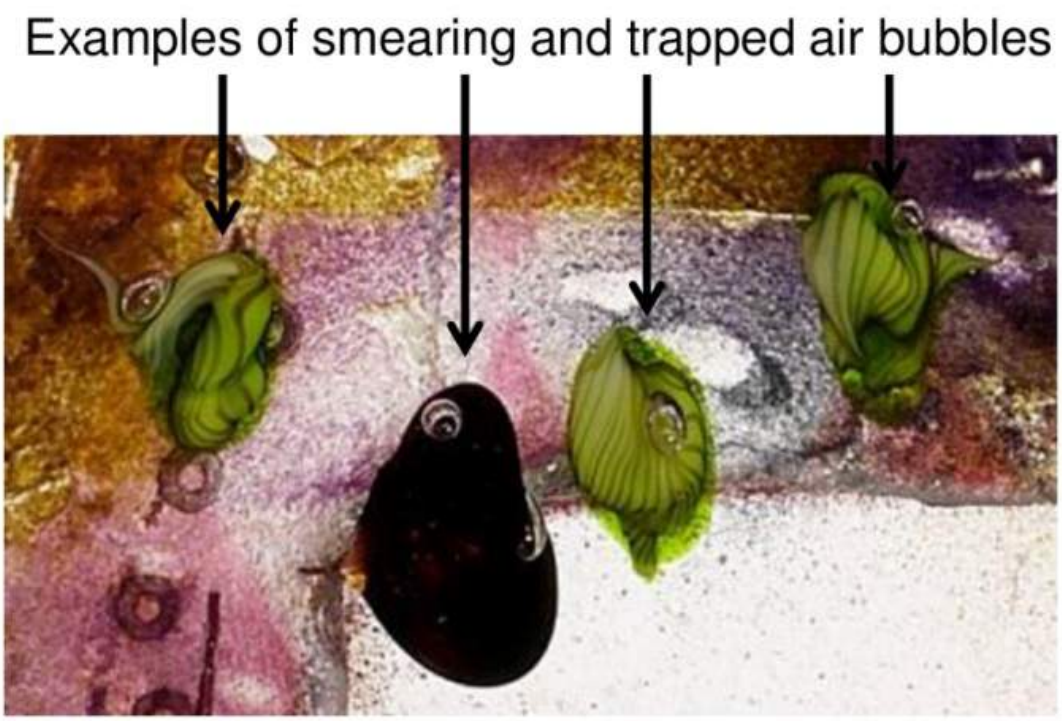


Figure 65 Visual examples of smearing problem occurring when flameworked inclusions are cast over, 2008, photography credit: J A Denton

Further, the use of a preheated mould led to the following benefits which included the possibility to increase the overall size of inclusions, to place inclusions correctly without mishap, and to increase the amount of flameworked components inside a cast. Therefore the proportions of the sandcast could be scaled-up because the multiple flameworked elements created larger inclusions without the risk of breakage or accidental misplacement during the making process. It changed the nature of how the cast appeared when completed in comparison to how a cast looked with components sandwiched in-between layers. This was not a deviation from the brief and it succinctly answered research question 1. By using the preheated mould method casts could be created which yielded consistent AND repeatable results.

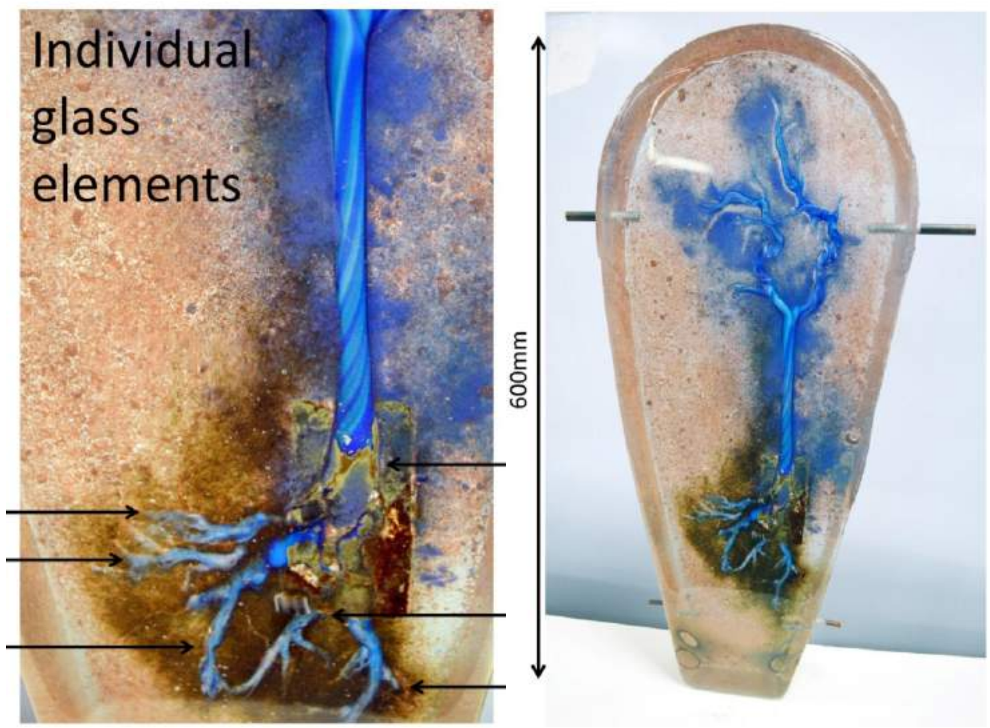


Figure 66 In the detail on the left, arrows point to the inclusions made in element form which were created to form a larger inclusion. This larger inclusion takes the form of a tree, 2014, photography credit: Kevin Moonan

It had been previously unidentified that the single inclusion was a size constraint until finding that flameworked elements could be used to form a 'whole' component. As previously stated this allowed for the possibility to make exponentially larger sandcasts with inclusions. The sandcasts could be as big as the inner dimensions of the lehr used for annealing and like Ben Tré the sandcasts themselves could equally be created in element form (see section 1.1, p. 13). In relation to this thesis, this unexpected result created a significant shift in the pattern of the investigation. The use of multiples both in terms of inclusions and sandcasts modified the previously envisioned hypothesis. The previous hypothesis visualised single sandcast forms encompassing flameworked inclusions which in any one place took up no more than 25 cm x 10 cm space within the cast form. Consequently since establishing the technique of creating inclusions in element form the 'transitional' inclusion radically unlocked the possibility for larger sandcasts incorporating assembled inclusions of equal or varied size (see figure 66, p. 140, for an example of this inclusion type).

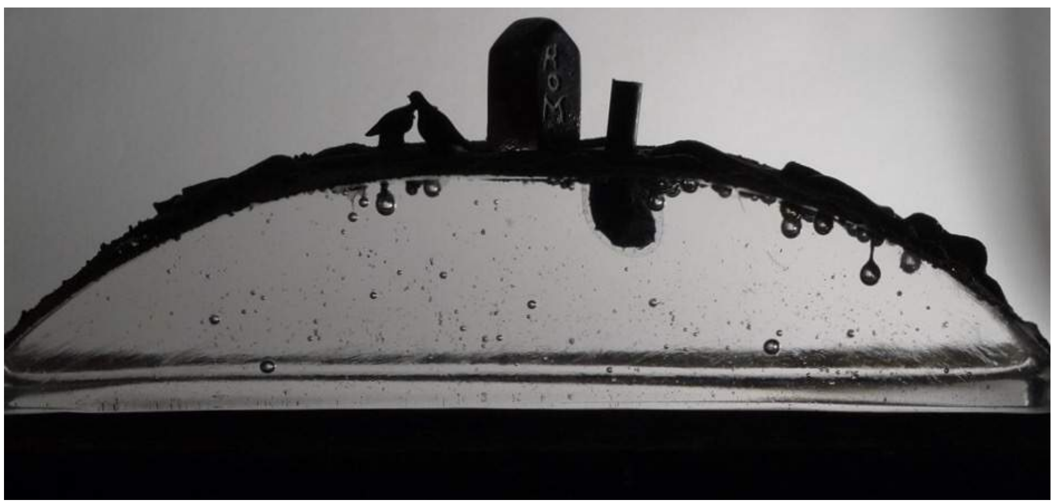

Figure 67 'Anima Mundi' series test piece – Using a glass inclusion to disguise the void made by a mandrel, 2017. Photography credit: Crispian Heath.

During this practical testing a series of tests developed from paperweight techniques were devised in accordance with the investigation concerned with question 2. This question asked if *flameworked encapsulation techniques previously used in paperweight making could be applied to flameworked inclusion encapsulations in the sandcasting process.* The reason for this cross pollination of techniques was mostly but not exclusively concerned with the visual clarity of transparent inclusions such as fingerprints and contamination from scratches. These scratches are formed on the surface of the glass rod before use and can be seen as ghostly markings on the inclusion once it has been sandcast (for further details see section 3.5.2, p. 153).

After these tests had been satisfactorily completed I wanted to develop a way to make a negative void inside the sandcast. Originally the void idea was to eliminate drilling the sandcast using a cold process after casting to create holes to mount the pieces onto a metal stand. *Mandrels* used for beadmaking were used to create these negative spaces in the sandcast. This was successful after some testing and further developed into a new inclusion technique called the 'partial' inclusion. This was a groundbreaking discovery because very detailed inclusions could be created which penetrated through the sandcast glass artwork. These inclusions could be made in as much detail as was needed consequently encouraging creativity rather than stifling it with technical constraints. Moreover, the inclusions did not have to be made from compatible glass because the partial inclusion slotted in and out of the sandcast at will. This allowed for greater safety when sending a finished glass artwork somewhere for further dissemination. Additionally in areas for further study, development of the mandrel technique could be developed further to include inclusions developed from paperweight techniques to enhance or fully disguise the negative void created by the mandrel (see section 5.4, p. 227 and figure 67, p. 141).

### 3.5.1 Three dimensional transitional inclusion testing

It was clear that the 'transitional' inclusion was a successful way to add inclusions to a sandcast and achieve consistent repeatable results. The previous tests had relied on the 'transitional' inclusion lying on the surface of the sandcast therefore it was appropriate to call it the 'surface transitional' inclusion. However, I also wanted to test how far the '**transitional'** inclusion could be taken out of the sandcast body before breaking. This changed the 'surface transitional' inclusion into a three dimensional encapsulation (see figure 68, p. 143). This inclusion ruptured the surface of the sandcast and extended it into the surrounding space. This inclusion type was tested because it could create an interesting contrast to the sandcast form (see figure 103, p.

204). One could create artworks which encompassed both a solid glass mass with juxtaposed flameworked components.

A series of three types of inclusion tests were devised. The first test type used furnace glass overlaid with powder, the second used only clear furnace glass and and the final inclusion test used solid System 96 coloured glass. Different transitional inclusion shapes were also used which included the sphere, the cube and the cone. These three shapes and three inclusion glass types made up the ‘3D transitional’ inclusion tests. Testing inclusion shape was undertaken because there had been problems with compatibility. I was convinced that both the shape of the transitional inclusion AND potential CoE differentials were equally responsible for cracking problems after casting.

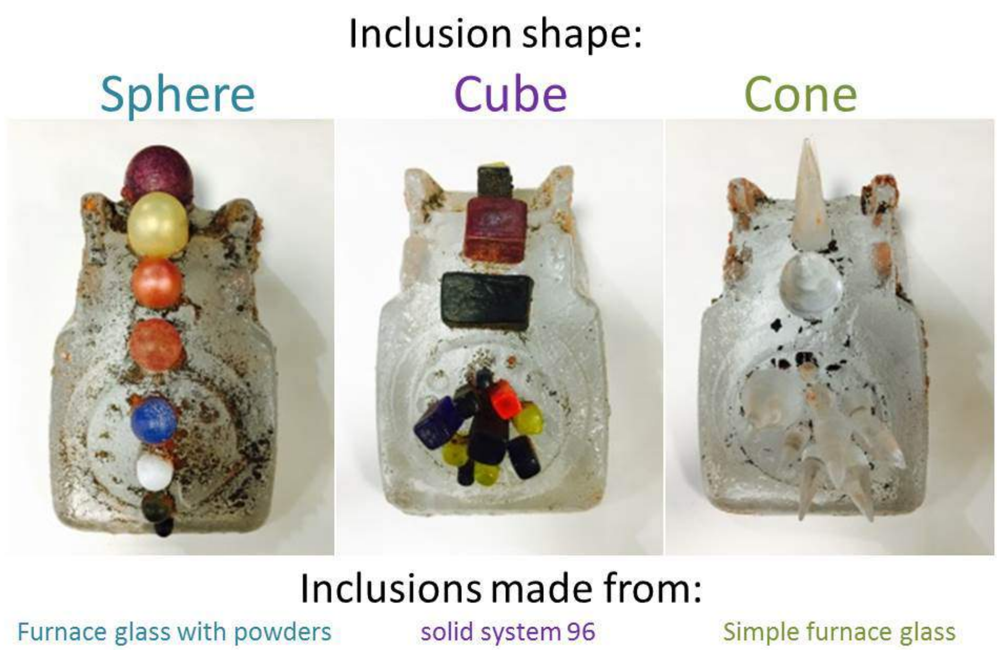


Figure 68 Tapered, cuboid and sphere transitional inclusion tests; 2015, photography credit: J A Denton

This hypothesis concerning inclusion shape and CoE differentials needed to be proved and this is why inclusion glass type plus inclusion shape were important factors in these tests. Each of the three tests were created using 2 cm, 4 cm, 6 cm and 8 cm '3D transitional' inclusions. Previous testing suggested that the transitional inclusions did not need a *glass post* (see figure 78, p. 158) for added attachment stability. These inclusion tests did not use a glass post for stability and they did bond solidly to the furnace glass sandcast mass. All rotary phone test casts (subsequently referred to as '*PhoneTest*') were successful except the 8 cm *PhoneTest*. This test gave unexpected results as shown in figure 69 below, which resulted in inclusion incompatibility with the furnace glass.

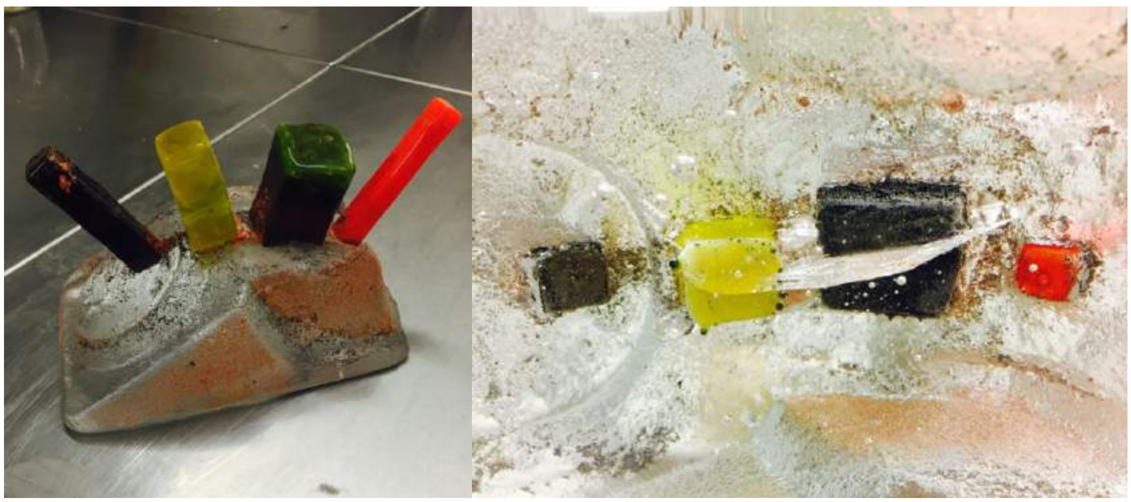

Figure 69 80mm test with solid System 96 transitional inclusion and Glasma furnace glass, 2015, photography credit: J A Denton

Before testing it was surmised that the protruding glass inclusions would break and they would break at the join where the glass bisects the cast surface. This breakage would be due to slight compatibility issues between the two glasses. However incompatibility in the 8 cm PhoneTest was not the case and the two thickest inclusions cracked when they **breached** the surface of the cast. This was the area where the inclusions met and protruded into the furnace glass. It is important to note that these inclusions were angled (squared off) and breached the surface of the cast by between 1cm and 2cm. The fact these inclusions breached the surface with squared edges was important because the other two inclusions which were flush with the mould surface pre-casting did not break. (N.B. Orange was the most incompatible System 96 colour and it did not break because it did not breach the surface of the cast. The orange inclusion was attached hot and it simply bisected the surface of the sandcast which meant it joined flush to the cast).

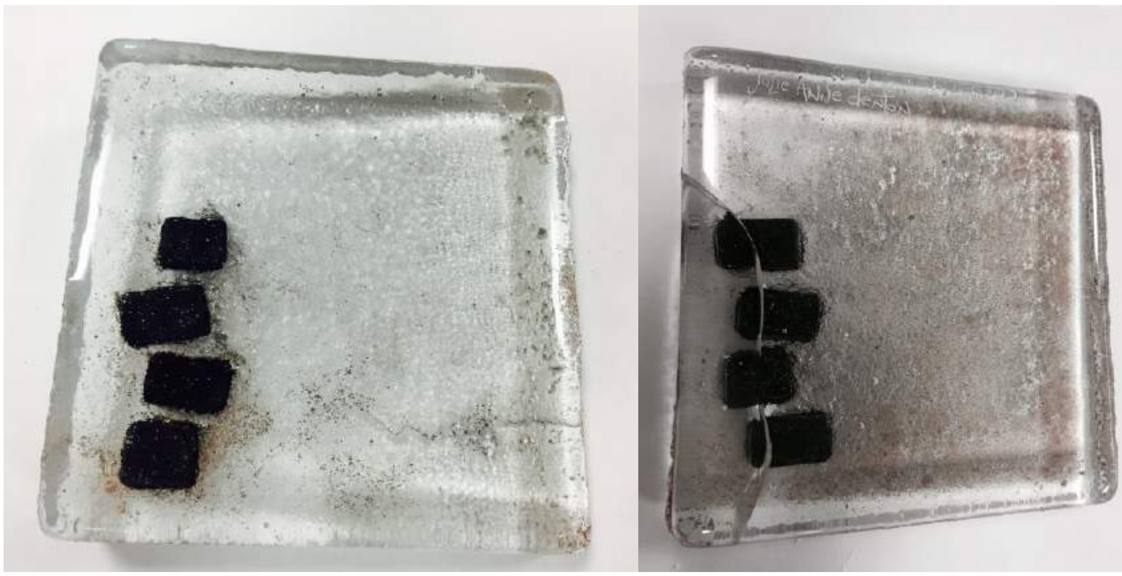

Figure 70 Small tests depicting physical proof of the theory of breach, 2013, photography credit: J A Denton

Why did this happen in this area specifically? What conclusions could be drawn from this and was there any written evidence to back up this theory? What further tests should be made in the future to prove these theories?

There were a few possibilities for these fractures:

A. (Unlikely) the coefficient of expansion between the furnace glass (Glasma) and the inclusion glass (System 96) glass did not fit.

B. (Likely) the corners of the square inclusions where the protrusions infiltrated the glass cast were problematic. In flameworking glass consistently cracks if a hard angle is created and not resolved (softened). This fact is stated in the book ‘Contemporary

Lampworking' *'Any time a sharp crease can be seen in glass, there is a high potential for cracking and breakage'* (Dunham, 1997, pp. 25-26).

C. Annealing (unlikely, the cycles were already over cautious).

Possibility B was the most probable reason for the cracking of the *PhoneTest* in figure 69 (p. 144) with a little help from possibility A. The reasoning behind this conclusion was by viewing the previous *PhoneTest* casts which utilised solid spectrum 96 in cube form (see figure 68, p. 143). Firstly these inclusion tests were flush to the surface of the sandcast and they had not cracked although they also used solid System 96 glass (potentially incompatible) as the inclusion glass. Another test was made to prove this theory as shown in figure 70 on p.145. Figure 70 clearly shows that both tiles made under the same conditions with the same inclusion glass were exactly the same but for one feature: In the tile which can be seen on the left of figure 70 the inclusions were pushed out to be flush with the surface of the sand mould before pouring; whereas in the tile on the right of figure 70 the inclusions were only pushed in half way before casting therefore **breaching** the cast surface. The tile on the right in figure 70 cracked and this shows that the breakage issue was not an issue concerned with compatibility alone.

**Tests to ascertain breach theory:**

Firstly a simple pull test of all available colours in System 96 in combination with Glasma furnace glass was undertaken (Since the PhD began the furnace glass at the university was changed from Philips to Glasma then to Cristallica). As shown in figure 71 (p. 147) the pull test revealed that certain system 96 colours did not have the same CoE as Glasma. This can be ascertained by the curvature of the glass *stringers*. In simple terms when glass is heated it expands. When glass cools it contracts. Glass with a higher CoE expands more than a glass with a lower CoE when heated, and contracts more when cooled than a glass with a lower CoE. As Glasma and System 96 were joined whilst molten any differences in the amount of contraction as they cooled were revealed by the curvature of the stringer. The glass on the acute side of the curve had the higher CoE because it contracted more. When there was evidence of curvature the glass with the higher CoE was system 96.

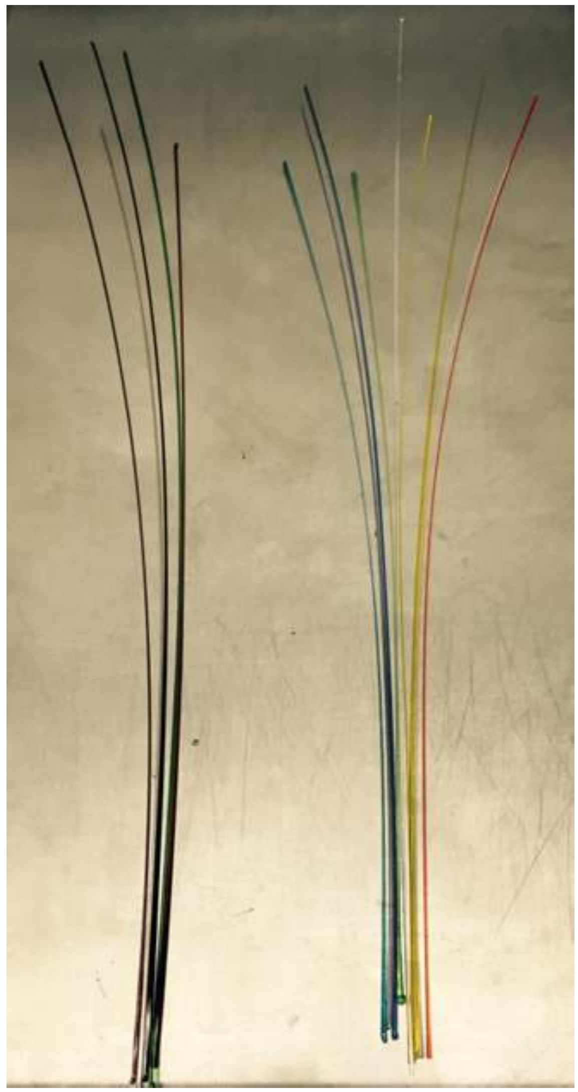

Figure 71 Compatibility pull test System 96 with clear Glasma furnace batch glass, 2015, photography credit: J A Denton

The next series of tests consisted of 10 cm x 10 cm glass tiles created using the most **incompatible** colour in the System 96 (opalino orange) range based on the pull test results. The test specifications were as follows:

- Square and oval inclusions made in System 96 and cast over with Glasma furnace glass – Inclusions **flush** with the sand mould surface.
- Square and oval inclusions made in System 96 and cast over with Glasma furnace glass – Inclusions **bisecting** the surface of cast.

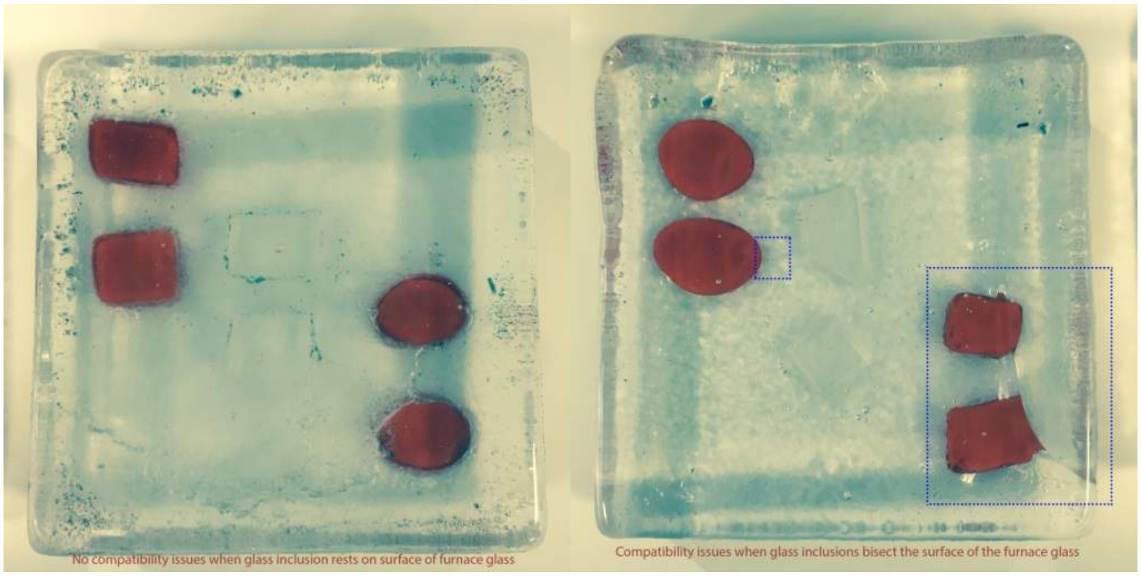


Figure 72 Compatibility issues between system 96 and Glasma, 2015, photography credit: J A Denton

As can be seen from this series of testing there were incompatibility issues with system 96 inclusion glass. There were three reasons for this which are as follows: Firstly although system 96 was the same coefficient as the furnace glass there were slight CoE variations between colours (Orange being the most incompatible). Secondly the reasons for breakage between the furnace glass and the inclusion glass were not only issues with CoE but also the differing viscosities of both glasses (as previously stated it is beyond the remit of this PhD research to test the viscosity of the glass). Thirdly and most importantly ‘glass’ is a naturally amorphous material and finds angles contradictory. The material glass favours rounded shapes and is liable to crack upon cooling when unresolved (more so with acute) angles are introduced to the material during a hot process. When inclusions breach the surface of the furnace glass the edge of the inclusion which breaches the sandcast surface creates *stress* in the glass body.

This stress intensifies any slight incompatibility issues between the inclusion glass and the furnace glass. See figure 72 on page 148 for visual evidence of all statements made here.

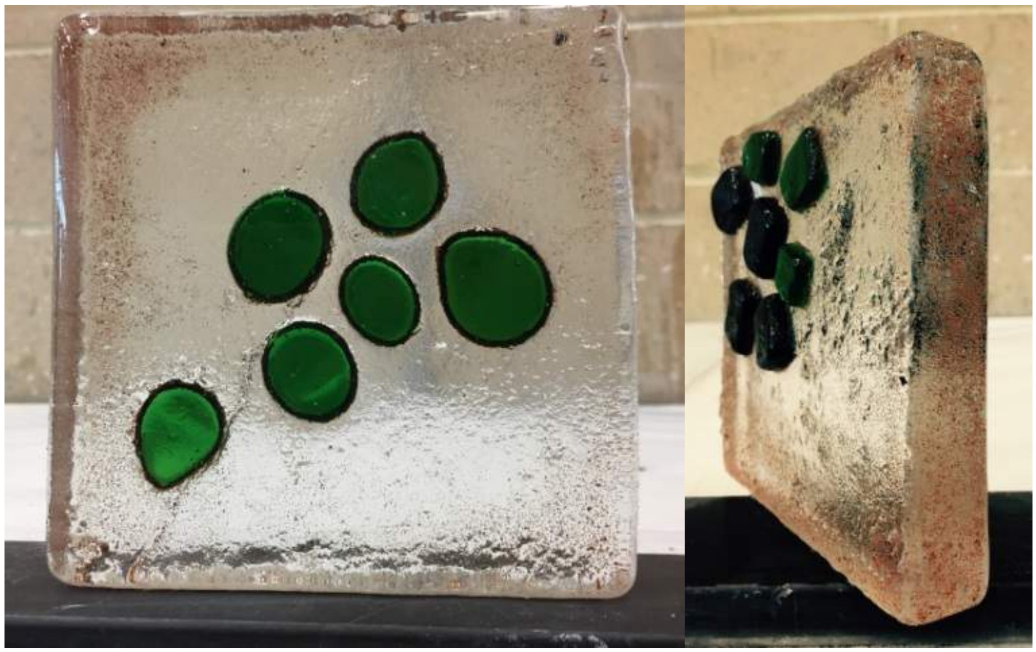

Figure 73 Test tiles created with most compatible encapsulation glass, 2015, photography credit: J A Denton

List of potential solutions for transitional inclusion compatibility issues:

1. Find a new inclusion glass with same CoE and viscosity.

2. Only include glass on the surface of casts – No breaching of the sandcast surface.

3. If the sandcast surface must be breached use only rounded inclusions – No sharp edges.

4. Only make inclusions from furnace glass with powders and/or paradise paint.

5. Only make inclusions from furnace glass which has been sandblasted.

To ascertain whether this was a compatibility issue or a breach issue the next series of tests consisted of 10 cm x 10 cm glass tiles created using the most **compatible** colour in the System 96 range (transparent green) based on the pull test results. The test specifications were as follows:

- Oval inclusions made in System 96 and cast over with Glasma furnace glass – Inclusions **bisecting** the surface of cast.

Square inclusions made in System 96 and cast over with Glasma furnace glass – Inclusions **bisecting** the surface of cast.

Two tiles were created with System 96 transparent green inclusions. One tile used square inclusions and the other used ovals. Both sets of inclusions breached the surface of the cast (figure 73, p. 149). It was clear that there were no compatibility or fit issues with oval or square (breaching the surface) ‘surface transitional’ inclusions. This indicated that the cracking problem mainly stemmed from an inclusion glass compatibility issue. If the inclusion glass **was** pushing its compatibility limits, this test confirmed that when using a more incompatible glass it could not be allowed to breach the surface of the sandcast. If it did the sandcast would break after annealing.

### 3.5.2 Further testing of the 3D transitional inclusion

A series of tiles were created testing the compatibility of the system 96 white which was not a good *fit* in tandem with Glasma furnace glass. This inclusion was made in the form of a cone. The cone comprised of clear furnace glass on the inside, encased in transparent red (compatibility ok), then further encased in white (compatibility not good) and finally encased in transparent blue (compatibility ok). All colours used were System 96 products (for more technical information about this encased cane see section 4.2.1, pp 174-175).The above test was repeated with powdered white Kuglar glass colour instead of System 96 in order to help with compatibility if there were issues. Kuglar is the standard brand used in the hotshop for blowing. The wide end of the cone inclusion intended to breach the sandcast was without colour. This allowed for only a minimal amount of System 96 inclusion glass to join with the furnace glass once cast (see figure 74 below).

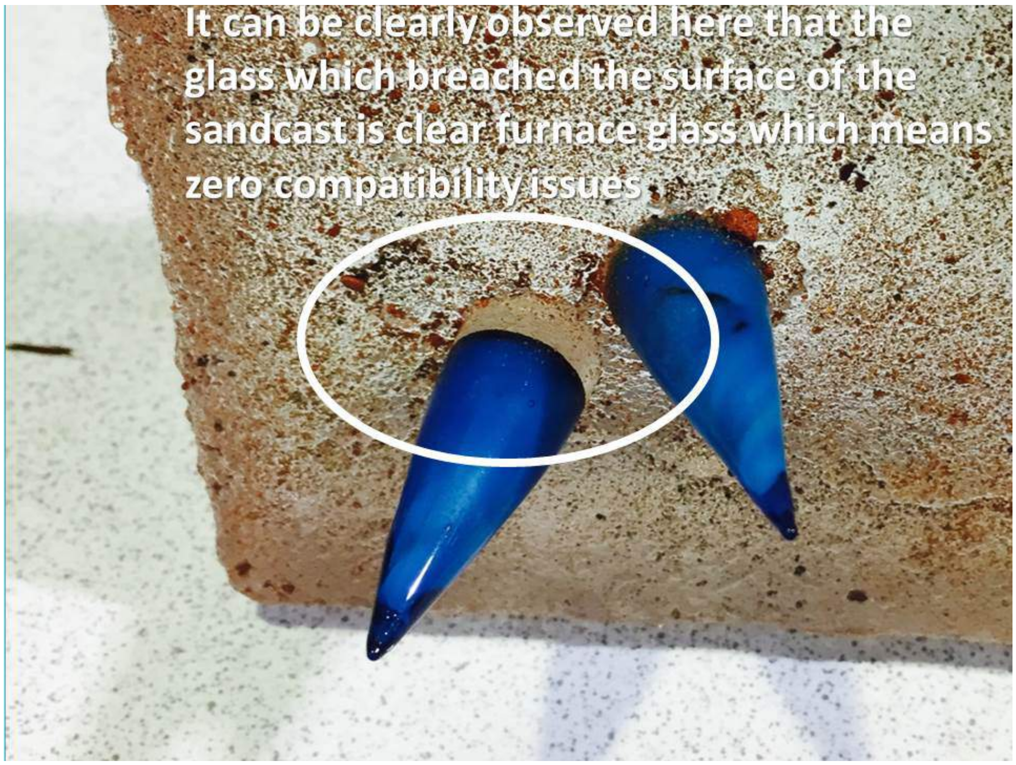


Figure 74 Inclusion bypassing the need to be made from perfectly compatible glass, 2016, photography credit: J A Denton

Both tests were a success proving that a single colour brand like System 96 with ±5 CoE differentials can be used not only flush with the surface of the sandcast cast, but can also be used breaching it. This was always successful when the inclusions were made with furnace glass in the middle of the inclusion. This avoided letting too much inclusion glass get into contact with the base furnace glass whilst casting. Interestingly using these style of inclusions brought up a new and unexpected problem often experienced by paperweight makers. This unexpected problem involved transferred ‘dirt’ from the inclusion obscurring the view of inclusion once cast in a sandcast. This new problem further developed objective 4 of the research which was to *design a series* *of tests based on the work of selected contextual review artists, and adapt their techniques to sandcasting with flameworked inclusions*. At this stage more of Paul Stankard techniques were researched and tested.

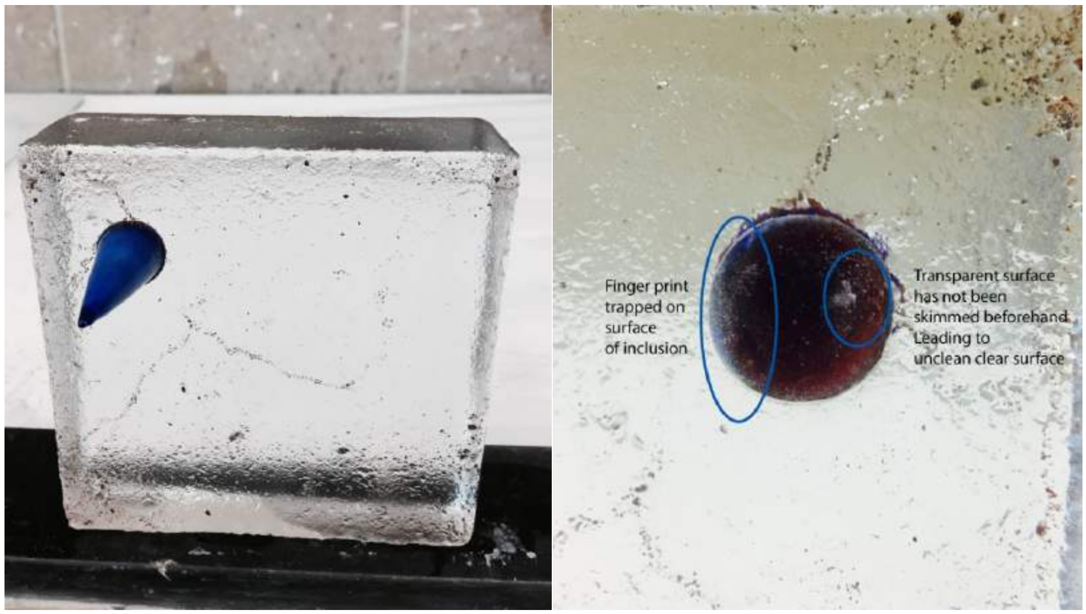


Figure 75 Two tone spike test cast. Right: Types of contamination, a fingerprint and unskimmed clear glass with veils, 2015, photography credit: J A Denton

During the paperweight making process there are two key applications which must be adhered to before inclusions are encapsulated in a mass of clear molten glass. Firstly any inclusions once made must be cleaned with alcohol and from that point on only touched with tools. This is because the oil from ones hand can transfer onto the inclusion glass. Should an inclusion be contaminated once encapsulated into a larger body of clear glass the oil from ones hand forms a fingerprint made from tiny air bubbles which are formed whilst pouring (see figure 75 above). This renders the paperweight which relies wholly on  the trompe l'oeil effect, a manmade object and therefore it is not fit for purpose. This is especially so in paperweight making, but at this stage it applied equally to this research.

Up until the series of work entitled 'Heartless Barstard' (see section 4.3, pp. 187-197) I had mainly been working with the sandcasts using a substantial element of coloured glass. Therefore cleaning the glass pre-casting was unimportant to the brief, as ‘fingerprints’ could not be seen on these colour cane inclusions. Due to the new concepts introduced in section 4.1, p. 172, and further developed in section 4.4 Heads - Case study 3 (pp. 197-209) these new (contamination) visual issues needed to be resolved.

The thematic interests of the artworks dealt with the visual representation of conflicting human emotions. The face that man shows the world (phenomenological experience), the feelings hidden within them and finally the subconscious emotions man has no control over (noumenal experience). By using inclusions inside the body of a clear sandcast the viewer could observe the outward ‘face’ of the work and they could view what lay behind the façade. Therefore the creation of ‘3D transitional’ inclusions which could be viewed from both sides of the cast with clarity became important to the research. If there were ‘fingerprints’ on the inclusions where they breached the sandcast surface the viewer’s sight would be obscured. The observer would not be able to see the inside of the inclusion from the glass side (back) of the sandcast. This was important to the themes of the artwork and therefore needed to be resolved.

The second key application in paperweight making is all transparent glass must be *skimmed* (see section 2.10.1, p. 74) Skimming is the technique of taking off the outer layer of glass when the clear *gather* is hot. Skimming is concerned with the clarity of the transparent inclusion and is another paperweight maker’s technique for dealing with the dirt that permeates the surface of the raw material – The glass rod. This ‘dirt’ takes the form of small abrasions and dust collected on the glass rod during transportation or while sitting in a box before use. These abrasions and dust have a detrimental effect on the surface of the rod once heated. If left unchecked the surface of the clear glass becomes blistered when heated. This is due to contamination from the abrasions and dust on the surface of the glass. Once the inclusion is made the blistering caused by contamination from surface scratches looks like a milky mist covering the surface of the inclusion (see figure 75, p. 152).

The paperweight maker deals with this problem by *skimming* the surface of the glass rod/glass mass before adding it to the inclusion or encapsulating the inclusion within it (see section 2.10.1, pp. 71-76). The paperweight maker does this because no amount of cleaning clear glass with alcohol will take away a scratch in the surface. The consequent blistering which occurs once heated would be considered a flaw in this context. Therefore to avoid blistering the clear space in the glass inclusion, the inclusion is skimmed revealing optically clear glass underneath.

To investigate the relevance of the issues experienced by paperweight makers concerning optically clear inclusions a further series of tests were concieved. These new tests consisted of 10 cm x 10 cm glass tiles created using coloured concical glass inclusions which were made with transparent furnace glass on the inside. The specifications for each test are listed below:

- Create one cast with cone inclusions which have had the clear furnace glass **skimmed** during the flameworking process.
- Create one cast with cone inclusions which have been highly **polished** on the wide end of the inclusion after the flameworking process.
- Create one cast with cone inclusions which have had the clear furnace **cleaned** with alcohol after the flameworking process.

The ‘3D transitional’ inclusion cones which were taken up to a fine polish on the wide end of the inclusion and these inclusions looked the most effective with no bubbling (see figure 102, p. 203 for visual results of all hree test types). The skimmed cones were also effective with few bubbles obscurring the view to the inside of the inclusion where they were flush with the surface of the sandcast form. The cones simply cleaned with alcohol had no impurities due to either oil from fingers or any other type of external contamination, e.g., dirt, but the negative aspects were high. The blisters created whilst making the inclusion in the flame combined with the glass not being skimmed meant that the flameworked inclusions looked misty when viewed from the glass side of the cast (see figure 75, p. 152).

In conclusion when using clear inclusions within a sandcast form, paperweight makers issues are relevant. The results from the above set of tests revealed that both the polished inclusions and the skimmed inclusions were equally successful. The inclusion which was only cleaned with alcohol still had misting and bubbles once encapsulated. Therefore in the context of this research flameworked inclusions utilising clear glass on the outer surface of the inclusions must firstly be made with skimmed clear glass. For further optical clarity the inclusions can be highly polished and cleaned before encapsulation in the sandcast. This series of tests and their results answered question 2 of this research in the affirmative. Question 2 enquires whether *flameworked encapsulation techniques can be applied to flameworked inclusion encapsulations in the sandcasting process?*

### 3.5.3 Partial inclusion - Use of a mandrel

Whilst creating the tests from section 3.5.2 (pp. 150-155) I realised that 'transitional' inclusions would need to be quite simple in form. Should inclusions protrude too extensively from the sandcast surface or be too detailed and fragile they would be in danger of breaking away from the main body of glass. Creating long or detailed inclusions came with two serious practical problems. Firstly glass struggles with an immediate transition from very thick to very thin. It will often break unless all angles in the transition have been resolved and the gradient from thick to thin is graduated (Dunham, 1997, pp. 25-26). Secondly the inclusion is so detailed and fragile that it is easily breakable whilst moving the cast, working further on the artwork in the cold processing area or during transportation.

The aforementioned constraints undermined creativity due to inclusion detail and size restrictions therefore an alternative path needed to be explored. An alternative which would allow for the addition of detailed, thin, tall inclusions blooming out of the sandcast surface. Due to prior knowledge of techniques synonymous with flameworking it could be possible that a *mandrel* (see figure 76, p. 156) traditionally used for beadmaking could be utilised in a sandcast? Would a mandrel be able to create holes in the glass in the same way as it does with beads? Could a bead mandrel create holes that breach the glass surface without breaking it during cooling?

**1 & 2**
Start from pulling some hairline stringers.

**3**
Other materials needed are silver leaf, Satake Glass SS10 (dark red) frit, gold foil stringer (see "Silver Foil Cane" in *Glass Line* 26.3) and latticino. All the glass used here is leaded.

**4**
Wrap some glass around a mandrel and form a cylinder with a thin wall as in the photo.

**5 & 6**
Cover it with silver leaf and heat it to melt.

**7 & 8**
Stick a clear stringer on the bead to make a dent and then make a dot there. By doing that the surface becomes three dementional. Repeat it at random along the surface.

**9 & 10**
Soften and reshape the bead.

**11**
Thinly encase it with clear (by making clear dots all around the surface and reshaping.)

**12**
Reshape the bead.

une/July 2013 www.HotGlass.com 31

Figure 76 Example of a glass bead being made on a mandrel (Okabe, 2013, pp. 30-35)

Beads are created on stainless steel rods. This rod is coated with a kaolin based *slip* which when air dried solidifies to form a barrier retarding the glass from sticking to the metal when hot. Molten glass is wrapped around the mandrel and a bead is formed. When cool the bead is released from the mandrel due to the kaolin coating and thereafter a hole is left behind. This process could be utilised in a sandcast.

A series of tests were established and a new bead release was specifically developed for this activity. I developed this bead release agent because a blend needed to be created to maximise the strength of the release agent (see appendix 9, p. 275). The successful use of a mandrel could create tubular voids within the sandcast body. These voids would enable the production of artworks with complicated or thin flameworked inclusions because a separate component could be flameworked with a *glass post*. A post made from glass (or any other material for that matter) could slot into the void created by the mandrel into the glass sandcast. These new inclusion types known from this point forward as the 'partial' inclusion (see figure 78, p. 158), could burst forth from the sandcast body without fear of breakage during or after the making process.

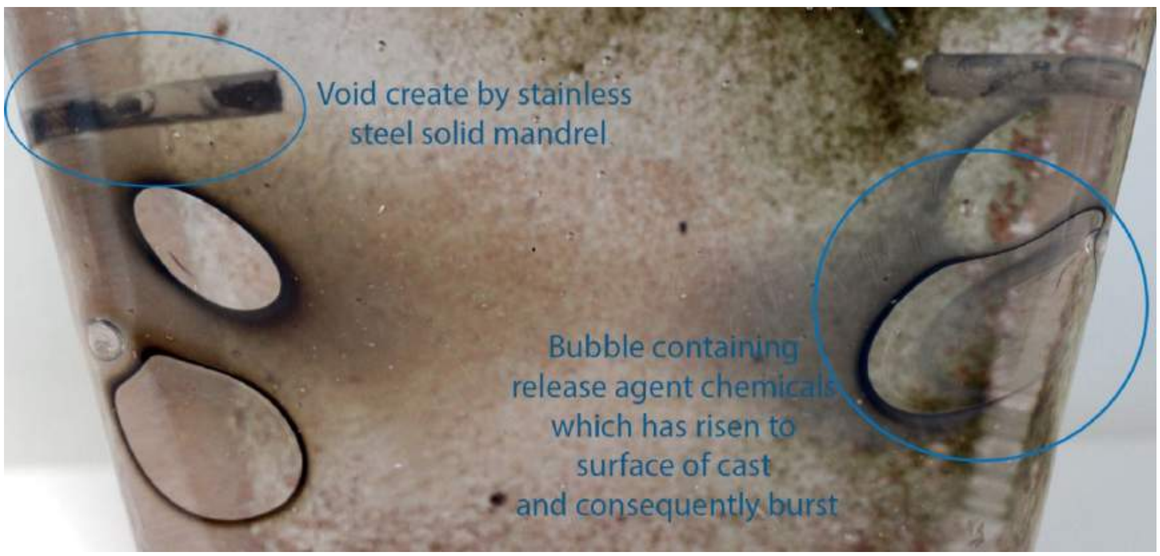


Figure 77 Evidence in the form of reduction bubbles from release agent gassing off into cast area due to use of solid mandrel, 2014, photography credit: J A Denton

During testing it was noted that solid stainless steel mandrels gassed off into the cast. The gas travelled through the glass body and consequently out through the surface of the cast in the form of dirty bubbles. These bubbles created a reduction atmosphere on the surface of the cast (See figure 77 above). The chemicals in the release agent which were burnt off during casting turned gaseous. This gas needed to dissipate through the easiest point of exit which in this case was into the hot glass body of the cast itself. The gassing into the glass cast itself needed to be resolved.

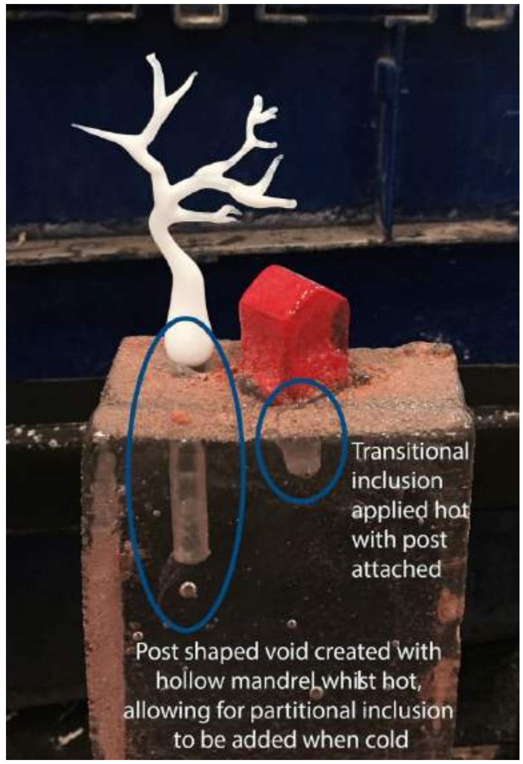


Figure 78 Example of void made with hollow stainless steel mandrel, and ‘3 D transitional’ inclusion attached with a glass post, 2014, photography credit: Kevin Moonan

The next experiment using this technique was with a hollow stainless steel tube. Results using hollow stainless steel tubing was successful (see figure 78 above) and no reduction bubbles were created in the sandcast glass. The easiest method of escape for the gases given off by the release agent during this line of enquiry was through the hollow area of the mandrel itself. This gas was then directed into the sand mould body instead of the glass cast. Thus a void was created with the minimum amount of effort. Further, there was no need for coldshop processes in the form of drilling thereafter. The hole created using this technique was clear. When drilling a hole in glass the void left behind is frosted and can be a visual distraction for the observer. The transparent void made with a mandrel did not draw the eye of the viewer away from focal point -The focal point being the ‘partial’ inclusion.

The 'partial' inclusion could be inserted into the void via a transparent glass post (see figure 78, p. 158). Later, the 'partial' inclusion could be separated from the sandcast part of the artwork at any point for security. Should the artwork need to travel for an exhibition, the component parts could be separated and shipped securely. Further, the 'partial' inclusion could be made from any CoE glass. The 'partial' inclusion does not need to structurally bond to the sandcast which gives the sandcaster/flameworker great freedom. The artist is also not restricted to sourcing glass which is compatible with their own furnace batch glass which is a saving of time, effort and money. This line of enquiry made the second contribution to new knowledge whilst satisfying aim 2 of establishing new approaches for incorporating flameworked glass components into sandcast glass forms for creative use, and objective 5 which was to unveil compatible combinations and/or alternatives when working with the furnace glass.

## 3.6 Methodological developments leading to new knowledge

A short taxonomy was created identifying and illustrating all inclusion types. This taxonomy identified both the currently accepted methods of incorporating glass inclusions into sandcasts plus the new methods discovered during this research. The techniques developed during the investigation were not previously researched academically due to the commonly erroneous conception that *'Flamework combined with sandcasting is a nice technique but too unpredictable'* (Bubacco, 2013). In this component of the research the terminology for the processes under investigation were defined. Two new techniques were developed during this research which contributed to new knowledge:

- Firstly the 'transitional' inclusion which was developed from an investigation into the sandcasting techniques of José Chardiet (see sections 2.6-2.6.1, p. 58-61). Adding inclusions to a cold mould and heating the mould pre-casting allows the flameworked form to be viewed on either side of the sandcast space and consistently achieves controlled repeatable results.

- Secondly the 'partial' inclusion which developed naturally through the testing period of this research. This technique allowed for delicate flameworked inclusions to be attached to the surface of the finished sandcast when cold thus negating the need to source compatible glass with the furnace glass. This technique retards accidental breakage of casts after annealing, in the cold processing area or whilst being transported to other locations because the work is designed to come apart. The taxonomy of techniques are defined in the next four sections.

### 3.6.1 Floating inclusion


Figure 79 'Turkish delight', 2013 by J A Denton. Cast in a sand , flameworked glass 'floating' inclusions: H. 12 cm, W. 12 cm, D. 5 cm, photography credit: Kevin Moonan

The 'floating' inclusions were fully immersed within the glass substrate and appeared to be suspended (see Figure 79 above). This technique is synonymous with Bertil Vallien (see sections 2.4-2.4.1, pp. 48-55). His floating inclusions are created as blanks in the hotshop. Once annealed he paints his inclusions with paradise paint and later heats them ready for placement in his sandcasts. This technique has been built upon because Vallien does not use flameworked inclusions (except in the most simple *filligrana cane* designs). Plus he does not need to source compatible glass as he paints blanks made from the furnace glass he casts with. This research sourced compatible glass to make flameworked 'floating' inclusions.

Figure 80. Floating inclusion process: left to right: Flameworked components, inclusion placed in cast between pours, inclusion sandwiched between glass substrate, 2012, photography credit: J A Denton

Techniques derived from paperweight making were also utilised during this part of the research satisfying question 2 which was to discover if *flameworked encapsulation techniques previously used in paperweight making could be applied to flameworked inclusion encapsulations in the sandcasting process.* Paperweight techniques were needed to create cleaner inclusions once encapsulated and retarded bubble formation from inclusions which had a crease, e.g., a heart (see sections 4.3.1, pp. 188-189 & 4.3.4, pp. 195-197). Further, figure 80 above left, shows an inclusion with clear glass struts which kept delicate inclusion components from deforming whilst being cast. This technique retarded thin components from elongating whilst hot furnace glass was being poured over them. This scaffolding technique was also developed from paperweight techniques. This gave the artist further control over an often accident prone technique when using detailed or thin inclusions.

### 3.6.2 Two dimensional transitional inclusion

This type of inclusion was fortuitously developed from the José Chardiet technique of sandmould preheating before casting (see section 2.6.1, pp. 59-61). Chardiet is known for his novel ‘still lifes’ (see figure 18, p. 58). These still lifes are very large for artworks made from glass (H. 91 cm, W. 27 cm, D. 21 cm). The casting glass needs to run down rather thin ‘legs’ in Chardiet’s sandmould (see diagram 4, p. 61). If the mould is not pre-heated the glass can cease to flow due to being cooled down by the sand mould.


Figure 81 Examples of transitional inclusions including process picture on the left pre-casting, 2014, photography credit: J A Denton

To combat heat loss Chardiet heats the complete mould to just above annealing temperature. Once the mould has reached this temperature Chardiet pours molten glass into the mould whilst it is still in the kiln. The glass runs into these long thin areas because a hot mould does not cool the glass as it is being poured. The hot sand mould allows the glass to pour down the ‘leg’ and fill to the bottom of the mould. As previously stated a cold mould would cool the molten glass and consequently the glass would not run into the bottom of the 'leg'.

Figure 82 Anima Mundi series 'The secret calendar', 2013 by J A Denton. Cast in sand mould with flameworked 'surface transitional' inclusions: H. 12 cm, W. 12 cm, D. 5 cm, photography credit: Kevin Moonan

Adding inclusions to a cold mould and then heating the mould up gave the artist the ability to strategically position inclusions when cold (see figure 81, p. 162). When adding inclusions in a hot environment ('floating' inclusion) there is a chance of accidental placement of inclusions. Accidental placement of inclusions is due in part to the time constraints when adding inclusions in between glass pours. Once in place the inclusion cannot be repositioned as it is literally 'stuck' to the molten glass beneath.

Further, the transitional inclusion technique negated any chance of the inclusions being smeared or elongated when the hot furnace glass was poured over it (see figure 82,p. 163). The inclusions could not smear or elongate because the sand mould acted as an anchor for the inclusions because they breached the sand surface (see figure 81 162 on the left, and section 4.2.1, pp. 174-179) . Also, the inclusions were only heated up to 540°C and were not physically hot enough to move when the molten glass was poured over them. Unlike the floating inclusion there was not an extremely hot heat source heating the 'transitional' inclusions from underneath. Finally there was no chance of inclusion breakage from a cold tool when being placed in the sandcast because there were no tools in use. This technique is also useful for the artist who works alone. When one is placing floating inclusions one cannot cast at the same time. Using the heated mould technique the inclusions are already in place and can be completeled from start to finish by a single person. The artist can simply cast into the sandmould and place in the annealer once cast or alternatively keep the whole mould in a chest kiln and cast into the kiln whilst the mould is still in place (see section 2.6.1, pp. 59-61).

### 3.6.3 Three-dimensional transitional inclusion

The three dimensional transitional inclusion developed from the 'surface transitional' inclusion. This inclusion type was utilised mostly for the artworks produced in sections 4.3, pp. 187-197 & 4.4, pp. 197-209. The three dimensional transitional inclusion was created by adding inclusions to cold sand moulds in the same way as the 'surface inclusion'. After inclusion placement the sand mould negative which was in a metal container was placed in the lehr and heated to just above annealing temperature approximately 540°C. It is a given that the specific annealing temperature is dependent on the selected furnace glass (see Table 3, p. 103 for relevant data concerning glass comparisons). The pre-warmed mould could be taken out of the lehr, cast into and placed back into the lehr to anneal. Two alternatives to this method would be first, to place the mould in a chest kiln and the molten glass could be poured directly into the mould in-situ. Secondly (this would be the best possibility), if one had a truck kiln on rollers (see Figure 56, p. 124) one can simply roll out the heated mould, cast into it and then roll the cast back into the kiln

Figure 83 Detail from 'The Bermondsey horror', 2013 by J A Denton. Cast in a sand mould with flameworked glass ‘3D transitional’ inclusions: H. 16cm, W. 5 cm, D. 6 cm. Site specific installation created for the Vitromusée exhibition. Photography credit: J A Denton

This inclusion type (see Figure 83 above) extended the boundaries of the previous inclusion types and allowed flameworked inclusions to escape the boundaries of the sandcast form. This inclusion type enabled further potential for the artwork to have a communication with the external space it occupied.

### 3.6.4 Partial inclusion

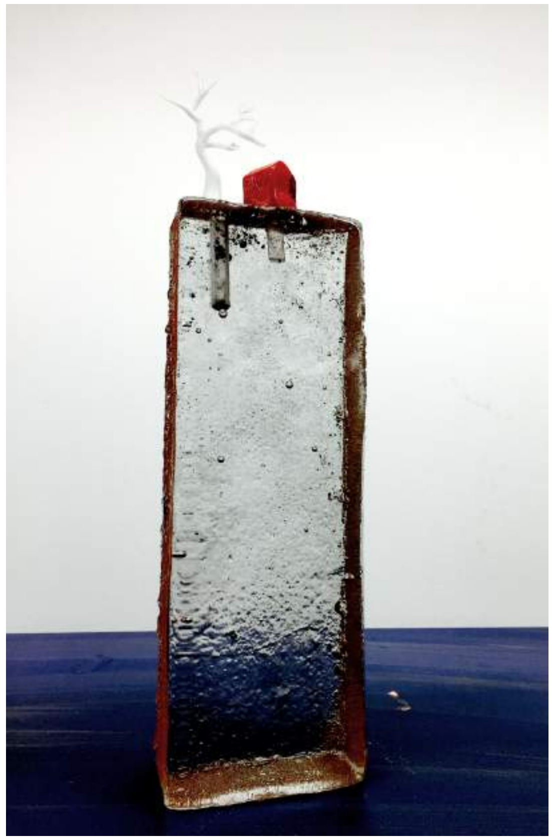

Figure 84 Anima Mundi series ‘Home #1’ 2015 by J A Denton. Cast in sandmould with flameworked glass with ‘partial’ ‘surface transitional’ inclusions; H. 40 cm, W. 6 cm, D. 5 cm, photography credit: Kevin Moonan

Due to prior knowledge of flameworking techniques the ‘partial’ inclusion was derived from the use of a mandrel in bead making. All the previous techniques mentioned above were limited. They were limited because compatible glass **must** be researched and acquired if using a refined inclusion colour palette. A refined colour palette referring to the types of ‘refined’ inclusion found in a paperweight (see figure 32, p. 75). Further, should the ‘3D transitional’ inclusions protrude too far from the surface of the sandcast they were at extreme risk of being damaged during processing. Breakage could occur whilst cold processing the artwork, moving it or transporting it for dissemination purposes. The security of the physical integrity of the artwork dictated that external inclusions should not be too detailed or too long. This safety issue combined with the need to find an inclusion glass that fitted with the furnace glass was a limiting constraint on creativity.

The ‘partial’ inclusion (figure 84, p. 166) negated the necessity of finding a glass that would *fit* the furnace glass. It equally allowed for external inclusions to be as detailed and/or as large as the artist saw fit. The partial inclusion was developed by adding a hollow metal mandrel covered in a clay based release agent to the sand mould pre-casting. Once the glass had been poured into the sand mould a tubular void would be created. After annealing the mandrel could be released from the sandcast. The void left by the mandrel was transparent and did not interfere with the aesthetic presentation of the cast. A drilled hole made during cold processing leaves a translucent grey tooling mark which can visually interfere with how the artwork is viewed later.

A further difficulty concerning drilling glass is that casts can be problematic to drill if they are amorphously shaped. Finally, the void created by the partial inclusion is created to accept a separate flameworked component. This flameworked object must have a *glass post* attached which slots into the void left in the sandcast from the mandrel. A flameworked component can be made from any glass even *borosilicate*, which has a much lower CoE than furnace glass. The ‘partial’ inclusion does not need to structurally bond to the sandcast because they are joined cold. A cold combination of the component parts gives the sandcaster/flameworker greater freedom and flexibility both during making and in terms of transportation logistics. Flameworked components simply slot in and out of the void created by the mandrel during casting via the glass post. Should the artwork need to travel for dissemination purposes the component parts can be separated and shipped securely.

In the reflective summary and areas for further study on p. 227 a little developed but important technique associated with paperweight inclusions was defined in reference to the space the mandrel occupies in the glass object. This definition led to an important next step for further study for the partial inclusion and can be visually understood in figure 67 on p. 141.

### 3.6.5 Scaling up

Traditionally the combination of flameworking with sandcast glass has been constrained to the size of a paperweight. Paul Stankard made a very important change to the way a paperweight is regarded by changing the viewpoint and shifting the point of balance by 90°. Stankards move from tradition gave the object a rectangular shape as opposed to the customary elliptical shape.

Sandcasting has the possibility to be manufactured on a much larger scale, but in relation to its combination with flameworking there is a constraint over how large one can make a flameworked insert. The size of the flameworked inclusion is highly dependent on the makers years of flameworking experience. Less experience means smaller inclusions as it is easy for them to break during the making process.

The ‘transitional’ inclusion gives the maker the opportunity to create an image/form/abstraction in component form. This essentially expands the possibility and scale of what can be created. This cannot be replicated when using the floating inclusion because there is a finite amount of time allotted for inclusion placement in between glass pours. Five inclusions per layer is probably the maximum amount before mistakes and bad inclusion placements occur. Whereas an infinite amount of small inclusions can be created (with or without extensive flameworking skill) and included in the sand mould when cold and afterwards preheated. This opens hitherto unthought of possibilities in scaling up the artworks.

## 3.7 Summary of chapter 3 and statement of new knowledge

This research concerning the encapsulation of flameworked forms into a larger sandcast mass has been approached primarily from a practical artistic perspective. This research provides insights which further develop and advance the use of detailed inclusions within a larger sandcast form for artists and small studio production facilities. Further applications of these new techniques include their transferable use in glass industrial design within the field of architecture (interior and exterior), and to enhance the individual artists' palette. The application of this research is mainly for artists wishing to create detailed scenarios in a larger glass body which are not fragile.

The originality of the 'transitional' inclusion techniques innovate the encapsulation process in sandcasting. The 'transitional' inclusion techniques give the artist working in glass complete control when adding flameworked inclusions into a sandcast form. Precision placement, retarding of smears/elongation can be achieved without serendipitous error using the new transitional inclusion techniques. Controlled results form a new potential for the creation of large scale sculpture incorporating detailed inclusions in component form.

The second inclusion technique which is a contribution to new knowledge is the 'partial' inclusion. This technique negates the need of the artist to source compatible inclusion glass which fits with the furnace batch glass. This inclusion technique allows the inclusion to burst through the surface of the sandcast without fear of breakage during or after casting allowing for unconstrained creativity if wished. This inclusion type can be separated from the sandcast artwork at any point for security. Should the artwork need to travel for further dissemination the component parts can be divided and shipped securely. The artist is furthermore not restricted to sourcing glass compatible with their own furnace batch which is a saving of time, effort and money. In chapter 5 in the reflective summary and areas for further study on p. 227 a little developed but important technique associated with paperweight inclusions was defined and led to an important next step for further study for the partial inclusion. The next step in this inclusion type was to cover the mandrel with glass pre-casting to form an inclusion which both hides the unsightly cavity left by the mandrel and adds to the theme of the artwork. This can be visually understood in figure 67 on p. 141.

This research forms the basis of a series of techniques initially conceived of using known methods in other glass fields such as paperweight creation and sandcasting with hot glass inclusions. These methods have been tested, developed and improved upon to create new inclusion techniques. The new techniques discovered in this research adhere to the controls set by question 1 which was to discover if flameworked glass encapsulations could be applied to the sandcasting process, what were the problems associated with the application of these techniques and how could they be controlled to achieve consistent repeatable results. The testing period in chapter 3 was led, reflected upon and developed further by the creation of a series of artworks engaged in to compliment this research. The three series of artworks developed personal ideas in conjunction with certain key aspects of the artistic vison of the case study artists from chapter 2. The technical innovations from chapter 3 are broken down in terms of their relevance to the thematic investigation and their success or failure on a technical level. in the following chapter.The thematic shifts, style changes in terms of inclusion detail and idea generation are broken down into case studies and dissected to compliment the technical investigation undertaken in chapter 3.

# 4 Artworks - Making the invisible visible

*As part of this research the creation of a series of artworks was undertaken to move the technical testing forward in chapter 3. In chapter 4 the practical and creative opportunities offered by the combination of sandcasting and flameworking were developed and are demonstrated through the creation of artworks. These artworks have been categorised and evaluated in relation to technical innovations and artistic themes through a series of case studies. This chapter is primarily concerned with the visual opportunities in glass presented by the new combination of flameworking with sandcasting. This has been approached by defining a visual language for each case study plus a breakdown of the success of these works both technically and visually.*

## 4.1 Introduction to the chapter

The 17th Century satirist Jonathan Swift said, "Vision is the art of seeing what is invisible to others." I chose to use the essence of this citation as the title for this chapter because glass has a unique quality unmatched by either painting or traditional sculpture. It is a special material which can be seen through, giving the visual artist the opportunity to describe concepts which would otherwise be 'impossible' to demonstrate in a material such as bronze for example as one cannot see into that material. The director of the Geelong Art gallery in Victoria, Australia gave a keynote speech at the Glass Art Society conference in Adelaide. He said of the material, '*glass is often so emblematic of things or ideas that are pure but precarious, delicate but destructible, eloquent but elusive, fine but fragile.*' (Edwards, 2005, p. 24). This citation is an eloquent way to describe the characteristics glass as a material can embody. Edward's adjectives aptly describe the contrasts and contradictions embodied in the glass artworks in the following chapter.

This chapter defines and evaluates the artworks created to both develop and demonstrate the technical investigations and innovations described in chapter 3. The main strands of testing established were based on three inclusion techniques: Namely the floating inclusion, the transitional inclusion and the partial inclusion. The inclusion technique which was improved upon was the floating inclusion and this satisfied question 2 of the research. Question 2 concerned the use of applied paperweight techniques to flameworked inclusions within the body of a sandcast. The new innovations developed were the transitional inclusion and the partial inclusion. The transitional inclusion was most useful regarding consistent repeatable results answering question 1. The partial inclusion transcended the need to find compatible glass with the furnace batch. Dispensing with the need to find compatible glass was a simple innovation but it allowed for the creation of very detailed inclusions. These inclusions could be taken out of the sandcast body at will and therefore exponentially reduced the possibility of breakage during transportation for dissemination purposes.

The thematic interests of the artworks lie in the visual representation of human emotions, especially when emotions conflict with each other - The face that man shows the world, the feelings hidden within them and finally the subconscious emotions man has no control over. By using inclusions inside the body of a clear sandcast not only can the viewer see the outward ‘face’ of the work, but they can also view what lies behind the façade through the transparent clear layers behind. This thematic exploration satisfied question 3 of the research as this question concerned *how the relative placement of an inclusion might change the narrative or the meaning of the conceptual content within the sandcast space.*

In terms of investigating a technically based thesis one must consider why artworks should be created in tandem with this type of research? The answer is that the artworks developed from the testing are what moved the technical investigation forward. The artworks created during this research period were used to focus the course of the research. Decision making occurred in the assessment stage of the research where each new batch of tests were critically considered. This period of reflection set the course for the next series of practical tests whilst simultaneously fine-tuning the lines of enquiry at every stage. Results were evaluated in relation to their technical and visual successes and suitable techniques were tested further.

During the research period a need to gently clarify why artworks should be made at all in terms of their use to society and/or the individual became increasingly necessary. It was essential to understand if the work created was not only self-indulgence but actually performed a specific task. This was both a philosophical question and a quantitative enquiry to which I would solicit the help of two academics. The first citation is from the PhD research of Dr. Mike Collier and it deals with the philosophical aspect of this simplified query. Dr. Collier said '…art is itself a phenomenological method of perceiving the world – it is philosophy in action' (2011, pp. 248-249). This indicates that art performs the function of visually communicating an individual's perception(s) of the world we live in. Secondly the  previous head of glass at the University of Sunderland describes the quantative function of art thus 'I see the artist as a catalyst, a transformational force and the visual arts as a means to communicate ideas and to achieve a dynamic creative society.' (Davies, 2012, p. 117) Therefore art (in its myriad forms) is an essential vehicle of 'unbiased' commentary concerning the development of a society. One example of art performing its quantitative function in society is when a number of artworks are banned or censored. One can arguably reason that the state policy (who banned the artworks) may be taking a dark turn. Both Dr. Collier and Dr. Davies show that art can give joy, act as a warning or elicit change in society or an individual.

Therefore, the artworks concerned with this research are based on a truth as seen from one artist's perspective. The artworks included in this thesis have been evaluated in relation to their themes and the success or failure of the technical developments employed to create them. The themes behind the works are described in order to define the visual language both for the artist working in glass and for the combination of hot inclusions with casting techniques. This chapter acts as an extension of chapter 3 and builds upon the technical study undertaken in that chapter. Plus this tanchapter critically develops the themes touched upon by the creation of artworks.

There were three main bodies of artwork developed during this research period and they were as follows:

- 'Anima Mundi'
- 'Heartless Barstard'
- 'Heads'

The 'Heads' series was an offshoot developed mainly from a refinement of the imagery used in the 'Heartless Barstard' series although this series also utilised elements from 'Anima Mundi'. In these works I endeavoured to create simple artworks in appearance, using minimal imagery and form. I did this to try to embody complex concepts which were concise, understandable and directly perceptible in their authenticity (for an explanation of the meaning of authenticity in this context go to section 2.11, p. 79). Therefore this chapter examines technically and thematically three bodies of artwork utilising the combination of sandcasting with flameworked inclusions.

## 4.2 Anima Mundi - Case study 1

*This Case study concerns the discovery of the transitional and the partial inclusion. The theme of the work was rather generic and focused on the tree as used in world mythology. This theme was undertaken in order to test the visual effectiveness of universally recognised imagery in a similar way to Bertil Vallien (see sections 2.4, p. 55 & 2.11, pp. 76-85).*

### 4.2.1 Transitional inclusion

Through working on the project 'Anima Mundi' the transitional inclusion was developed. In this series of artworks the flameworked inclusions are viewed two dimensionally on the surface of the sandcast and can be observed from either side of the finished artwork. This dual view effect was achieved by adding the inclusion(s) to the sand mould pre-casting and thereafter heating the mould up to 540°C.

Figure 85 Detail of how the transitional inclusion works in component form – This section is comprised of six different flameworked components, H. 60 cm: D. 30 cm W. 8 cm. Photography credit: Kevin Moonan

The surface transitional inclusion technique allowed for larger inclusions to be built up in component form. It became increasingly difficult to create tree inclusions over 25cm tall and 10cm wide from 96 CoE soft glass. Working with soft glass on a glass *torch* is technically challenging as the bigger the piece becomes the danger of cracking increases. This is especially the case when a number of colours have been encased to create a single cane (see section 3.5.2, p. 150). Flameworking with a rod that had different colours overlaid on top of each other became temperamental and the inclusion could crack or explode during the making process. The way to retard this was to anneal the newly made colour cane before use in the flame. This did not entirely solve the problem. Annealing made the glass cane as stable as possible and reduced the potential of the cane cracking during use in the flame.

The colour cane was made with a transparent glass core made from furnace glass in the middle to even out the *CoE/viscosity* differentials between batch glass and flameworking glass. White *system 96* glass was encased over the clear and black *stringer* decoration which was added to aid the visual sense of depth. Finally two different transparent blues encased the complete cane. An example of this cane can be seen in figure 85 on page 175 and shows the cane once it has been cast using the previously mentioned transitional inclusion technique.

The colour cane was made to aid the three dimensional suggestion of a tree form which was created much in the same way a painter creates depth in a painting – By adding a series of varied colours to build up a three dimensional quality to the painting. The glass tree inclusions could take on a cartoonish quality if made in a single block of opaque colour. If the trees were made with transparent glass the tree form would disappear into the transparency of the sandcast glass mass. The visual difference in terms of colour is demonstrated in figure 86, p. 177.

A further problem which was solved by the transitional inclusion was related to the gaffer who was pouring the glass (see section 3.2.6, pp. 121-121). When using the floating inclusion technique the caster had to be very specific in their pouring method. When pouring over delicate inclusions after placement on the first hot layer of glass the inclusions needed to be *capped*. If the second pour was poured directly on top of each inclusion these thin encapsulations had a high chance of smearing (see figure 65, p. 139). This smearing or elongation was due to two reasons: The first was because the heat from the furnace glass itself raised the temperature of the inclusions and increased their internal temperature. The second was that the heat that radiated from the poured glass already in the sand mould equally heightened the internal temperature of the inclusions which were only heated to 540°C originally.

An alternative needed to be found, and it was at this point the realisation that the José Chardiet technique of heating up the sand moulds pre-casting could be adjusted and utilised. Therefore in this context, the use of the transitional inclusion negated the need for either precision casting or the necessity to take heavy moulds in and out of the annealing oven by the gaffer because a. The gaffer could cast directly into the kiln the sand mould had warmed up in, b. The inclusions were not overheated because the layer of sand they were placed in was the same temperature as the inclusions themselves and c. The sand mould the inclusions were partially placed in retarded any potential movement from the inclusions as they were being poured over.

Figure 86 This test using surface transitional inclusions shows the visual difference between opaque white glass in the middle, opaque encased with a colour transparent glass on the next circle and on the outer rim of each circular inclusion the transparent only, 2014, photography credit J A Denton

The transitional inclusion could be created in component form and used to create a two dimensional ‘picture’ which would allow for the creation of larger inclusions – In a similar way to how mosaics work. Cold inclusions could be placed together in the sand mould, heated up together in a kiln and consequently larger casts up to the size of the lehr could be created. It meant that the casts could either be cast in the kiln (see b. above) or with more industrial equipment such as a forklift (see figure 87 below) or a casting truck kiln on rollers (see figure 56, p. 124). Using industrial equipment and larger lehrs could increase the size of sandcasts with glass transitional inclusions exponentially.

Figure 87 Casting with use of forklift to take out and replace sand mould from lehr, 2014, photography credit: Anon

To extrapolate on the point made on the previous page, by using the transitional inclusion and creating forms such as tree forms in component form, these components could be pressed into the surface of the sand mould when cold to create a larger 'picture'. Utilising this method meant that as the flameworked inclusions were pressed into the sand mould cold, they could not move anywhere accidentally when poured over once the mould was pre-heated. This technique newly developed by this research investigation gave the artist complete control over the end result and became a breakthrough technique. The transitional inclusion was a breakthrough in the research because of the high success rate of the later casts. This satisfied question 1 of the research because *consistent and repeatable results* could be achieved using the transitional inclusion technique.

### 4.2.2 Partial inclusion

Whilst experimenting with the three dimensional aspect of the inclusion coming out of the surface of the cast (see sections 3.5, p.142 & 3.5.3, pp. 155-159) a realisation dawned that any very delicate inclusions, e.g., a tree or its branches could be easily damaged after the work was cast and cold processed. Figure 88 (p. 180) shows a *linisher* in use for polishing glass, and like all industrial equipment used in the coldshop the linisher spins fast when in use. Any thin inclusions which emerge out of the surface of a sandcast could snap off with just a small amount of pressure in the wrong area. Further, if the polisher (person who is polishing) slips with the work accidentally, external inclusions can easily be broken.

The issue of chance breakage to external inclusions whilst polishing needed to be addressed. Why not take this risk out of the process altogether? Another observation was that it would be difficult to pack and ship glass artworks safely when they had thin components protruding externally. How could artworks arrive in one piece to their final destination if they had detailed external inclusions protruding out of the surface of the sandcast? The initial answer to the security of external inclusions came in the form of reflection over one of the test casts created during phase 1 of this research period. For display purposes a mandrel used in flameworking to make beads had been used in the side of a test cast and had created a void (see sections 3.5, p.142, 3.5.3, pp. 155-159 plus figure 66, p. 140 & figure 77, p. 157).

The use of a mandrel to create voids was the answer to the problem of the safety of external detailed inclusions (see figure 78, p. 158 & figure 84, p. 166 for detailed visual examples). Originally mandrels were tested because in order to hold the artwork with a metal, stone or wooden frame holes must be drilled into the glass. It can be difficult to drill holes in a three dimensional sandcast form after casting. Furthermore, the mark a drill makes in the glass is often ugly (an unpolished grey hole) and out of character with the artwork. The holes made by the mandrel were clean comparatively speaking and were created during the casting process simultaneously simplifying the process of creating voids in a three dimensional artwork.

Figure 88 An example of one type of water-fed industrial polishing equipment being used by master glassblower Thomas Blank, 2017, photography credit: J A Denton

Why not adapt the process relating to the presentation of the artwork post-casting and utilise it as a further inclusion technique? Why not create voids which could after casting hold an inclusion which slots in and out of place in the cast? A separate component of the artwork which could be removed for safety at will. By creating an external inclusion which can be removed from the sandcast one does not even have to create an inclusion in the same type of glass (in terms of *COE* and *fit*, see section 3.2.6, pp. 116-121). This further increases the potential of both the size and detail of the overall sandcast artwork whilst minimising the potential for damage whilst in transit, whilst being poured or whilst cold processing. This is how the partial inclusion was developed and can be referenced in section 3.5.3, pp. 155-159.

### 4.2.3 Themes

This work looked at the similarities between a variety of differing mythologies. It set (in this construct) the tree as the guiding premise of the research. The tree depicting the interconnected heritage human beings share through archetypal myth and legend. Indicating that although the myths are different and concern different characters they are comparative and to some degree universal, i.e., archetypal.


Figure 89 Map of human migration 60,000 years ago, National geographic 2017

This work was a topical commentary on the contemporary issue of migration (immigration) which has occurred since the Homo erectus species started migrating across Eurasia (see figure 89 above). Many pre-modern populations found a need to emigrate due to changing climate, landscape and/or inadequate food supply. In the modern world emigration is also driven by the same basic principles. These principles can be arguably summed up in short using Everett Lee's model of migration (Lee, 1966, pp. 47-57) as the struggle to obtain opportunity, freedom, sex and security.

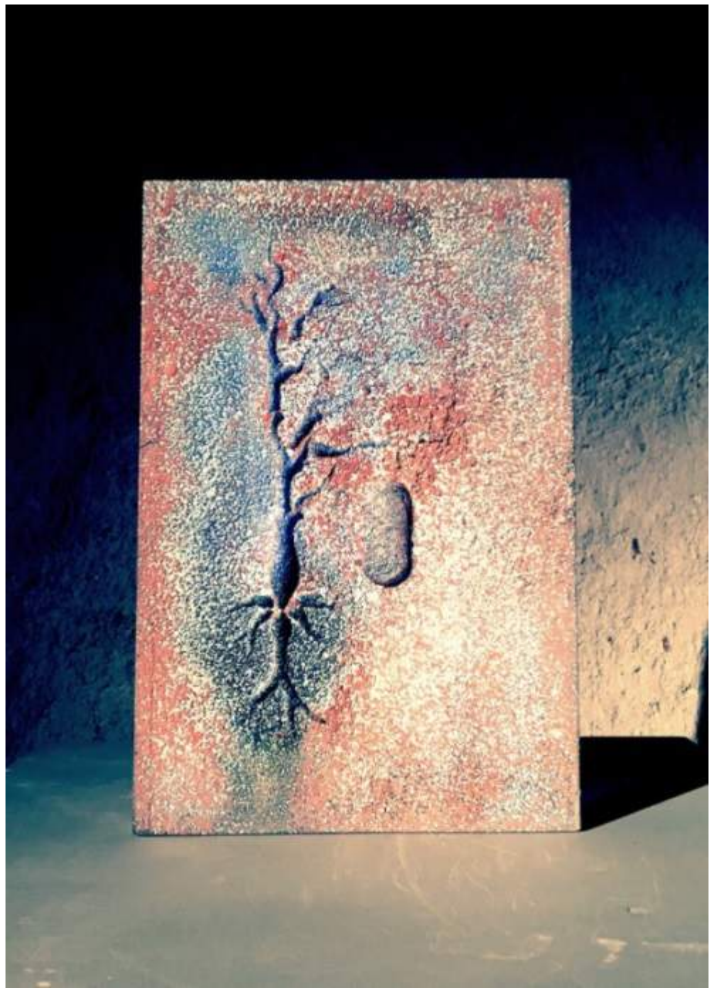

Figure 90 JA Denton Anima Mundi series 'Next plane (Egyptian), 2014 by J A Denton. Cast in sandmould with flameworked glass 'surface transitional' inclusions; H. 30 cm, W. 21 cm, D. 4, photography credit: Kevin Moonan

This visual line of enquiry was designed to celebrate and embrace diversity whilst correspondingly drawing on the similarities of our cultural roots. Claude Levi Strauss the French anthropologist believed that the myths purpose was to "mediate" oppositions thereby resolving basic tensions or contradictions found in human life or culture. The work created during this research period around this theme endeavoured to visually embrace the observation of Levi Strauss.

Concerning the tree motif it has appeared often throughout my artwork including before this research was undertaken (see appendix 7 pp. 267-272). The tree in terms of technique was a technical breakthrough by the discovery of the transitional inclusion. The transitional inclusion technique allowed the ‘picture’ of a tree to be made in components and consequently scale up the inclusion dimensions from 15 cm to as large as the lehr (1 metre, 2 metres, 3 metres and more*)*. For an example of the ability to scale up inclusions with the use of the transitional inclusion see figure 85 (p. 175) and figure 90, p. 182. The ‘Anima Mundi’ artworks were enhanced by using the surface transitional inclusion technique. The tree form was complimented when used in conjunction with the surface transitional inclusion because of the knotwork on the surface and in the roots and branches of many trees.

The tree is synonymous with stability, longevity, growth and renewal (Underwood, 1978, pp. 347 - 359). The political atmosphere man lives under in 2017 is at the very least unsure and although we are assured of growth, one cannot count on renewal, longevity or stability. The times we live in are far removed from the lifecycle of the tree. Each nation in this world wants to protect what is theirs. Populations are on the increase and debatably capitalism will break down by 2050 (Mason, 2016, p. 24). Prosperity must spread further and increasingly countries are imposing severe checks on migration control in order to keep their current level of amenities and economics stable (Lee, 1966, pp. 53-54).

There are no concrete answers when dealing with the themes of this series. The ‘Anima Mundi’ series was developed to inform without preaching to human animals that our ‘roots’ are from a common source. Our basic needs are no different from that of the tree or any other species including ourselves. Here is one example of the common theme which is spread throughout the individual pieces through their sub-themes:

The sub-theme concerned with the artwork shown in figure 90 on p.182 is based on "the sycamores of turquoise" in Egyptian mythology. This sacred tree embodies the spirit of the mother goddess figures called Nut & Hathor. On their journey to the underworld dead souls are given food and water from the branches of the tree. The branches of the Sycamore become the hands of the Egyptian mother goddesses offering sustenance to those that are dead.

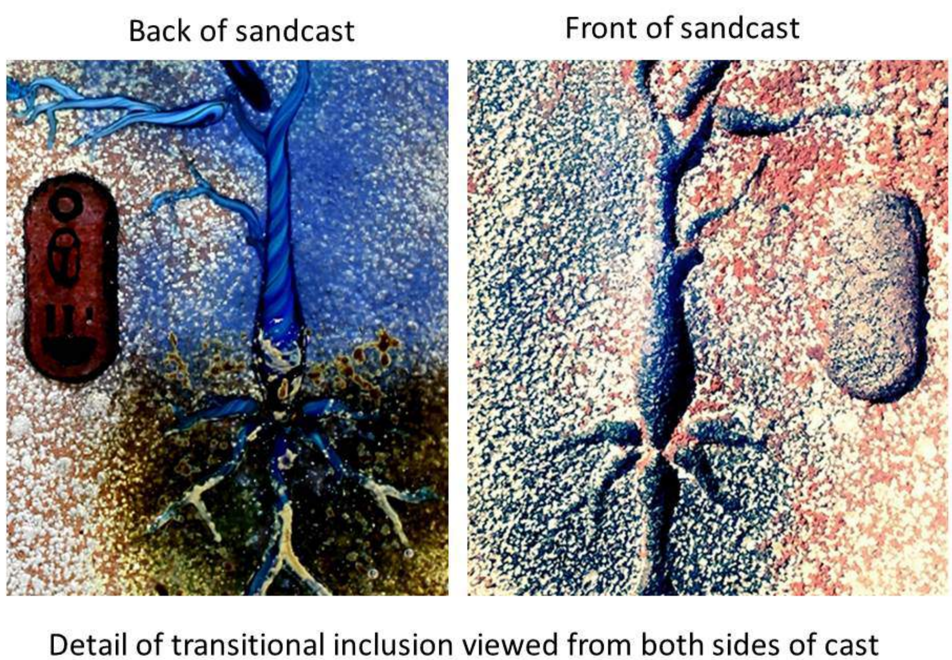


Figure 91 Example of the striking difference in the look of inclusions between the sand side of the cast (front - anterior) and the glossy side (back - posterior), photography credit – Kevin Moonan

The hands were designed to embrace the two-dimensionality of the Egyptian hieroglyph. A cartouche adorned the artwork, not because it should be readable but to utilise language as a visual reference for origin rather than a readable plot device. The work was dualistic as on one side it looked like an archaeological find and in contrast the other glass face was illustrative (see figure 91 above). This gave a visual clarity to the narrative concerned with the artwork on the glass side (posterior side) and an air of abstraction and mystery to the anterior side of the cast.

### 4.2.4 Evaluation of Anima Mundi – Artwork series 1

In terms of evaluation of the process and the artworks 'The next plain' was interesting. During the making process the anterior side (sand surface) of the mould which held the inclusions was heated too high in the kiln before pouring (approx., 560°C). Due to the kiln firing too high the transitional inclusions melted slightly into the sand mould surface (see figure 90, p. 182). Fortuitously this became a visually and thematically successful artwork. The themes of the work were based around archetypal myth and the piece itself on the anterior side appeared to have been buried in the ground for millennia adding to the ambiance of the overall work. This was not planned.

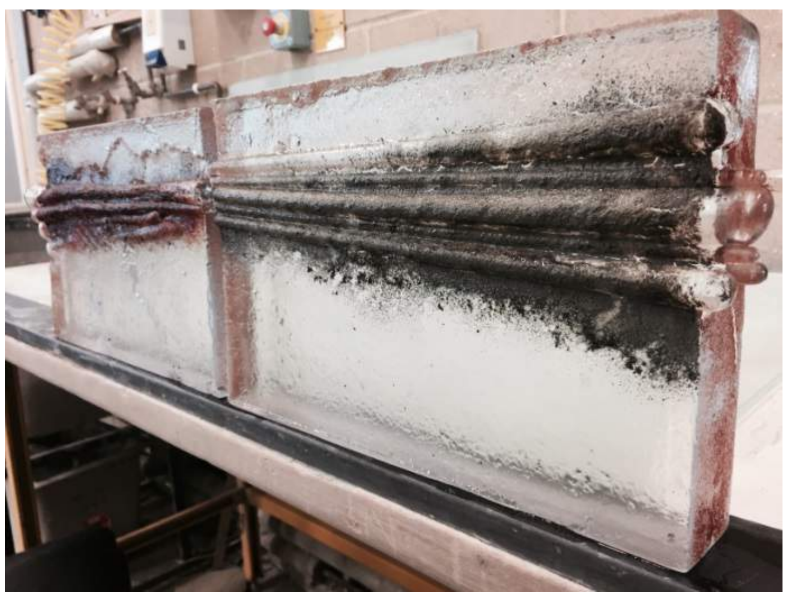

Figure 92 Work in progress: Polishing undertaken in order to juxtapose the form breaking out of its 'frame', 2015, photography credit: Kevin Moonan

At this stage in the testing I became concerned that only the inclusions were being utilised to describe the theme of the work much in the same way that Paul Stankard presents his paperweights (see section 2.11, p. 85). This was not bad per se, but it was not what I had originally wanted to achieve at the start of this research. I had wanted the work to transcend the purely representational (see Stankard, figure 10, p. 15) in a similar way to Bertil Vallien. Vallien not only uses the inclusions to visually represent an idea but he also utilises space and form. Vallien where possible will strategically place his artwork in an environment which has a relevance to the artwork. Further, the forms he chooses contribute and compliment the themes described by the inclusions in the interior. Equally Steffen Dam (for a breakdown of artworks by Dam and Vallien see section 2.11, pp. 76-85) uses the form of the casts to add to the comprehension of his artworks (see figure 23, p. 66).

Figure 93 JA Denton Anima Mundi' series "Untitled', 2015 by J A Denton. . Cast in sandmould with flameworked glass ‘surface transitional’ inclusions; H. 21 cm, W. 68 cm, D. 4, photography credit: Kevin Moonan

I wanted at the least, the sandcast form to be a thematic accompaniment to the work in unison with the inclusions. At this stage I began to create work which would not just figuratively, but also literally break the mould (see figure 92, p. 185). This move instigated a new starting point, creating artworks comprised of additional possibilities, which included the outside physical form of the artwork, plus the space it was displayed in. Using the form of the cast and the place in which it was viewed was taken on to add depth to the work and convey themes more clearly and more concisely. On page 186 figure 93 shows the work created during this period of experimentation insitu at a glass exhibition at the Vitromusée in Romont, Switzerland 2015. Other works displayed at the Vitromusee include figure 99 (p.198), and figure 85 (p.175). Figure 93 describes how the space contributed to the way the artwork was apprehended by the viewer.

In conclusion this was the first series of finished artworks which emerged from the research. In terms of the technical process the transitional inclusion was a breakthrough and a contribution to new knowledge. Plus the techniques transferred from paperweight making helped to make the process of combining flameworking with sandcasting more controllable. This series of artworks visually satisfied the investigation concerning questions 1 & 2. Plus the investigation to *establish new approaches for incorporating flameworked glass components into sandcast glass forms for creative use* which concerned aim 2 of the research instigated the starting point of this series of artworks. Each of the following case studies including this case study dealt with objective 4 (*design a series of tests based on the work of selected contextual review artists, and adapt their techniques to sandcasting with flameworked inclusions, then refine and improve upon their methods*) which was the basis for all further research excepting the partial inclusion. In terms of narrative and theme this work was merely a starting point.

## 4.3 Heartless Barstard - Case study 2

*This case study examines the traditional floating inclusion and builds upon the uses of the transitional inclusion in three dimensional space. The themes of the work were derived from personal experiences. This was undertaken to decide if personal themes were simply self-indulgent or thought provoking and a valid line of enquiry.*

### 4.3.1 Floating inclusion


Figure 94 Example of unwanted  air bubbles. Heartless Barstard series ‘He’s gotta lotta heart…’ 2012 by J A Denton. Cast in sand mould with flameworked glass ‘floating’ inclusion; H. 45 cm, W. 24 cm, D. 7 cm, photography credit: Kevin Moonan

The floating inclusion is an inclusion made from glass which is sandwiched in between glass layers as a sandcast is being poured. In this series of artworks an inclusion in the shape of a heart was encapsulated in the breast area of the sandcast bust. This inclusion was not detailed (see Figure 94 above). The heart insert did not have any thin glass protrusions coming out of the body of the inclusion and was not liable to elongate during casting. The heart inclusion which was hidden behind the glass fist was a stable mass. The only problem area to be aware of was the crease at the top of the heart. This would catch unwanted air bubbles (see section 3.5 and Figure 94). Therefore Paul

Stankard's paperweight techniques (see section 2.10.1, pp. 71-76) were needed for a successful artwork to be created.

The crease created in the heart encapsulation was covered with skimmed clear furnace glass. This negated the potential of air bubbles forming and being trapped in the crease during casting. Further, because the glass was *skimmed* it was not apparent to the naked eye that extra glass had been added to the heart when being viewed in the finished sandcast thus achieving a *Trompe l'oeile* effect.

### 4.3.2 Transitional inclusion

In this series the 'transitional' inclusion morphed from being a technique that formed a two dimensional picture (see figure 85, p. 175 - now referred to as the 'surface transitional' inclusion). The transitional inclusion changed into a technique that formed a further three dimensional component of the sandcast which will be called the '3D transitional' inclusion. Once more 3D transitional inclusions like the surface transitional inclusions could be used in component form and did not have to be placed in the mould whilst it was being poured. The 3D transitional inclusions were placed in the mould pre-casting giving the artist time to strategically place inclusion components, unlike the floating inclusion which must be placed in the sandcast in between pours whilst hot. The placement of floating inclusions must be achieved quickly and leaves room for failure, as there are several variables to consider. These variables include:

- Not enough/too much heat in the inclusion due to radiated heat from the hot furnace glass underneath and above.
- The time it takes the caster to make the next pour into the cast.
- Faulty placement of inclusion and accidental smearing or elongation of inclusion by caster.

As previously stated in section 4.2.1 (pp. 174-179) the transitional inclusion was an advantage in terms of:

- Larger cast size potential.
- Considered inclusion placement in terms of time .
- The scaling up of inclusions in terms of size.
- Use of inclusions as multiple components.
- No accidental smearing or elongation of flameworked components during casting.

Figure 95 Example of 3D transitional inclusion from the front (left) and the side (right). Heartless Barstard series 'RedMist', 2013 by J A Denton. Cast in sand mould with flameworked glass '3D transitional' inclusions; H. 45 cm, W. 24 cm, D. 7 cm, photography credit: Kevin Moonan

The work 'RedMist' (see figure 95 above) used the multiple '3D transitional' inclusion to create a spiky representation of a strong emotion. Although the theme of representation of strong emotions has been succinctly introduced on page172, it is further unpicked in sections 4.4.1-4.4.2 (pp. 197-201). The 3D transitional inclusion components for the artwork 'RedMist' were created from handmade colour cane which was made with clear glass on the inside, white *encased* over the top and a variety of transparent reds encasing the white. Encased cane was used for two reasons: Firstly the inside of the cane was made from clear furnace glass in order to even out the CoE differentials in the colour rod to give the encapsulations the best survival rate. Secondly an opaque and a transparent colour were used to give the inclusions a feeling of depth. A single transparent colour rod can disappear and a single opaque colour can look flat (see 3.5.2, pp. 150-148 & 4.2.1, pp. 174-175). This 'rule' was not always the case but this series of artworks worked best with a grounding opaque colour underneath and a transparent over the top to 'pop' the three dimensionality of the artwork.

The spikes were made on the end of a bead *mandrel* as it was difficult and time consuming to create the spikes freehand. There was an issue when extracting the spikes from a *holding rod*. The holding rod is made from *borosilicate* glass for strength – in a similar way a punty iron holds the hot furnace glass in the hot shop). If the glass spike got too cold it would crack off the borosilicate punty ruining the inclusion and this is why inclusions were made on the end of a mandrel. Also, when using a metal tool to hold the spike whilst it was still warm to get it off the punty, the spike could easily deform which meant it was unusable. As an alternative one could attach a soft glass punty onto the pointed part of the spike, but one risked breaking the spike when trying to melt away the soft glass punty after the inclusion was complete. Therefore in this case using a bead mandrel was the easiest and quickest way to create a large selection of different sized glass spikes.

If the spikes were placed too close together in the cast there was a possibility that the separate components would touch together accidentally during the casting process. If two separate pieces of glass touch together whilst hot and the join is not fully fused there is a high chance of cracking. Therefore the inclusions had to be placed in the sand mould carefully so as none of the individual pieces touched together when cold.

### 4.3.3 Themes of Heartless Barstard – Artwork series 2

This series of works began to explore more philosophical existential issues and was less representational comparatively speaking when compared with the 'Anima Mundi' series. Quoting from an exhibition catalogue about my supervisor Colin Rennie's artwork, I can draw similar parallels to the themes concerned with this research *'I want to create forms that are beautiful and deadly, symbolic and obscure, or allusive and defined'* .colin rennie p.6 (Rennie & Vanlatum, 2006, p. 6)

Figure 96 Heartless Barstard series 'Clever Monkey' 2016 by J A Denton. Displayed for exhibition at Zweisel Glastage ausstellung, Zweisel, Germany in 2016. Cast in sandmould with flameworked glass 'floating' inclusion and separate flameworked filigree apple; H. 45 cm, W. 24 cm, D. 7 cm, photography credit: Kevin Moonan

The artworks made as part of the 'Heartless Barstard' series used the freeform mould technique (see section 3.2.1, p. 98) which included a glass fist which bisected the chest area of each bust. The outer form of the glass cast became a vehicle for communication to the observer; this is in contrast to the outer form of the ‘Anima Mundi’ series which was used like a simple picture frame which added little to the narrative of the artwork. The ‘picture frame’ grounded the scene within so as the imagery inside the cast was the main focal point. The process of moving away from this picture frame style sandcast was touched upon in the ‘Anima Mundi’ series (see section 4.2.4, p. 185-187) and was developed further in this the ‘Heartless Barstard’ series.

The ‘Heartless Barstard’ (see figure 96, p. 192) artworks took their inspiration from the ancient Moai[34] figures which populate Chile’s Easter Island – It is a seminal head effigy or 'everyman' and recognisable by all. The theme of the work concerned the primitive part of mans nature, the violent side, the base component that does not want to show that 'he' is capable of 'feeling'. This idea was visualised using the fist motif emerging from the heart area. The heart within the body of the glass chest signifies that even with a hard exterior ‘everyman’ has a softer gentler side albeit buried deep. In an effort to understand how a masculine mind works this series of works endeavoured to visually represent the dualistic nature of violence. These works are strong in theme but they are not nihilistic.

In terms of the reasoning behind the concept one can ask what occurs when subconscious thought becomes conscious action - what is produced? Reactions to situations based on impulse and ‘heat of the moment’ consequently bring forth raw emotion. If acted upon this can end in a lack or loss of control over oneself. 'He's got a lot of heart…’ concerns raw internal emotions expressing themselves into the exterior world by way of the fist (see Figure 94, p. 188). Figure 95 (p. 190) suggests an explosive end culminating in actual physical violence or at least consequences associated with control loss.

In relation to the concept of the work including the shape of the cast itself, the sandcast was the physical part of the concept. The physical form of the sandcast was a recognisable image of a man and a fist. The encapsulation inside completing the narrative took the form of a heart and this heart alluded to a softness the hubristic

[34] Name given to statues made by the ancient people of Rapa Nui circa 1250 -1700 AD

‘Heartless Barstard’ figures endeavoured to hide and subdue so as not to ‘lose face’. The fist draws the attention of those onlookers directly connected to the situation, and it equally acts as a protection for the protagonist from being seen inwardly. Being seen inwardly refers to the protagonists own feelings and emotions This human animal (the protagonist) tries not to show emotion externally and it remains in the ‘hidden’ demesnes. The floating inclusion is the area in the concept of these artworks where emotion resides. The heart represents an emotional side of which the protagonist is aware but which is hidden from most other humans. The concept of ‘softer’ emotions could not be depicted as a realistic pulsating heart because this hidden concept resides in the ephemeral ‘floating’ inclusion zone. This emotion which the protagonist is aware of (conscious thought) should be measured in terms of something that is not tangible ergo the universally accepted symbol depicting the heart sufficed in this context. The physical sandcast which represents the façade we show the world and outward thought, is made from clear glass therefore the inner emotion depicted within the sandcast through the inclusions can be viewed from the anterior and the posterior of the artwork. This scenario gave the observer (voyeur) of the artwork a fuller understanding of what was happening in the narrative or was about to occur.

The spikes in figure 95 (p. 190) are an external representation of anger and therefore a total loss of control. This is symbolised primarily by the use of the colour red which in relation to colour theory (Eckstut, 2014, p. 32) is associated with energy, war, danger, strength, power, determination as well as passion, desire, and love. Anger can be both an internal emotion and anger can manifest externally. The specific placement of the 3D transitional inclusion spikes on the eyes of the bust formed a physical distortion of vision and encapsulated a dual metaphor: Blind with rage and sightless to what is occurring or to what has taken place. In retrospect the spikes in this piece should have been blue and green because this piece was not as concerned about external violence it was about the potential of it. This series was about creating a visual opportunity to see the goodness in a person when outwardly all appears to be negative. This is why on page 193 it was stated that these works were not designed to be nihilistic.

The sandcast artwork can be viewed in two ways: through the glossy glass surface at the 'back' (posterior), or directly through the sand surface on the 'front' (anterior). The two ways in which each cast can be viewed carry their own set of logical semantics concerning sense, implication, reference and presupposition (see section 5.4, p. 228). The metaphorical opportunities of the anterior of the sandcasts embrace subjects related to hooliganism, domestic violence, anxiety, personal boundaries and difference. The surface of the anterior was dry, dusty in appearance and rough thus obscuring the view inside the cast. In contrast to the obscured view of the anterior of the sandcast artwork the posterior surface automatically created a sense of depth and space due to the optical qualities of the material, thus giving the voyeur a clear window into the 'inner self'. These two differing views provided a deeper (authentic?!) experience of the artwork and the concepts encapsulated within.

### 4.3.4 Evaluation of Heartless Barstard – Artwork series 2

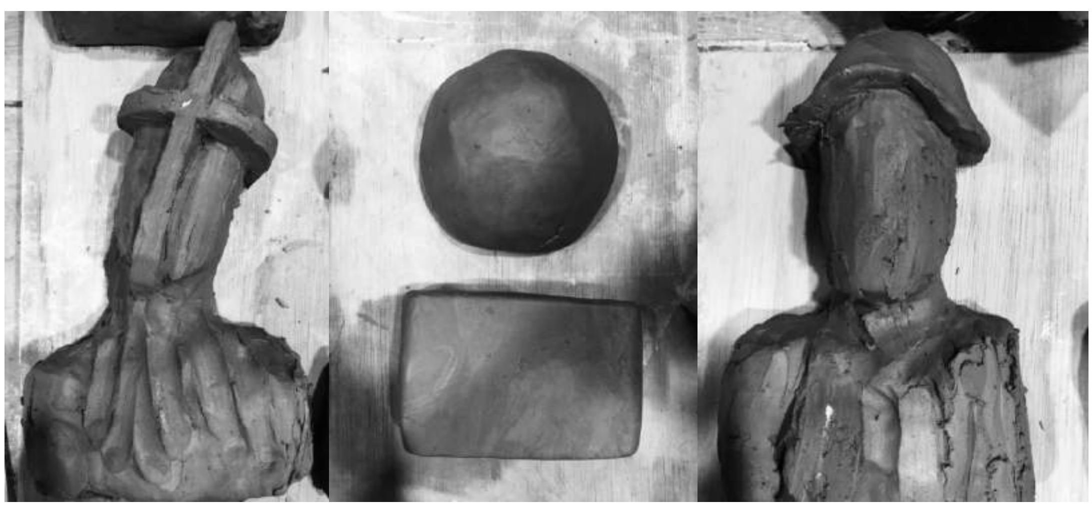

Figure 97 Selected clay maquettes brainstorming everyman theme, 2015, photography credit: J A Denton

These works were simple in terms of execution but the imagery made the artworks strong in terms of theme. As the well-known kilncaster Silva Levenson explains in

Neues Glas regarding her own work, *'I do not believe the more complex the technique, the better the result. I think that a good piece begins with a good idea. I don't like virtuosity in art. I love feelings, pathos, intuitions. Being a slave to technique is boring'* (2008, p. 42). I agree with this statement. The simplicity of the techniques in the Heartless Barstard series is noted throughout the case study.

Figure 98 Clay maquette being cast and finished sandcast maquette, 2015 300 x 200 x 50mm photography credit: J A Denton (left) & Kevin Moonan (right)

In terms of technique the floating heart encapsulated in every artwork which was producing bubbles from the crease was a technical problem. Once the paperweight technique of adding clear skimmed glass to the surface had been discovered and administered there were no further technical problems concerned with the whole series of artworks. However, the work 'RedMist' (see figure 95, p. 190) was challenging and needed to be cast on a number of occasions. The transitional inclusion spikes often touched each other in the cast and consequently the piece cracked after annealing. This problem was solved by very carefully placing the transitional inclusions in the sand mould so as they did not touch. More bentonite was also added to this mould mix to give the mould extra strength as the multiple inclusions often destroyed the sand mould through crumbling of the sand surface.

After some time I realised that the ‘head’ was not stylised enough and perhaps the Easter Island imagery was too obvious. Visual material was researched in terms of what type of style may be interesting. From this imagery, a series of clay maquettes (see figure 97, p. 195) were created to try to resolve this visual problem through the process of making. Some of the maquettes were further resolved in glass (see figure 98, p. 196). This was to gain an insight of their visual impact in glass and if they were more or less successful than the current ‘Easter island’ head. This line of enquiry was only developed as far as this stage and deserves further research at a later date which is evidenced in section 5.4 on page 228.

## 4.4 Heads - Case study 3

*This Case study draws together the multiple uses of the transitional inclusion and the floating inclusion. The theme of the work was a fusion between case studies 1 & 2. The imagery used and the form of the sandcast was abstract and ambiguous. The themes were complicated in terms of the role of each inclusion type and their relative placement.*

### 4.4.1 Themes of Heads – Artwork series 3

Key to the conceptual analysis of this series of artworks was the consideration of the inner and outer plains of the sandcast. How could the sandcast object act as a metaphor for the internal mind and the external persona as perceived by others? The floating inclusion type suggested temporary thoughts of the inner or subconscious mind. The transitional inclusion provided an opportunity for hidden emotion (conscious and subconscious) to be projected through the sandcast surface into the exterior world of the viewer. The sandcast form itself offered the physical presence which ‘everyone’ can see and relate to on an existential level.

Figure 99 Anima Mundi / Kindergarten series fuse ‘Head #1’, 2013 by J A Denton.. Cast in sand mould with flameworked glass ‘floating’ inclusion and metal foils; H. 40 cm, W. 30 cm, D. 15 cm. Artwork insitu at the Vitromusée, CH for 2015 glass festival exhibition, photography credit: Kevin Moonan

The ‘Heads’ series endeavoured to build upon four key narrative devices:

- The exterior inclusions on the anterior side of the cast (see figure 100, p. 200) and their visual ability to externalise an emotional state to a third party (the observer).

- The interior inclusion (see figure 99, p. 198) which was equally thematically important and acted as the space concerned with hidden emotions and subconscious thought of the protagonist, perceived only by the voyeur (the observer) through the posterior side of the sandcast artwork.
- The physical body of the sandcast which had a relationship with the inclusions. Thematically I wanted this body to act as a point of reference or grounding factor in a physical context, e.g., a head.
- The gesture (abstract or detailed) associated with both the inclusions and the physical mass of the sandcast which affected both the theme of the narrative and the overall aesthetic value of the artwork. Detail suggested a sense of clarity whereas abstraction could be interpreted in a variety of manners. In the case of the inclusions it represented thoughts/secrets/subconscious. In the case of the sandcast the simplification of the head utilised Plato's theory of Forms[35] to represent the essence of the thoughtful human animal.

The philosopher Daniel C. Dennett designed a taxonomy relevant to this research which originally referred to the social sciences. Dennet has concerned himself for a number of years with consciousness. He researches consciousness using a variety of sources which include psychology, artificial intelligence, mysticism and neuroscience. Through an investigation of the book 'Consciousness explained' (Dennet, 1991, p. 45) and a further investigation connected to the artworks of case studies 2 & 3, I endeavoured to utilise Dennet's phenomenological thought taxonomies. By focusing inclusion placement on the levels of consciousness of a human being the thematic line of enquiry steered the artworks in this case study into an abstract format. The abstracted inclusions were far removed from the narrative role flameworking plays traditionally (see section 1.1, p. 2).

From this point, observable or physical manifestations of consciousness in the themes of the sandcast artwork will be referred to as '**phenomenologial experience'**. Consciousness which is not directly accessible through observation will be referred to

[35] Every object has a quality in reality, but how can one object, e.g., a dog be many things in particular, i.e., a series of differing breeds. Therefore Plato's theory of Forms recognises a distinct singular form that can use plural representations of itself.

as **‘noumenal experience’.** This can be referenced in terms of the themes of this work in section 4.1 on page 172.

### 4.4.2 Representation of ephemeral emotion

Figure 100 Heads series ‘Emotion #1,’ 2016, by J A Denton. Cast in sand mould with flameworked glass ‘3D transitional’ inclusions; H. 60 cm, W. 30 cm, D. 8 cm. Artwork just out of the lehr after annealing, photography credit: J A Denton

Noumenal experiences are manifest inside the body of the sandcast using the flameworked inclusions especially in the context of this research the floating inclusion. As previously stated flameworking is often associated with fragility, detail and narrative, but flameworking does come in many forms. Take for instance Scientific lampworking or fibre optics. In these artworks both strength AND flexibility are embodied over fragility, detail and narrative. Theoretically the concepts of strength or fragility can refer to certain emotions. Emotions that encompass strength due to the power of the emotion, or strength due to the depth of it, are they the same thing? It is known that anger is a potent emotion - annoyed or irritated is weaker. If one is deeply irritated does that give this softer emotion strength due to its intensity or does it turn the emotion from irritation into anger? (Sargent, 2014) Arguably it depends on the potency and the emotional investment given to the irritation.

Depth of feeling suggests emotional investment and power of the emotion can be for one of two reasons: It is either something upsetting not only in the eyes of the individual but also wrong in the eyes of society at large, or it is something that upsets ones' own set of personal values. When irritation becomes so deep it morphs from one level of strength to the next it creates anger (Sargent, 2014) which is explosive and often unexpected/unintended. This denotes a loss of control. One example of a fragile emotion is pride and this could be represented using the floating inclusion technique as a delicate and abstract element trapped between glass strata. Further the depth at which an inclusion is trapped between glass strata can also denote where in the subconscious this 'emotion' is hidden, e.g., When the inclusion is closer to the posterior surface of the sandcast, it is buried deeper in the mind of the protagonist.

### 4.4.3 transitional inclusion

Filigree glass is made by joining thin rod together over and over again to form a matrix. This matrix looks like a web. After being formed on the torch this glass matrix was slumped in a kiln over a former. The former was the same shape (only a little smaller) as the mould used for making the concave impression in the sand (see figure 80, p. 161 for mould shape). Once the glass was slumped in the kiln, the finished piece was sandblasted and placed in the sand mould pre-casting ready to be heated and cast over. Once cast the sandblasted network on the surface of the sandcast looked similar to a net.

Figure 101 ‘Waveform vessel’, 2016, by J A Denton. Flameworked glass, slumped and sandblasted; H. 20 cm, W. 40 cm, D. 1 cm, photography credit: J A Denton

Both the surface transitional inclusion and the 3D transitional inclusion were in use for the ‘Heads’ artworks. The surface transitional inclusions used in this series were originally derived from current flameworked vessels developed through professional practice as a working artist. The filigree vessel design was used as a template for conscious thought during this research and the flameworked vessels developed through professional practice were shown at the Saatchi Gallery at ‘Collect 2017’ (see figure 101 above). This surface inclusion was originally based on the Fibonnaci sequence and utilised an age old flameworking technique called lace or filigree glass. In her PhD thesis Ayako Tani researches this flameworking technique thoroughly (2014). On the posterior side of the sandcast a semi-transparent layer was formed which caught tiny bubbles on the surface because the sandblasted surface was rough. The sandblasted surface once cast over created tiny air pockets which manifested as tiny bubbles across the glass matrix. In terms of theme this thin membranous layer represented the protective wall humans build to deter secret emotions and feelings from being divulged to other humans. This cold glass matrix acted as a metaphorical barrier and could be categorised under ‘**experience of constraint’** (see section 5.4, p. 229).

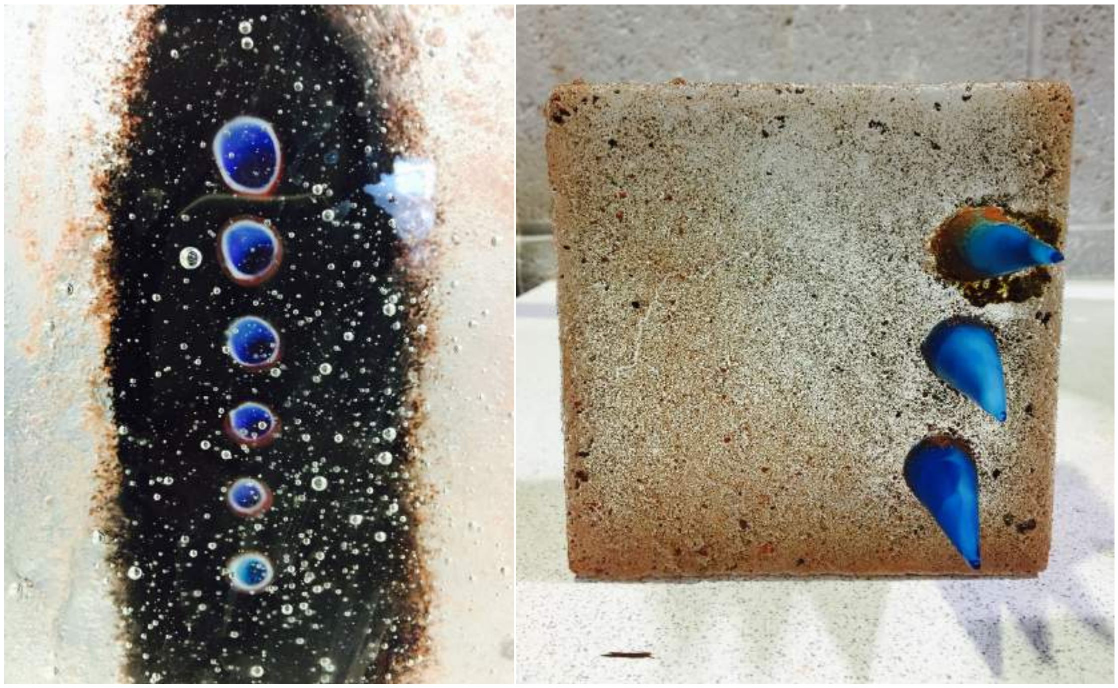

Figure 102 Examples of transitional inclusions: Left, viewed from the posterior (inside) side of the cast. Right, viewed from the anterior (outside) side, 2016, photography credit: J A Denton

The three dimensional transitional inclusion was thematically utilised in the ‘Heads’ series as a movement from unrealised thought to action. Using Dennet’s taxonomy this meant the transitional inclusion visually moved through nounmenal experience into phenomenological experience. In the physical sense this meant that the inclusion transited from the inside of the cast and further on through to the surface of the sandcast and beyond the outer layer into the physical world. In terms of technique these spike inclusions were not made on the end of a mandrel (see section 4.3.2, pp. 190-191) because thematically it was important that the inclusions could be viewed in full on both sides of the cast (see figure 102 above). Therefore these inclusions were painstakingly created on the end of a borosilicate *holding rod.* The inclusions were created using *skimmed* transparent glass in the middle of the inclusion[36], a transparent colour overlay, an opaque white overlay and finally a transparent colour encasing the entire inclusion. This created an inclusion with a different colour on the inside, e.g., red juxtaposed with the colour on the outside, e.g., blue. The white opaque served as a neutral grounding colour and stopped the transparent colours from mixing together.

Figure 103 Heads series 'Emotion #1', 2016 by J A Denton. Heads series 'Emotion #1,' 2016, by J A Denton. Detail of anterior side of sandcast. Cast in sand mould with flameworked glass '3D transitional' inclusions; H. 60 cm, W. 30 cm, D. 8 cm, photography credit: J A Denton

Once the spike had been made on the torch the spike end was puntied with a clear soft glass rod. The spike was then taken off the borosilicate glass punty and allowed to cool a little so as it could be held with a metal tool. If the inclusion wasn't cool enough the tool would make a mark on the glass due to it being too soft. The glass spike once

[36] once cast unskimmed glass inclusions make the viewing end of the spike dirty and cloudy due to small scratches on the outside of the flameworking rod creating tiny airbubbles once melted

removed from the borosilicate punty was then carefully heated to remove the final soft glass punty. There was not a 100% success rate as some of the spikes did break due to the excess heat used to extract the final soft glass punty.

If the clear glass was skimmed, once cool the inclusions were cleaned with alcohol and added to the sand mould with gloves. If not skimmed during the making process, the clear ends of the spikes were hand polished and inserted into the surface of the sandmould with clean gloves. Once cast this created a clear window with which to view the inner space of the spike inclusions (see figure 102 - left, p. 203). The anterior side of the sandcast artwork depicts the phenomenological experience of both the voyeur and the protagonist; this can be viewed in figure 103, p. 204.

### 4.4.4 floating inclusion

The floating inclusion was utilised in the most abstract of ways in this series of works as thematically it was used to represent noumenal experience. All inclusions were created with hand coloured *encased* cane which can be seen in figure 104 (p. 206) & figure 99 (p.198). Whilst encapsulating the floating inclusions into a sandcast there was a high chance of smearing (see section 4.2.1, pp. 176-178). This problematic variable could be further retarded by adding clear glass struts or structural scaffolding to hold the branches in place (see figure 80, p. 161 on left). The addition of clear scaffolding to inclusions to retard movement during casting developed specifically from paperweight inclusion techniques in accordance with question 2 which was to establish if *flameworked encapsulation techniques previously used in paperweight making could be applied to flameworked inclusion encapsulations in the sandcasting process*. As the scaffolding technique became more involved and the sandcasts became larger and larger (up to 50cm x 30cm as seen in figure 85, p.175) it became clear that in their entirety these helpful techniques needed further development (see section 5, p. 218 & p. 227)


Figure 104 Head series 'Head #2', 2015 by J A Denton. Poster advertising group show at the White House Cone glass museum to celebrate the re-opening of the building. Cast in sand mould with flameworked glass ‘floating’ inclusion and metal foils; H. 40 cm, W. 30 cm, D. 15 cm, photography: Simon Bruntnell

### 4.4.5 Evaluation of Heads – Artwork series 3

The early heads utilising the floating inclusion technique were what inspired the development of the transitional inclusion. These heads motivated the development of the transitional inclusion because the tree forms which made up the central focus of the sandcast broke (see figure 39, p. 89) whilst being added to the sandcast on more than one occasion. The trees broke because the hot inclusions were chilled too much by being placed in the cast with a cold tool. A broken inclusion was not necessarily a mistake in reference to the theme or look of the finished artwork but it was not intended. Therefore an alternative needed to be found and this came in the form of the transitional inclusion (see sections 3.6.2-0, pp. 162-166) and its computation possibilities which were the surface and three dimensional transitional inclusions.

Figure 105 JA Denton Heads series 'Head #1' 2015, 600 x 350 x 100mm photography credit: Kevin Moonan

At the beginning of the research period whilst creating the heads I decided they would be displayed on a stand. This could have been interesting and desirable but after working with a blacksmith it became clear that my vision and their skills were not in unison and the envisaged steel stand looked clunky and primitive (see figure 105 above).

## 4.5 Summary of chapter 4

The first two themes of the case studies appeared to be wildly different, but somehow became fused in the final case study 3. In this case study elements from both the earlier studies were included in the final artworks. These artworks were based on phenomenological (physical) and noumenal (secret/hidden) experience. Question 3 which concerned *how might the relative placement of an inclusion change the narrative or the meaning of the conceptual content within the sandcast space* was satisfactorily answered in this chapter.

To sum up, the floating inclusion provided the opportunity to suspend artefacts of glass or copper within the cast body giving a sense of floatation or stasis. Objects held within the glass were inaccessible to touch and preserved within a clear impermeable solid mass. These qualities contrasted with the exterior surface of the sandcast which was rough and textured creating a visual and physical contrast.

The transitional inclusions sought to penetrate the sand surface of a cast. This penetration through a variety of sizes and thicknesses gave the possibility to significantly change the look and meaning of an artwork. To give two examples, an inclusion which barely broke the surface (see figure 3, p. 5 & figure 85, p. 175) created a work which when viewed was understood in a two dimensional context like an illustration. Contrarily by adding an inclusion so it protruded through the surface of the cast (see figure 102, p. 203) created projections which pierced the surface to such a degree that they changed the inclusion from two to three dimensions. This allowed the work to be apprehended in a new context both as a physical object and as a narrative tool.

Artworks utilising the 3D transitional inclusion developed at a turning point in the style of the artworks. This new work with a new inclusion type leant toward the abstract. Here I was faced with a decision concerning which aesthetic direction should be taken. As was asserted in section 1.1 (p. 2) that the trade of flameworking is associated with detail. This was the visual expectation of my maestro Emilio Santini, and that view was compounded by what I had observed of the field over my 20 year career. It was challenging to move away from everything one has known. To take an unexpected new path. I became captivated with the abstract sandcasts, although they sat in the studio for two years before I could appreciate their simple beauty; but such a major move away from my previous work filled me with apprehension.

Concerning methodology and the consideration of concept - In terms of this research and research in general for the creative practitioner; there are periods of making which are reflected on before execution. During this time deviation is inevitable. However this observation of results and consequent reflection is very important afterwards in order to organise what was important and what was deviation. This reflection on practice must be exercised on a regular basis in order to find ones concept and actively steer the artworks created in that direction. This reflection creates a technical and conceptual path which ultimately should become rather specific - forming and informing. If an artist cannot reflect or begin to specify and make decisions, then their path widens. This creates a modernist problem - That of too much choice. Arguably one cannot become a master if one chooses too many differing directions. An artist with a non-specific path is in danger of spreading themselves too thin and achieving little or nothing. Picasso was a driven artist and he said *'Our goals can only be reached through a vehicle of a plan, in which we must fervently believe, and upon which we must vigorously act. There is no other route to success.'* (2017)

It became clear that my work could not be viewed in the same way as Paul Stankard – A microcosmic pictoral narrative. The opportunity to place the sandcasts in context of their surroundings was not available during this research period, so the work is unlike that of Bertil Vallien. Therefore, as an artist working with sandcasting and flameworking as this point in the research my work can be likened to that of Steffen Dam – It uses the imagery within and the contextual physicality of the sandcast form to convey its message. In conclusion the successful completition of aim 3 to *produce a body of artworks in glass that develop and demonstrate the potential of incorporating flameworked glass components into sandcast glass forms from one artist's perspective as a critical study which others may adapt and build on in the future* was achieved.

# 5 Conclusions and areas for further study

*This concluding chapter establishes the contribution to new knowledge ascertained through a list of accepted definitions of originality. Conclusions are drawn in reference to the set questions laid out in chapter 1 of this thesis. The conclusions from each chapter of the research thesis are restated and areas for further research are suggested.*

## 5.1 Definitions of originality

This list of 18 definitions of originality was first defined by E.M. Philips at a conference in 1992. These definitions were derived from her own studies of supervisors and students. There were 21 definitions at that time. Since then the book 'Visualising research' (Gray & Malins, 2004, p. appendix 3) has condensed the list down to 18 distinct definitions of the originality of a thesis:

1 Saying something nobody has said before.

2 Carrying out empirical work that has not been done before.

3 Making a synthesis of things that have not been put together before.

4 Making a new interpretation of someone else's material or ideas.

5 Trying out something in this country that has previously been done only elsewhere.

6 Taking a new technique and applying it to a new area.

7 Being cross-disciplinary and using different methodologies.

8 Looking at topics that people in my discipline have not looked at before.

9 Adding to knowledge in a way that has not been done before.

10 Testing existing knowledge in an original way.

11 Writing down a new piece of information for the first time.

12 Giving a good exposition of another's idea.

13 Continuing a previously original piece of work.

14 Carrying out original work designed by the supervisor.

15 Providing a single original technique, observation or result in an otherwise unoriginal but competent piece of research.

16 Having followed instructions and understood the original concepts.

17 Having many original ideas, methods and interpretations all performed by others under the direction of the postgraduate.

18 Bringing new evidence to bear on an old issue.

Using the above list as an approach to gauge the contribution to new knowledge this research offers, five potential new routes to originality which are clearly defined and read as follows:

- The first route refers to definition 2 which was to *carry out empirical work that has not been done before.* This was achieved by researching and developing two glass techniques, namely flameworking combined with sandcasting. The combination of these techniques has never been academically researched previous to the publication of this thesis.
- The second route refers to definition 3 to *make a synthesis of things that have not been put together before*. As previously stated the combination of sandcasting and flameworking is little used due to the high breakage rate of casts and smearing of inclusions. This research has devised a number of ways to achieve consistent and repeatable results in the combination of sandcasting with flameworked inclusions. Please refer to the breakdown of question 1 in section 5.3, pp. 216-220 for further details regarding how this was achieved.

- The third route to new knowledge refers to definition 4 and concerns *making a new interpretation of someone else's material or ideas*. The starting point of the technical investigation utilised a technique devised by José Chardiet and developed into the transitional inclusion technique. Later in the technical enquiry paperweight techniques used by Paul Stankard were adjusted to suit this research and tested for use with both the transitional and the floating inclusion. Concept, sandcast type and presentation ideas from Vallien, Dam and Stankard were critiqued in section 2.11 (pp. 76-85) in order to gain a deeper understanding of what drives these artists work and why the work is successful. Some of the ideas analysed as part of this critique were tested mainly in sections 4.2-4.2.4 (pp. 174-187) and were summed up in the conclusion section of chapter 4 (pp. 208-209).
- The fourth route to new knowledge refers to definition 8 and considers *looking at topics that people in my discipline have not looked at before*. Topics that peers have not researched previously in this context can refer to both the technical investigation into the combination of sandcasting with flameworked inclusions and the endeavour in chapter 4 to define and synthesize the conceptual space of the cast glass object. Conceptual space refers to the use of the sandcast body in unison with the flameworked inclusions in case studies 2 and 3 in chapter 4 (pp. 187-206).
- The final route to new knowledge refers to definition 11 and concerns the *writing down of a new piece of information for the first time*. This new combination of glass techniques has never been researched academically previous to this publication. Plus, the theoretical critique concerning the conceptual space and the relationships between the sandcast and the flameworked inclusion has not previously been defined.

I am confident by using these five definitions of originality that this investigation does make a new contribution to academic knowledge.

## 5.2 Abridged summaries from each chapter

**Chapter 1**

In conclusion this research has been undertaken because sandcasting with flameworked inclusions has not been previously researched in academia. I felt that this research could contribute to the glass art field and the industrial area of architectural glass. The questions, aims and objectives clearly state in which direction this research should move forward. The anticipated direction was to investigate other artists who have been using paperweight techniques or hot encapsulation techniques with casting.

Chapter 1 establishes for what purpose this research has been undertaken and gives a concise overview of each of the techniques which are to be combined. A suitable methodology was considered in terms of necessity to the investigation and applicability during this type of practical research. A short philosophical discussion was also engaged in to define the need for academic research into the arts and the precise nature of tacit knowledge and its importance to practice-led[37] research.

**Chapter 2**

After creating a contextual review in accordance with aim 1 it became clear that the artists who rely heavily on ‘play’ and ‘chance’ are producing work which is arguably celebrated on a more localised level. The artists whose work dictates a higher degree of precision are bolstered to a higher level of recognition. This precision is quantifiable in several ways including in the polishing process, the use of inclusions, or the tight manner in which it is displayed. This higher level of recognition could perhaps simply be due to a perceivable technical mastery of their process.

Chapter 2 indicates through the surveys (pp. 35-42) that flameworking is a popular technique soon to become a major player in the glass art field. It also indicates that the

[37] Practice-led research leads primarily to new understandings about practice, whereas practice-based research relies on the creative artefact as the basis of the contribution to new knowledge.

combination of sandcasting and flameworking for at least the last 20 years is not common. The inclusions in sandcasts are mostly hot formed and often painted. Flameworked inclusions are only in standard use in the field of paperweights. The supposition derived from this chapter is that there is a technical need for this research.

Furthermore, it appears that results derived from the journal reviews indicate that sandcast objects are rarely successful in terms of popularity. This conclusion is derived from the lack of representation of sandcast objects in the journals Neues Glas and New Glass Review. Similarly, the paperweight is also sporadically included in these journals. One can arguably conclude that this is due to the traditional constraints the paperweight must so strictly adhere to. Few paperweights transcend their craft object origins into an artwork which moves beyond its inherent usefulness.

**Chapter 3**

This research which is concerned with the encapsulation of flameworked forms into a larger sandcast mass has been approached primarily from a practical artistic perspective. The research provides insights which further develop and advance the use of detailed inclusions within a larger sandcast form for artists and small studio production facilities. Further applications of these new techniques include their transferable use in glass industrial design within the field of architecture (interior and exterior), and to enhance the individual artists' palette. The application of this research is mainly for artists wishing to create detailed scenarios in a larger glass body which are not fragile.

The originality of the transitional inclusion techniques innovates the encapsulation process in sandcasting. The transitional inclusion techniques give the artist working in glass complete control when adding flameworked inclusions into a sandcast form. Precision placement, retarding of smears/elongation can be achieved without serendipitous error using the new transitional inclusion techniques. Controlled results form a new potential for the creation of large scale sculpture incorporating detailed inclusions in component form.

The second inclusion technique which is a contribution to new knowledge is the 'partial' inclusion. This technique negates the need of the artist to source compatible inclusion glass which fits with the furnace batch glass, unless the mandrel is covered with glass pre-casting to form an inclusion to hide the unsightly cavity left by the mandrel (see figure 67, p. 141 & section 5.4, p. 227) and compliment the theme of the overall artwork. This inclusion technique allows the inclusion to burst through the surface of the sandcast without fear of breakage during or after casting allowing for unconstrained creativity if wished. This inclusion type can be separated from the sandcast artwork at any point for security. Should the artwork need to travel for further dissemination the component parts can be divided and shipped securely. The artist is furthermore not restricted to sourcing glass compatible with their own furnace batch which is a saving of time, effort and money.

This research forms the basis of a series of techniques initially conceived of using known methods in other glass fields such as paperweight creation and sandcasting with hot glass inclusions. These methods have been tested, developed and improved upon to create new inclusion techniques. The new techniques discovered in this research adhere to the controls set by question 1. The testing period in chapter 3 was led, reflected upon and developed further by the creation of a series of artworks engaged in to compliment this research.

**Chapter 4**

To sum up, the floating inclusion provided the opportunity to suspend artefacts of glass or copper within the cast body giving a sense of floatation or stasis. Objects held within the glass were inaccessible to touch and preserved within a clear impermeable solid mass. These qualities contrasted with the exterior surface of the sandcast which was rough and textured creating a visual and physical contrast.

The transitional inclusions sought to penetrate the sand surface of a cast. This penetration through a variety of sizes and thicknesses gave the possibility to significantly change the look and meaning of an artwork. To give two examples, an inclusion which barely broke the surface (see figure 3, p. 5 & figure 85, p. 175) created a work which when viewed was understood in a two dimensional context arguably similar to an illustration. Contrarily by adding an inclusion so it protruded through the surface of the cast (see figure 102, p. 203) created projections which pierced the surface to such a degree that they changed the inclusion from two to three dimensions. This allowed the work to be apprehended in a new context both as a physical object and as a narrative tool.

Artworks utilising the 3D transitional inclusion fashioned a turning point in the style of the artwork. This new work with a new inclusion type leant toward the abstract. Here I was faced with a decision concerning which aesthetic direction should be taken. As was asserted in section 1.1 (p. 2) the trade of flameworking is associated with detail. This was the visual expectation of my maestro Emilio Santini, and that view was compounded by what I had observed of the field over my 20 year career. It was challenging to move away from everything one has known to take an unexpected new path.

It became clear that my work could not be viewed in the same way as Paul Stankard – A microcosmic pictorial narrative. The opportunity to place the sandcasts in context of their surroundings was not available during this research period, so the work is unlike that of Bertil Vallien. Therefore, as an artist working with sandcasting and flameworking at this point in the research my work can be likened to that of Steffen Dam – It uses the imagery within and the contextual physicality of the sandcast form to convey its message. In conclusion the successful completion of aim 3 was achieved.

## 5.3 Synthesis of conclusions derived from this research

There were three key questions set out in section 1.3.1 were intended to lead this research investigation into the combination of sandcasting with flameworked inclusions. The questions have been addressed and evidenced throughout this thesis within the context of the wider glass art community. Below is a succinct synopsis of precisely how these questions were addressed and answered:

**Question 1- Can flameworked glass encapsulations be applied to the sandcasting process, what are the problems associated with the application of these techniques and how may they be controlled to achieve consistent repeatable results?**

Question one was addressed mainly in chapters 3 & 4. Initially relevant techniques assimilated from the contextual review in chapter 2 and common materials used whilst creating sandcasts were examined and tested in phase 1 (pp. 93-121) of the technical investigation in chapter 3. The purpose of these experiments was to ascertain which areas gave potential for new creative work. The initial tests highlighted common problems associated with the encapsulation of flameworked components into a larger glass mass. The main technical problems are listed below:

- Compatibility issues between the furnace batch glass and the encapsulation glass. This was caused by differing properties in the glass centring on CoE and viscosity differentials.
- Distortion or breakage before, during and after annealing.
- Accidental movement, smearing or elongation of flameworked components during casting. This was due to accidental misplacement whilst adding the inclusion to a hot cast or overheating of flameworked components whilst the molten glass was ladled onto the cast and inclusion surface.

In phase 2 (pp. 121-131) of chapter 3 the criterion for testing refined as applications in phase 1 were either resolved, worth further exploration or dismissed. It was necessary to test specific techniques developed by key artists examined in the contextual review (see José Chardiet 2.6.1pp. 59-61 & Paul Stankard 2.10.1, pp. 71-76). As this research was an unexplored area (especially in academia) none of the chosen artist’s techniques were directly related to combining sandcasting with flameworked inclusions. Artist's techniques were adapted to suit this research.

The adaptation of artists techniques led to four discoveries. The first discovery and one of the routes to new knowledge was the surface and 3D transitional inclusion. This new inclusion type was developed from José Chardiet's preheated mould technique and involved placement of cold inclusions in a cold mould which was later pre-heated and cast over with molten glass. Using this method, flameworked inclusions could be pressed into the sand mould cold and after preheating the inclusions could not move anywhere accidentally when casting as the sand mould acted as an anchor to the inclusions. The transitional inclusion technique gave complete control over the end result and became a breakthrough in the process because of the high success rate of casts. The use of a preheated mould led to further benefits which included the correct placement of inclusions without mishap plus the preheated mould allowed for the increase of flameworked components inside a cast and their complexity in component form. Consequently the proportions of the sandcast could be scaled-up because the multiple flameworked elements created larger inclusions without the risk of breakage or accidental misplacement during the making process. Using a preheated mould changed the nature of how the cast appeared when completed in comparison to how a cast looked with components sandwiched in-between layers. This was not a deviation from the brief and by using this method casts could be created which yielded consistent AND repeatable results.

The second discovery was adding skimmed clear glass struts to floating inclusions pre-casting. I would not call the addition of struts to a floating inclusion a route to new knowledge but I would impress that with the small amount of research time dedicated to this technique it did help to yield consistent repeatable results in reference to the floating inclusion. This scaffolding technique protected any thin delicate elements such as tree branches from elongating when cast over with hot furnace glass. This technique developed specifically from paperweight inclusion techniques developed from the artwork of Paul Stankard.

The third discovery which was a route to new knowledge and answered the second aspect of question 1 was the development of the partial inclusion technique. In relation to the 3D transitional inclusion which protruded out of the surface of the sandcast it became clear that these inclusions could be easily damaged. Should inclusions protrude too extensively from the sandcast surface or be too detailed and fragile they would be in danger of breaking away from the main body of glass. The alternative to counteract 'transitional' inclusions which broke after casting stemmed from a discovery concerning the usage of bead *mandrels*. Originally mandrels were used to create voids inside the sandcast to allow for the insertion of metal bolts after casting to mount and display the artwork. During phase 4 of the research in chapter 3 the partial inclusion technique was developed further. The technique consisted of a separate glass element which fitted into the surface of the sandcast using a glass post, similar to a *dowel joint* in carpentry. This technique bypassed the material constraints of joining transitional elements in a hot form and once more increased the size potential of a cast should there be a need. The partial inclusion transcended the need to find compatible glass with the furnace batch. Dispensing with the need to find compatible glass was a simple innovation but it allowed for the creation of very detailed inclusions. These inclusions could be taken out of the sandcast body at will and therefore exponentially reduced the possibility of breakage during transportation for dissemination purposes.

The development of these lines of enquiry allowed the flameworker full control of inclusion placement and stopped the inclusions from being smeared due to overheating, misplaced during casting and also negated the need to find a compatible inclusion glass. The final discovery concerned alternative methods when a compatible inclusion glass simply could not be sourced. These alternatives were researched because it was important that this research should apply to the whole glass community and it is not always possible to source a compatible furnace glass. The resultant findings discovered in chapter 3 gave ample alternatives in terms of inclusion possibilities. The alternatives involved using the 'designated' clear furnace glass pulled into rod form. This rod could then be flameworked on the torch and combined with powders in a hot process or with high fire enamels (akin to Vallien) in a cold process.

Similarly clear flameworked inclusions (furnace batch glass) could be sandblasted to create a ghostly veil perceivable to the naked eye after casting.

These four developmental lines of enquiry fully answered research question one.

**Question 2 - Can flameworked encapsulation techniques previously used in paperweight making be applied to flameworked inclusion encapsulations in the sandcasting process?**

This question was dealt with mainly in technical chapter 3. Paperweight inclusion techniques were utilised in unison with the floating inclusion and the transitional inclusion. The transitional inclusion used paperweight techniques in two ways. The first technique derived from paperweight making was the use of inclusions in element form (see figure 85, p. 175). Using inclusions in element form was inspired by Paul Stankard's method of creating elements for his paperweight flower scenes (See section 2.10.1, pp. 71-76). Therefore not only could soft glass flameworked inclusions be embedded in the sand surface retarding movement and blurring, but inclusions could also be created in component form to create a larger focal area in the cast. Making inclusions in element form greatly increased the size potential of the inclusions, as one cannot make a single inclusion over 25 cm long (approximately) before it begins to become difficult to work on without cracking. Consequently and if desired the size of the sandcast could be increased exponentially depending on the size of the lehr. The work was no longer reliant on a single inclusion dictating the size of the cast.

The second technique derived from paperweight making which refers to the transitional inclusion was regarding the skimming of any clear glass inclusions (see section 2.10.1, p. 74). Skimming is the technique of taking off the outer layer of glass when the clear *gather* is hot. Skimming is concerned with the clarity of the transparent inclusion and is a paperweight maker's technique for dealing with dirt that permeates the surface of the raw material – The glass rod. This 'dirt' takes the form of small abrasions and dust collected on the glass rod. Skimming clear glass is necessary because these abrasions and dust have a detrimental effect on the surface of the rod once heated. If left unchecked the surface of the clear glass becomes blistered. Once the inclusion is made the blistering caused by contamination from surface scratches looks like a milky mist covering the surface of the inclusion (see figure 75, p. 152). The paperweight maker deals with this problem by *skimming* the surface of the glass rod/glass mass before adding it to the inclusion or encapsulating the inclusion within it (see section 2.10.1, pp. 71-76). The paperweight maker does this because no amount of cleaning clear glass with alcohol will take away a scratch on the surface. Therefore to avoid blistering the clear space in the glass inclusion, the inclusion is skimmed revealing optically clear glass underneath.

A series of tests were undertaken to ascertain whether skimmed inclusions were actually necessary to the visual aesthetic and theme of the sandcast artworks. The results from the tests revealed that polished inclusions and skimmed inclusions were equally successful visually and thematically, whereas the inclusion which was only cleaned with alcohol and had not been skimmed still had misting and bubbles which could be seen once encapsulated within the sandcast body. Therefore in the context of this research, flameworked inclusions utilising clear glass on the outer surface of the inclusions must be made with skimmed clear glass. For further optical clarity the inclusions could be highly polished and cleaned before hot encapsulation in the sandcast.

The floating inclusion technique equally used paperweight making techniques in regard to the accidental stretching or smearing of inclusions when cast over or to avoid trapping unwanted air bubbles. This was achieved also in two ways. The first paperweight technique in use was through the research in the ‘Heartless Barstard’ series. In this simple yet strong series a floating heart inclusion was a consistent part of the narrative of these artworks. The heart insert did not have any thin glass protrusions coming out of the body of the inclusion and was not liable to elongate during casting. The inclusion which was always hidden behind a glass fist was a stable mass. The only problem area was the crease at the top of the heart. This crease would catch unwanted air bubbles (see section 3.5, p. 138). Therefore Paul Stankard’s paperweight techniques (see section 2.10.1, pp. 71-76) were put into use for a successful artwork to be created. The crease created in the heart encapsulation was covered with skimmed clear furnace glass. The clear glass overlay negated the potential of air bubbles forming and being trapped in the crease during casting. Further, because the glass was *skimmed* it was not apparent to the naked eye that extra glass had been added to the heart when being viewed in the finished sandcast thus achieving a *Trompe l'oeile* effect.

The second and final way paperweight techniques were utilized to create more successful flameworked inclusions inside the body of a sandcast glass mass was with the use of skimmed transparent struts or scaffolding (see figure 80, p. 161). Inclusions made with clear glass struts kept delicate inclusion components from deforming whilst being cast. This technique retarded thin glass components from elongating and smearing whilst hot furnace glass was being poured over them. Plus these struts disappeared into the body of the cast so the viewer was unable to see them once the cast had cooled. The scaffolding technique gave the artist further control over an often accident prone technique when using detailed or thin floating inclusions.

In conclusion the techniques transferred from paperweight making helped to make the process of combining flameworking with sandcasting more controllable and satisfied the investigation concerning question 2 of this research.

**Question 3 - How might the relative placement of an inclusion change the narrative or the meaning of the conceptual content within the sandcast space?**

This third question was less tangible and I feel that I barely started to research this subject, as there was so much scope for further development. Development of this question is an area for further study and will be discussed in section 5.4 (pp. 225-229 Question 3 was focused on in chapter 4 but was related to section 2.11 (pp. 76-79) which analysed the processes and themes of three contextual review artists. The case studies in chapter 4 were where this thematic investigation took place.

Key to the conceptual analysis of this series of artworks was the consideration of the inner and outer plains of the sandcast. How could the sandcast object act as a metaphor for the internal mind and the external persona as perceived by others? The floating inclusion type suggested temporary thoughts of the inner or subconscious mind. The transitional inclusion provided an opportunity for hidden emotion (conscious and subconscious) to be projected through the sandcast surface into the exterior world of the viewer. The sandcast form itself offered the physical presence, which 'everyone' can see and relate to on an existential level.

The 'Heads' series endeavoured to build upon four key narrative devices:

- The exterior inclusions (see figure 100, p. 200) visual ability to externalise an emotional state to a third party (the observer).

- The interior inclusion (see figure 99, p. 198) which was equally thematically important and acted as the space concerned with hidden emotions and subconscious thought of the protagonist (the sandcast form), perceived only by the observer through the posterior side of the sandcast artwork.

- The physical body of the sandcast which had a relationship with the inclusions. Thematically I wanted this body to act as a point of reference or grounding factor in a physical context, e.g., a head.

- The gesture (abstract or detailed) associated with both the inclusions and the physical mass of the sandcast which affected both the theme of the narrative and the overall aesthetic value of the artwork.

The first two themes of the case studies appeared to be different, but became fused in the final case study 3. In this case study elements from both the earlier studies were included in the final artworks. These artworks were based on phenomenological (physical) and noumenal (secret/hidden) experience which are terms coined by Daniel C. Dennet (Consciousness Explained, 1991, p. 45). The artworks were concerned with the visual representation of human emotions, especially when emotions conflict with each other - The face that man shows the world, the feelings hidden within them and finally the subconscious emotions man has no control over. By using inclusions inside the body of a clear sandcast, not only could the viewer see the outward 'face' of the work, but they could also view what lay behind the façade through the transparent clear layers behind.

I do not feel that question 3 was developed enough to become a contribution to new knowledge but perhaps in the future further research time may be given to this subject. On a philosophical level the chance to create a visual language exclusively concerned with the placement of inclusions within hot cast forms was interesting and potentially important. It has the potential to become an important visual and philosophical contribution to current scientific exploration into consciousness and is worth further exploration.

To sum up, three inclusion types were developed, tested and reviewed during this research period. The inclusion which had already been developed but proved problematic when used in combination with sandcasting was the floating inclusion. The placement of floating inclusions needed to be achieved quickly and left room for failure, as there were several variables to consider. These variables included:

- Not enough/too much heat in the inclusion due to radiated heat from the hot furnace glass underneath and from above.
- The time it takes the caster to make the next pour in the cast.
- Faulty placement of inclusion by the artist and accidental smearing or elongation of inclusion by the caster.

The inclusion techniques which were developed and became this researches contribution to new knowledge were the transitional inclusion and the partial inclusion. The transitional inclusion was a contribution to new knowledge because:

- Larger cast size potential.
- Considered inclusion placement in terms of time.
- The scaling up of inclusions in terms of size.
- Use of inclusions as multiples components.

- No accidental smearing or elongation of flameworked components during casting.

The partial inclusion was a contribution to new knowledge because:

- Negated the necessity of finding a glass that would *fit* the furnace glass.

- Greater freedom and flexibility both during making and in terms of transportation logistics.

This research has allowed me to produce an in-depth investigation into new technique types combining the successful combination of flameworking and sandcasting. The technical research I am confident makes a contribution to new knowledge. I have drawn conclusions derived from three questions which drove the research concerning the technical combination of flameworking with sandcasting and I have produced a new and original body of practice based research.

## 5.4 Reflective summary and areas for further study

This research has raised several areas worth further academic investigation. The main areas are listed below and explained:

- Chance art
- Sandblasted inclusions
- Bicarbonate of soda effect
- Scaffolding technique and the floating inclusion
- ‘Heartless Barstard’ cast shape
- Logical semantics
- Taxonomy of the definitions of consciousness

The ‘chance art’ aspect of this research was touched upon in section 3.3.3 (p. 129) and remained mostly undeveloped. During this component of the research an initial test (figure 58, p. 128) using Jose Chardiet’s heating mould technique was conducted. The sandblasted ‘oghams’ placed at the sides of the ‘night cast’ sandcast test fell into the mould after the first gather of glass was ladled into the mould. This collapse of the inclusions was due to the intensity of the heat from the freshly ladled pour, but fortuitously the sandblasted inclusions acquired a new ephemeral ‘chance art’ quality which was worth further exploration.

What was interesting about ‘chance art’ was the sandblasted furnace glass inclusions were allowed to move of their own accord. Glass as a process is often engaged in with a firm idea of how the end product should appear. Arguably this is glass mastery at it’s finest but this can also encourage artistic ennui. It was essential to this research to create tests which yielded consistent and repeatable results and this was achieved in this research period.However after achieving constistent and repeatable results the next stage of development would take a chance art approach. In future research accidental happenstance in terms of the inclusions would be encouraged. The new visual qualities derived from a chance art approach could be  developed further through interesting new themes in the work and extend the expressive possibilities of sandcasting with flameworked inclusions.

Sandcasting with sandblasted furnace glass was also an area worth further exploration because the inclusions created using sandblasted furnace glass were both subtle and visually interesting. Further, there was no need to source a compatible glass with this type of inclusion. Not having to source glass compatible with the furnace meant that virtually all the research time could be spent on exploring the visual possibilities this technique had to offer. Equally the use of bicarbonate of soda explored in section 3.3.2 (pp. 126-131) created a number of small bubbles on the surface of the inclusion in a similar way to sandblasting. Sometimes the pressure of the sandblaster is too much for delicate flameworked inclusions and they can break. With further development the use of bicarbonate in unison with sandblasting could be a highly effective series of inclusion techniques visually.

There were two inclusion types which could have been developed further. The first was the floating inclusion and the main problem with this type of inclusion was that the inclusions often smeared or elongated during casting. This accidental and unwanted movement occurred during pouring. Elongation and smearing can be avoided but this is in the control of the caster. The caster must first cast around inclusions which are placed in the cast and then pour over the top of them. The artist is not always in control of this aspect of the creation of artworks and often the caster will cast directly on top of the inclusions which cause them to smear and elongate. Therefore alternative methods were developed to retard the inclusions from moving when cast over. The alternative method to retard unwanted movement in inclusions was developed from paperweight making techniques and involves the use of clear skimmed glass scaffolding (see section 5.3, p. 222). The transparent scaffolding held any fragile components in place and disappeared from sight once the cast was made because it was made from clear clean compatible glass. As the process became more involved and the sandcasts became larger and larger, up to 60cm x 30cm as seen in figure 85 (p.175), it became clear that this technique had a lot of potential and floating inclusions could equally be scaled up. During the research testing period the floating inclusion and the techniques associated with it were not considered a route to new knowledge. The techniques designed to complement the floating inclusion could have been developed much further and would form a complicated and interesting area for further study.

The second inclusion type which deserved further study was the partial inclusion because by the end of the research period this inclusion had only just started to develop. During the research this inclusion was developed to create holes in the sandcast surface to add further inclusions to the outer surface of the sandcast in any type of glass (see figure 78, p. 158). Towards to end of the research paperweight techniques were developed further and the mandrel was utilised inside the sandcast form with glass on it which was cast over. This glass insert took the form of roots for trees as can be seen in figure 67, p. 141. Adding glass to the mandrel both to hide the mandrel made hole and to add further glass detail to the inner and outer scenario was an exciting development in harmony with the overall asthetic of the work and deserved further exploration in terms of form, its detail potential and the possibilities this glass inclusion had to offer the overall artworks.

The ‘Heartless Barstard’ series deserved further development in terms of the shape of the cast itself. It was felt later in the research period that the imagery used for this series may be too ’obvious’ and could be further developed in a series of different ways. Visual material was researched in terms of what type of style may be appropriate. From this imagery a series of clay maquette's (see figure 97, p. 195) were created to try to resolve the visual problem of the heads through the process of making. Some of the maquette’s were further resolved in glass (see figure 98, p. 196). This was to gain an insight of their visual impact in glass and if they were more or less successful than the current ‘Easter island’ heads. During the research period there was no time to develop the form of the bust. This theme was strong and deserves further exploration in the future.

In terms of narrative the first two themes in case studies ‘Anima Mundi’ and ‘Heartless Barstard’ appeared to be completely different from each other, but they became thematically fused in the final case study 3. The ‘Heads’ case study contained elements from both of the previous case studies and the final artworks produced in this series were based on phenomenological and noumenal experience (see section 5.3, pp. 222-224). There is considerable scope for development in the philosophical aspect of this investigation into consciousness. The ‘Heads’ series deserves further research for its theme potential.

The conceptual investigation into the narratives generated when combining hot inclusions with cast glass should have further and extensive time dedicated to the subject area. Therefore firstly, in order to create a fuller picture of the ‘Heads’ series it is key to engage in further research regarding the philosophical premise of logical semantics. It is an interesting aspect of philosophical debate and I feel it is an important theme to comprehend fully in terms of the creative potential and further development of the themes of emotion which drive the narrative content of the artworks. Logical semantics is the study of meaning in formal and natural languages using logic as an instrument. Formal and logical languages are both seen as sets of sentences of which the truth conditions have to be specified relative to a model, an abstract representation of the world. This means that logical semantics can be described as truthconditional and model-theoretic semantics. In the context of the artworks created in case study 3 the sandcast artworks can be viewed in two ways: Through the glossy glass surface at the ‘back’ (posterior), or directly through the sand surface at the ‘front’ (anterior). The two ways in which each cast can be viewed carry their own set of logical semantics concerning sense, implication, reference and presupposition. As previously stated my understanding of this philosophical concept is basic but I feel with further research logical semantics can be applied to the themes behind the heads artworks and strengthen the developing taxonomy of themes.

Finally in the areas for further research, I would be interested in developing a more extensive taxonomy concerned with definitions of consciousness concerning the visual opportunities glass can offer the artist (see chapter 4, pp. 171-174 & 197-201). The conceptual investigation concerned with this research began to unpick and explain how glass specifically, as a transparent material could be utilised as a vehicle for philosophical expression over traditional sculptural materials. The topic was wide-ranging and the research period only allowed for a basic research into the exploration of the glass cast as a vehicle for communication of action, thought and thought processes. Ideas surrounding consciousness and what it is are basic even in the scientific field and it is a highly interesting and area of study in an artistic and philosophical context The study of consciousness is important both to develop the narrative a cast glass object has to offer and it is important to the integrity of the sandcast with flameworked inclusions artworks created in the future. What began with a rudimentary taxonomy of experience derived from the philosopher and cognitive scientist Daniel C. Dennet deserves further and extensive research dedicated to it.

In conclusion there are a number of areas in this research which could and should be developed further. The areas for further study listed above should be developed firstly to gain a deeper technical knowledge and understanding of the use of flameworked inclusions within the sandcast form. Secondly the areas for further study concerning the narrative the cast glass object has to offer should be developed for its potential visual contribution to the field of glass art.

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# Appendix 1 – Glossary of terms

| | |
|---|---|
| *α* | Coefficients of linear expansion are represented by the Greek letter α (alpha) |
| Annealing | Process used to gradually and evenly cool glass from its annealing temperature (450oc -5650c commonly, except quartz which has a much higher annealing temp) to room temperature in order to relieve internal stress and subsequent cracking of the finished piece. |
| Annealing oven | Most often used in the hotshop to anneal large glass objects. |
| Batch | Refers to a mixture of chemicals blended to a specific glass formula, which is then heated to melting temperature in the furnace. For example borosilicate glass is made with Boron Trioxide ($B_2O_3$) and soda-lime (sodium carbonate + calcium oxide) ($Na_2CO_3$ + $C_aO$) which make up 90% of todays manufactured glass. |
| Batch Annealing | A series of glass objects are gathered once cool and annealed at the same time to lower electricity costs |
| Bead release | Clay formula (bentonite, kaolin, graphite) which acts as a resist between glass and metal, generally used to stop a glass bead from sticking to a mandrel. |
| Bentonite | Clay formed from airborne volcanic ash. Can be added to ordinary sand to increase its clay content for sandcasting. |
| Birefringence | The optical properties of a material having a refractive index which depends on the polarization and propagation direction of light. Birefingence only occurs in materials which are not isotropic. Normal glass is isotropic, but stress introduces anisotropy. Therefore tempered glass can have birefringent properties, visible e.g. as a streaky reflective pattern on plate glass windows. |
| Blowing iron | Steel rod approximately a metre in length which is hollow on the inside which allows molten glass to be blown |
| Borosilicate glass | Type of glass used to make scientific apparatus. The main glass forming constituents are silica and boron. It has a low COE of .32, making it more resistant to thermal shock. |
| Capping | When a floating inclusion has been placed into the first layer of hot glass in the sand mould, the second layer should be poured around the edges of the inclusion to ‘cap’ it in place and stop the possibility of distortion by the inclusion melting and moving due to high temperatures. If the furnace glass is poured directly on top of the inclusion the inclusion will melt and distort. |
| Cane | Glass rod pulled from furnace or made industrially for use in flameworking and other glass processes |
| Chance art | Dada terminology for the act of accidental placement of objects to create a work of art |

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| Chromophore | The component of a molecule responsible for colour. Colour arises when a molecule absorbs certain wavelengths of visible light and transmits or reflects others. |
| COE | Also known as Coefficient of expansion: A measurement of a material's tendency to expand when heated and contract when cooled. The higher the coefficient of expansion, the lower the thermal-shock-resistance. In firing dissimilar materials in contact with one-another the coefficient of expansion must be matched. See ‚Thermal expansion'. |
| Cold processing | Includes all tools and machinery associated with polishing glass, such as the flatbed grinder, polishing wheels, sandblaster, glass drill, glass saw and glass linisher among others. |
| Compatible | When two types of glass are able to exist able to fuse together without cracking or internal tension. |
| Crucible | High firing ceramic pot for use within the furnace to hold the |
| molten glass. | |
| Crystal | Pure glass form – fused sillica – extremely low COE |
| Cullet | Broken or waste glass suitable for remelting. Also the term used to describe premelted batch glass. |
| Dada | Anti-art movement established in the early 20th Century |
| Dowel joint | Also known as a dowel reinforced butt joint, commonly used in carpentry for reinforcing butt joints in furniture. |
| Drafting | To remove a positive form from a sand mould. |
| Effetre | Brand name for 104COE Italian flameworking glass |
| Modulus of elasticity | Or Young's modulus, is a number that measures an object or substance's resistance to being deformed elastically (i.e., non-permanently) when a force is applied to it. The elastic modulus of an object is defined as the slope of its stress–strain curve in the elastic deformation region. A stiffer material will have a higher elastic modulus. |
| Enamel | An opaque or semi-transparent glossy glass applied by vitrification (heat and fusion) to glass, metallic or other hard surfaces for ornament or as a protective coating. |
| Encase | Covering a rod of glass with a different colour, generally clear. |
| Encapsulation | The process of covering flameworked glass components in a substantial layer of clear glass. |
| Fibre Blanket | Heat resistant material which allows glass to cool slowly. |
| Filigrana cane | Type of glass cane with twisted threads of colour running through it. |
| Fit | Term referring to the compatibility between two glasses either made by different companies or with COE variants. |
| Fusing | Process of firing separate glass components in a kiln until they bond together to form a single unit |
| Gaffa | Brand name for 96 COE New Zealand colour bar glass for |
| blowing | |

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| Gaffer | Skilled glassmaker in charge of the hotshop who controls team of skilled workers and/or helps artisan/designer to create their vision |
| Gather | A relative term defining a large amount (generally of the same colour) gathered to create a large amount of glass. |
| Glasma batch glass | Brand name for a barium based 96 COE American furnace |
| Glass | Pure silica which has oxides and minerals added to lower the melting temperature turning it into a silicate. |
| Glass blank | An object created in glass which after painting/cold processing etc… will be re-manipulated using a hot process. |
| Glass post | A post is a piece of glass which biscects the surface of another piece of glass. This is either as a cold process fitting in to a hole, or as a hot process anchoring a 3D transitional inclusion into the sandcast glass mass. |
| Glass Schools | Non-accredited institutions focused on the dissemination of myriad glassmaking techniques and skills taught by master glassmakers from across the world. Famous schools include: Pilchuck (USA), Haystack(USA), Penland (USA), Corning (USA), The Glass Furnace (TR), Bildwerk (DL), Jam Factory (AUS), Lybster (UK). |
| Glory hole | Chamber to reheat glass after it has been worked on the end of an iron |
| Gradient seal | Seal made from glass that joins glasses of different COE's together in steps. Mainly used in scientific glassblowing |
| Holding rod | Similar to a punty iron used in glassblowing, this glass rod often made of a more heat resistant glass is used in flameworking to handle hot pieces in the flame. This rod is always detatched when the flameworked piece is finished. |
| Kelvin | The kelvin is a unit of measure for temperature based upon an absolute scale. It is one of the seven base units in the International System of Units (SI) and is assigned the unit symbol K. Kelvin is the temperature at which all thermal motion ceases. |
| Kelvin-Voigt material | Also called a Voigt material, is a viscoelastic material having the properties both of elasticity and viscosity. |
| Kilncast | Glass cast into a mould with a kiln |
| Kuglar | Brand name for 97 COE German flameworking glass, and blowing colour bar |
| Ladle | Large steel ladle used for gathering large amounts of glass from a furnace. |
| Lehr | Oven designed specially to anneal glass, Commonly used in hot shop and flameworking studios |
| Linear expansion | A change in one dimension (length) as opposed to change in volume (volumetric expansion) |
| Linisher | Piece of industrial glass polishing equipment. |
| Mandrel | Stainless steel wire or tubing used to form beads around. |

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| Mansfield sand | Mansfield Sand is quarried in the UK and is the standard mould sand for casting within Europe. It has a natural bentonite content which is 17.7%. |
| Marver | Hip height rectangular metal table on roller with a heavy metal top. Used by glassblowers to initially shape their glass when it is drawn out of the furnace. |
| Murrine | Small discs of glass with a colourful pattern, which are latterly incorporated into larger objects |
| Overlay | See ‘Encase’ |
| Oxide | A class of chemical compounds in which Oxygen is combined with another element. Within the field of ceramics and glass generally used for colouring glass rod and creating ceramic glazes |
| Paradise paints | Discontinued high fire lead based glass enamels |
| Paraphernalia | Utilitarian deviced generally associated with taking drugs, especially canabis but also heroin, crack cocaine etc… |
| Pate de Verre | Glass technique using glass powder or frit and glue applied to a mould surface and fired to a low termperature until it tack fuses. Literally translated from the French as glass paste |
| Pixie Dust | Otherwise known as Mica is a chemically inert, insulating material which is thermally stable at 500°C (Muscovite). Phlogopite mica remains stable at higher temperatures (to 900°C) |
| Philips 3300 | A batch glass for the furnace, developed by Gaffa but manufactured by Philips and Spruce Pine. |
| Plaster/silica | Plaster/silica is a mould mix that maintains its integrity in the high fire process better than plaster. In English terminology this is also known as plaster/investrite mould |
| Poisson's ratio | Named after Siméon Poisson, also known as the coefficient of expansion on the transverse axial, is the negative ratio of transverse to axial strain. When a material is compressed in one direction, it usually tends to expand in the other two directions perpendicular to the direction of compression. This phenomenon is called the Poisson effect and Poisson's ratio $\nu$ is a measure of this effect. The Poisson ratio is the fraction (or percent) of expansion divided by the fraction (or percent) of compression, for small values of these changes. |
| Polariscope | Instrument used to test compatibility between two different glasses or colours. |
| Puck | Term which refers to the transparent glass blank used to encapsulate paperweight inclusions. |
| Punty iron | Steel rod used in glass blowing to transfer blown pieces onto, or used for heating up gathers of glass |
| Reduction | Tends to occur when there is not enough oxygen in the hot environment causing the metal oxides in the molten glass to release their oxygen content and turn the surface of the glass silver or grey. |

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| Sandblasting | Process used to roughen or clean the surface of a glass object with a jet of sand driven by compressed air. |
| Seeds | Small bubbles trapped in a batch melt. |
| Shearing | To cut molten glass with shears. |
| Short glass | Glass with a low COE that melts at a high temperature and has a short working time. |
| Skimming | The process of cleaning the dirty and scratched top layer of glass on a blank whilst it's molten with the use of tweezers |
| Slip | A creamy mixture of clay and water. |
| Slumping | Process involving 'sheet' glass, which is warmed up in a kiln until it slumps into or over a mould form. |
| Soak | This is the process of putting inclusions of any sort into a kiln for any period of time, at annealing temperature to relieve any stress caused to the pieces whilst they were being made. Or to ensure the pieces are warmed all the way through ready for a further hot process, such as including them in a hot cast for example. |
| Sodium silicate | Common term used for a compound sodium metasillicate, $Na_2SiO_3$, also known as water glass or liquid glass. Commonly used in the glass making industry to form rigid mould from sand. |
| Solid worked | Glass object created in the hotshop using a punty iron without using the blowing technique. |
| Stained glass | Glass using for decorative applications on windows, especially common in churches |
| Stress | Caused by glass molecules cooling in an erroneous amorphous structure. This can also be caused when two glasses with different coefficients of expansion are joined together in a hot process. |
| Striped Cane | Cane formed with horizontal lines across its surface |
| Stringer | Thin (approximately 1-2mm) cane pulled from the furnace or in the torch |
| System 96 | Brand name for 96COE American flameworking, kiln, casting glass (previously traded as Spectrum) |
| Tacit knowledge | Can be defined as knowledge which cannot be adequately passed on even by expert practitioners through verbal means. |
| Thermal expansion | The physical expansion and contraction which accompanies the heating and cooling of most materials. See 'Coefficient of expansion'. |
| Thermal shock | Thermal shock occurs when a thermal gradient causes different parts of an object to expand by different amounts. |
| Thompson enamels | Brand name for ceramic and glass low and high fire enamels from the USA. Creates enamels for use with stained glass, window glass and effetre flameworking glass. |
| Torch | Piece of equipment for flameworkers which melts the glass and generally runs off oxygen and propane. |

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| Trompe l'oeil | French for "deceive the eye", is an art technique that uses realistic imagery to create the optical illusion that the depicted objects exist in three dimensions. |
| Vaccuum oven | Instrument used for making paperweights |
| Vermiculite | Puffed up form of mica is a chemically inert, insulating material commonly used for annealing small pieces of glass, before 'Batch annealing'. |
| Viscosity | The resistance to thermally activated plastic deformation. The stiffness of any type of glass, which is measured in "Poises". Viscosity describes a fluids internal resistance to flow and can be thought of as a measure of fluid friction. Water has a low viscosity and is described as "Thin" whilst Glass has a higher viscosity like honey, and is described as "Thick". A fluid with no resistance to shear stress is known as an 'ideal form'. For example, water has a viscosity of 0.00899 poise at 25 °C |
| Wedging | Process of kneading the clay with the hands to remove air-bubbles and insure homogenous mass. |
| ZIRCAR | ZIRCAR Mold Mix 6 is a refractory-molding compound designed to allow replication of three-dimensional objects in glass. It comes as a paste, which is applied to a suitably prepared pattern and hardens on drying. Properly prepared molds of Mold Mix 6 will resolve the finest details and possess good strength. However, it remains sufficiently friable to permit easy removal after annealing. Mold Mix 6 is highly resistant to reaction with hot glass and gives the fired work a high quality surface free of-hazing common to investment type molds. Mold Mix 6 may be used for hot casting, kiln casting methods and slumping, all with excellent results. The greatest advantage of Mold Mix 6 is its ease of use and this manual will show you how to use it most effectively. |

# Appendix 2 – Interview with Lachezar Dochev 23.08.2015

This interview took place at the Luxembourg Glass Symposium (Asselborn) after jointly giving a sandcasting with flameworked inclusions demonstration

JAD Who have you studied under and where?

LD My first education in glass started in Riga, Latvia in the Art Academy. I took the full course of education which was 6 years. I finished both the studios – One for stained glass and the other for glass design and sculpture.

JAD Glass design and sculpture involves which specific techniques?

LD We weren't very well equipped, but we made projects for blowing, other industry – Automated production like centrifuge casting, bottles etc… As well as free blowing and we also had some fusing kilns, so we could do some things in practice at the academy. There was a lot of grinding and engraving and polishing.

With the kilns we usually only worked on tack fusing because there is no need for a mould and it can anneal quickly.

JAD I believe that you have been to Pilchuck!

LD Yes. I returned from Riga to Bulgaria in 1999. I started my studio. I built my first kiln in 2002 and in 2003 I received a scholarship for Pilchuck. There I learnt hot casting with Mitchell Gaudet. In 2004 I was teaching assistant for Yanovich Yalentinovich.

JAD Who is he?

LD YY was born in Poland. Then when he was a child he moved to Denmark. Now he is residing in the United States. He is a famous kiln casting artist. He occasionally mixes kiln casting and hot casting whenever he needs to include glass into glass.

JAD You mean when he wants to add inclusions?

LD Yes. He would make a premade object in the kiln which would be included in the larger hotcast. For example he put a gun in a bible. Several guns in a ladies handbag. He had a show perhaps 10 years ago called 'Guns save lives' which was his protest about the gun situation in the States. He is an artist who lives the Fall and the Winter in the States and in the Summer goes to Denmark. He has a Danish citizenship but he resides in the States. In 2005 I was once again the assistant at Pilchuck for Mitchell Gaudet who taught me hot casting the first time I was at Pilchuck. So I went there 3 years in a row. In between that I also went to Northlands Creative Glass in Lybster – 2004 in the late Summer, to do a very strange class with the late Richard Posner. It was about casting small objects that will later be assembled in architectural.

JAD They were cold assembled?

LD They were hot cast, but they would be cold assembled later for architectural situations.

JAD Why was it strange?

LD Because he seemed quite unprepared technically, he was leading a concept class and it was good that he had no students without any experience. If he had a novice student he wouldn't know what to do with that student.

JAD Are there any other artists who you have studied under?

LD No that's it

JAD Out of the three which would you say was the most influential technically and conceptually; and is there a conceptual influence?

LD No there is no conceptual influence. The technical is a mixture between Mitchell and Janusch.

JAD They were equally influential?

LD Janusch is all about predicting what will happen everywhere, and he will make the perfect mould, that will survive the heat in the kiln, while Mitchell is much more about improvising and fast working – But then that's what you have with hot glass. Therefore Mitchell would make a very simple demonstration in the morning and let us do our thing in the afternoon, whereas Janusch was much more concentrated in the mould making and controlling the process before one gets to the glass.

It was good that I got them in the correct order – First Mitchell and then Janusch because I met someone who had them in the other order and he said that Mitchell was much better than Janusch. I told him to imagine if he'd had them in the other order that it would have been much more useful for him – So in this I count myself lucky.

And about conceptual, I believe I am very influenced in my thinking by my teacher in Latvia Arnold ….. I believe you know him!

JAD He is very well thought of by others, as far as my knowledge goes.

LD Yes. He is the type of teacher who would torture the pupils to do everything precisely and nothing else. At the time he was a big tyrant.

JAD Really? He was a pussy cat when I met him

LD Now he is such, but the way he was was very good for our study because he made us develop our thinking. We [his students] have a good thinking process. If I get a commission that I don't like to make. I can do it due to this thinking… And it will be good!

JAD Bacause he's taught you to think in a certain way?

LD In a certain way and to find solutions to problems - Now learnt a lot of really practical things from Mitchell and Janusch but on the other hand, I have this inventive thinking I got from Arnold …… Because we were in situation as a country from Eastern Europe, a glass department with almost no equipment and we could still make very interesting stylish things – And that is his school.

JAD He was the head? 8.09min

LD He was the head of history, there were two studios. He was head of the glass design and sculptural studio, while the stained glass head was Professor Daneis Grasiz who is no longer alive.

JAD My next question – Where do you draw your inspiration from for your personal pieces?

LD Music, history and some pre- civilizations of art. It's a mixture but I like to think of my pieces like it is a musical composition, so I want an introduction, a graduation then a counterpoint, and then again going down like that, as if it was a kind of symphony or something.

JAD When you say, pre-civilisation, what do you mean by that?

LD I mean before countries, before classic, before Greece, before Egypt even. So the cavemen!

JAD So, perhaps caves of Lascaux, ideas of making a representation of something

LD African masks, and I mix the cultures. It doesn't have to be African, Bulgarian or Mexican. Nordic, I would mix the styles (*this is also what I am planning on doing – perhaps my concept is a little less vague*). But they are from very ancient times.

JAD What were the other inspirations, you said music

LD Yes music, architecture, archeology and this prehistoric art!

JAD OK! Now what techniques do you tend to include with sandcasting? What I mean by that is, are you using oxides, are you putting stringers in ladles, are you using inclusions? Then I will ask you why

LD So the strings in the ladles – It's my discovery as far as I know, no one did it before or since. Which I thought of the first time I was at Pilchuck. Mitchell Gaudet was showing how to mix colours in the ladle. He would add some powders and stir with a butter knife. This looked like a cake, I did not like it. I wanted to have control when I make the colours or put the colours in the glass, and at the same time I wanted to have it vivid. Therefore I came up with the idea of putting *stringers* in the ladle and then cap it with more clear glassso it's sandwiched in between two layers of clear glass (*like an inclusion*!) Whe I pour this into the mould, it turns into a beautiful string of colours and I am actually drawing with and moving the ladel around and making a pattern with the molten stringers. This is one thing I like very much, I don't do it very often because most places I visit either don't have good ladles and in the necessary quantity or there are not enough people to make these pieces. I need 4 people for this. Then I like using metals like copper, brass and aluminium.

JAD You mean oxides in powder form? 11:53

LD No foils

JAD So this is in the cast itself

LD Yes in the cast! Either in between the layers or on the surface of the cast, it depends. I like to cast into wood combined with sand so as the glass will get into the ashes of the burnt wood. One thing I usually like to make; and this is the way I differ from those who do the same thing. I would pack or wrap the wood in aluminum foil and then cast the glass on it. So I have this sparkly surface from the aluminium and I also have the texture of the burnt wood.

JAD Do you find that the steams into the glass cast?

LD It wouldn't destroy my composition

JAD This is fine in reference to your vision?

LD This is fine! If I want to control it there is a way – Pour very slowly from one side to the other, therefore you are pushing the steam out of the glass. Also you can choose a thinner piece of wood and there won't be much burning after you have finished ladling.

JAD Tell me about your use of inclusions.

LD **Inclusions** – I don't do so much because it needs more preparation and better or **strong concept** in order to use them. Usually when I have access to a hot glass it's more of an improvised situation, so I don't want to make such challenges that will most likely not survive the annealing process. I don't remember if I made inclusions at Pilchuck – Perhaps not! I want to do this eventually in my own studio. We are rebuilding the house at the moment. I have installed gas which is at a much higher pressure than in the normal domestic situations, so as I can build a furnace in the future. Then I will work further on inclusions.

JAD So in essence it is something you want to explore, but as yet it is not the correct time?

LD Yes… Because I think if you are making inclusions of one form into another form, then you need to have good control. It's already too specific concept. It's not for improvisation. It's nice to watch the process but the end result is disappointing.

JAD I agree. I see you are also using kilnforming to make your work, but they also look like sandcasts. Do you consider them to be sandcasts

LD Yes, they are sandcasts. The mould is made entirely of sand. I do it because I like the sand texture so much, but as I don't have a hot casting facility I do kilncasting. The big difference is: For kiln sandcasting you pack the sand very very tightly, and obviously you dry it before you place the glass inside because you are putting in cold hard glass which would destroy a fragile mould. So you need to bake it first.

JAD So you put quite a lot of bentonite in the sand?

LD Actually it is the same amount, just the packing differs. I always work with 10% bentonite and whatever sand I can get.

JAD I work with 3 or 4%, for sandcasting

LD Mitchell Gaudet was using 11%. You won't make an undercut using 3 to 4% of bentonite, it will fall down.

JAD I don't really make undercuts

LD I do that a lot

JAD Yes you do make a lot of undercuts in your work. Why do you make undercuts? What is it you like about them?

LD It's not the fact that they are undercuts. I like to have an architectural form. This is the main reason I like casting over blowing, because blowing is always round and I like to have a line and an edge, so by adding things that are stretching down it's just the need of another geometrical form getting out of the main body. So I don't create faces or round things in my sculpture, it's always a structure.

JAD Although, I see faces inside your structures?

LD Inside my structures, yes!

JAD Inclusions, yes?

LD Mould inclusions not made from glass, but yes! I make faces but there is always a larger form that is more architechtural.

JAD Do you feel there are any extra benefits to making these pieces in a kiln?

LD One has better choice and control of colours. How you place them, because you can work with sheet glass, stringers, cullet, casting patties, billets, everything that you have in the fusing market, you can put it in a sculpture for kiln sandcasting. That's a benefit. The draw back is that you can't include glass in glass [glass inclusions]

JAD when you talk about the face inclusions, you have made them beforehand and then you place them in the sand and that's the only way you can use them. For example you can't have them in the middle of a cast dur to the fact it's melted in a kiln.

LD Yes, because it will lose its shape. While the two glasses are melting there is some air between them and when the glass is melting that air will raise up and the inclusion will deform.

JAD That makes sense.

LD Now that you ask that question, that could be interesting because I think at this very moment this idea came to me. I think that if you paint the inclusion the way you paint glass for grall blowing and then it becomes distorted; it could be interesting in kiln sandcasting to have a painted piece of glass deformed. But I never tried.

JAD What would you consider useful about the glass inclusion? What do you like about the glass inclusion?

LD That you can move from a big recognisable form into smaller details inside that form, so what I like that catched my eye in a piece of art is first – The large shape, and then when I am approaching it and getting closer, I enjoy seeing smaller things that will make me curious. Therefore it's not necessarily the inclusion, but if I were making inclusions it would be in this way that I would approach it.

JAD Why have you chosen the medium of glass to make your works? When you could be a metalsmith or a ceramicist…

LD That's a very long story and it goes back to my childhood when I was 8. The first time I went abroad was to Riga, Latvia. My father took me to an organ concert in the Dome Cathedral in Riga where the biggest organ in the world resides. There I saw the stained glass windows. Therefore the two things together: The power of the organ music and the stained glass windows which

I also saw also for the first time because stained glass is not popular in Bulgaria. This made a great impression on me as a child, and this stayed with me until I finished my education in Bulgaria. So we went to Riga, and as a matter of fact I was the first student in the Latvian Academy of Arts, after Latvia was free from the Soviet Union. They didn’t know administratively how to deal with me and so I offered them to take Latvian students around Bulgaria and I would show them Bulgarian culture. They normally accepted three state sponsored students; and I was the fifth student, so I was not taking a Latvian seat. So once again my love for glass was connected with music. It started with stained glass, but during my education, I got more interested in the three dimensional. I should say that my father is an architect and he had connections with many Latvian architects because Rousse where I am from and Riga are brother cities which was a practice in the Socialist imes. By these cultural connections and the exchange of Rousse and Riga he made a lot of aquaintences there.  So it wasn’t like I was moving to ANY foreign country. It was simply that I would live in a foreign country with friends of my father.

JAD This is a more difficult question. You understanding that there is the inside of the glass cast and then there is the other surface. Do the two different aspects of the glass cast represent anything for you? Or is everything one?

LD I think it is different in each case with each work.

JAD Sometimes you will use the inner surface as a tool to derive meaning, and the outer surface to derive another meaning?

LD If you are describing that we have a hollow space in the glass because it’s the only medium where one can play with the outer and the inner shape and they are different. When I first tried to do it myself I had the basic or ‘meaningless’ shape on the outside, in order to try the process of core casting or hollow form that carried the meaning of the piece, but recently I started working with two part kilncasting moulds in the kiln. Therefore I have one back and the reservoir is in the front of the piece. This allows me to have very controlled negative spaces. Then I have a really good sculpting of the inside and the outside of the glass, by this process of the two part mould. So one is responsible for the back of the piece and it holds the core mould, and then there is the shell that closes this and the reservoir on top. I would cut and polish that piece so as it becomes a window into the sculpture.

JAD Why would you Make ‘windows’ inside a sandcast?

LD That’s the way to see what I have sculpted inside

JAD When you work with this ‘negative’ versus ‘positive’ technique, does it have a consistent meaning for you or does the meaning change with the piece?

LD The meaning is always different for each piece. The thing is I am either growing up or getting old. But for the last 5/6 years, I imagine my piece is finished and as soon as I see it finished I know the process. It’s like *clicks fingers*, so I don’t make sketches or try to think how I would do this and then try to change it whilst making sketches. So it is finished in my mind and I know what to do. It’s very genetic the core and the outer form, they are one thing.

JAD Furthermore conceptually speaking what are you trying to say with the work you are making. Is it one theme? Or is it many?

LD It’s never one thing. You can say that I have certain themes that I develop in more than one piece. But they are not one after another. So I don’t finish one series and start the other series. I am jumping from one theme to another and I return to the first one like that.

JAD How many themes would you say you have going at this moment in time?

LD Maybe 10/15, I’m not sure

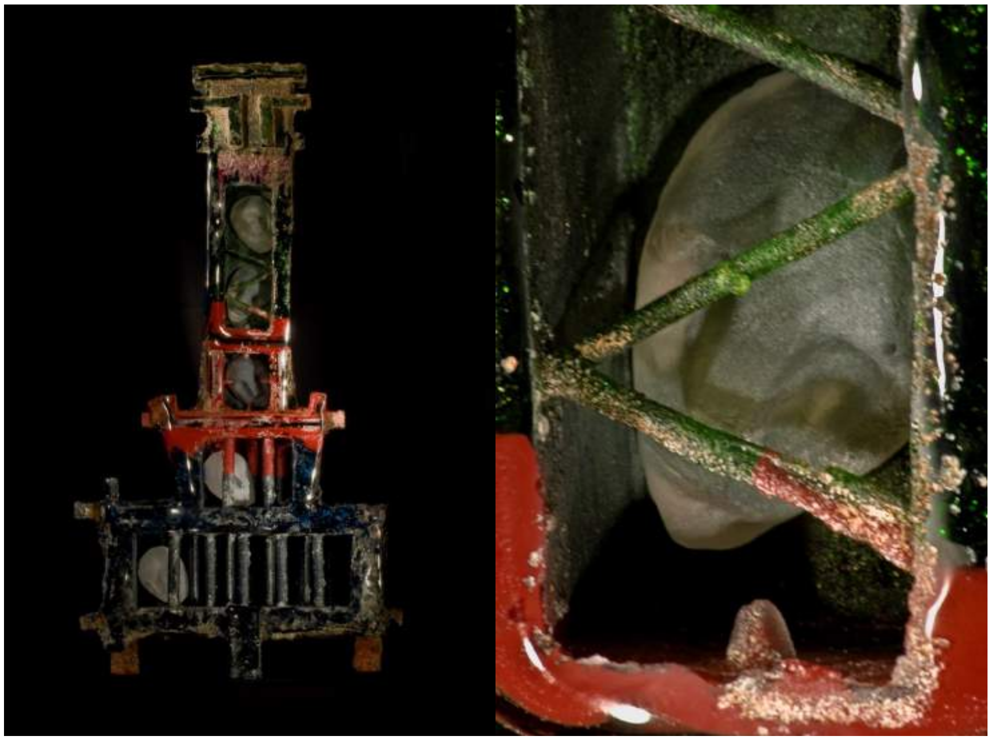
JAD How long is the longest theme you have had?

LD Five to six years I think. I finish when I am bored, because sometimes things don’t come out correctly, but I don’t want to repeat it, because I have finished it in my mind and I cannot force myself to make it again.

JAD So Lucho that is the end of my questions, thank you very much!

# Appendix 3 – 'Starless' - the making process

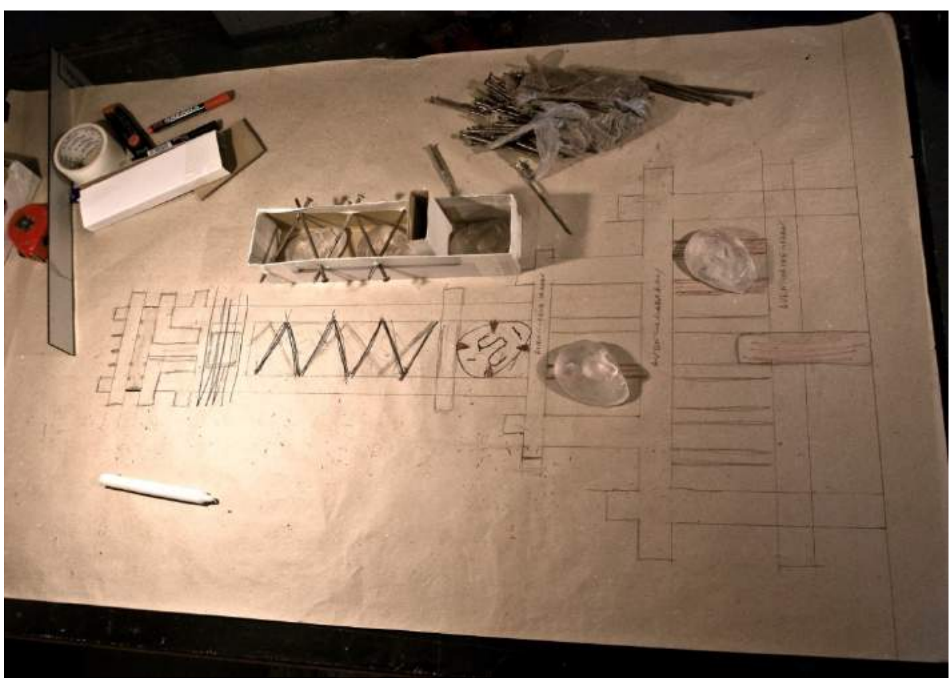
Process conceived of and written by Lachezar Dochev. Photographed by Lachezar Dochev & Venzo Danev.



"Starless" – The ready piece and detail of a 'head' behind bars.

Details - The 'heads' are behind the 'bars' but not touching them.

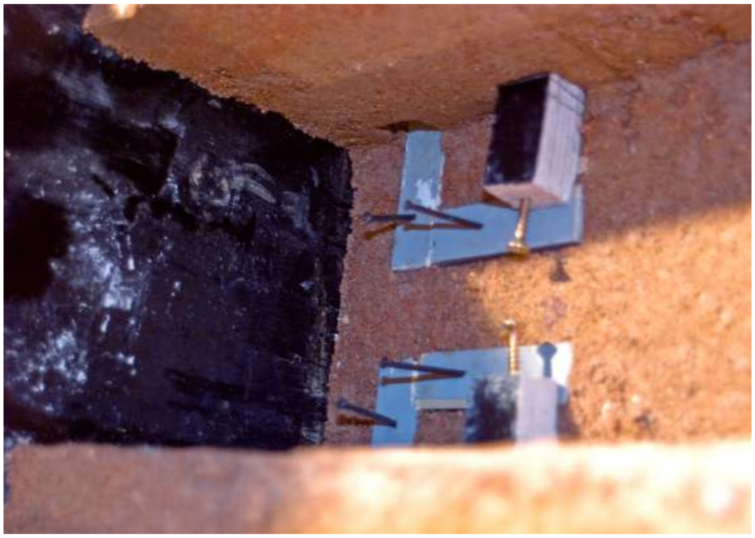
Detail



The sketch is used for volume calculations for the quantity of glass. The precast ‘heads’ will be placed in a cardboard box to be included in a sand positive mould.

The main negative mould is dug in tightly packed sand–bentonite-water mix. Different templates are used to achieve the shape.

The negative mould with the wooden bits forming the ‘feet’ and other details in place.



Again with small wooden bits some undercuts are formed. The screws and nails help to take the bits out of their impressions.

The precast glass heads are included in a special sand mix that will form negative space in the ready piece and fuse to the rest of the glass. Here it is important that the core mould shrinks more than the glass on cool down or otherwise it will crack it. The quartz inversion at 573ºC is used to our advantage.

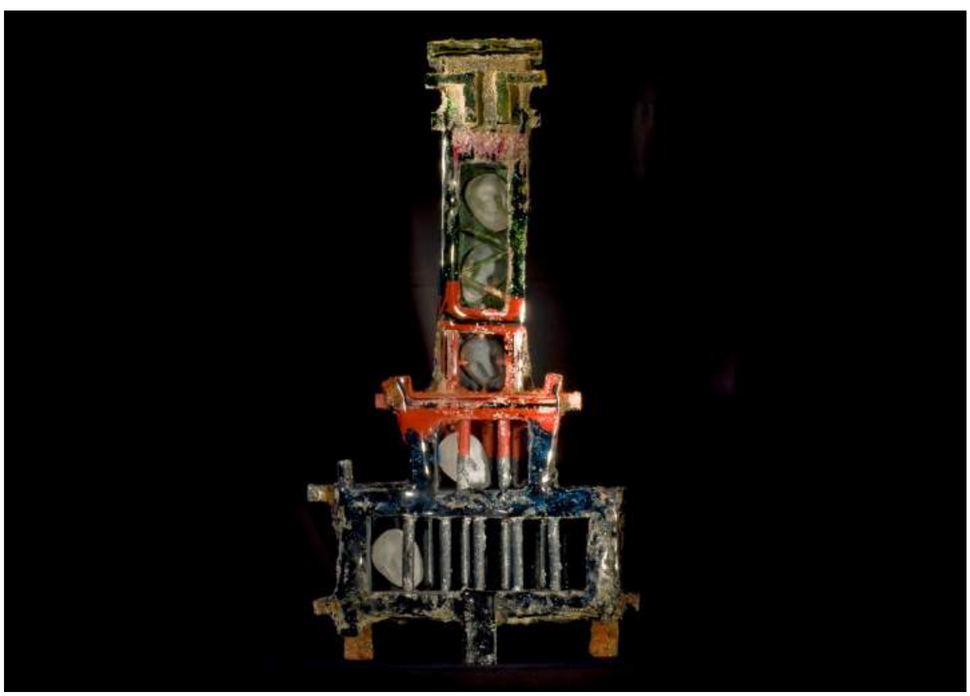

The ‘bars’ are lost wax candles included in the sand mould along with the ‘heads’. After setting these sand positives are placed in the negative mould, adhered to the main body with more bentonite sifted in the right place. Then the whole thing is dried in the kiln for calculated time depending on the quantity of water to be evaporated at 300ºC.

Sometimes the cardboard does not burn completely during the drying cycle, as there is not enough oxygen in the closed kiln. So I burn it with the flame torch.

It is enough to burn the corners only, so the ring is split and then one can take out the paper with tweezers. The importance is to leave as little contamination in the mould as possible.

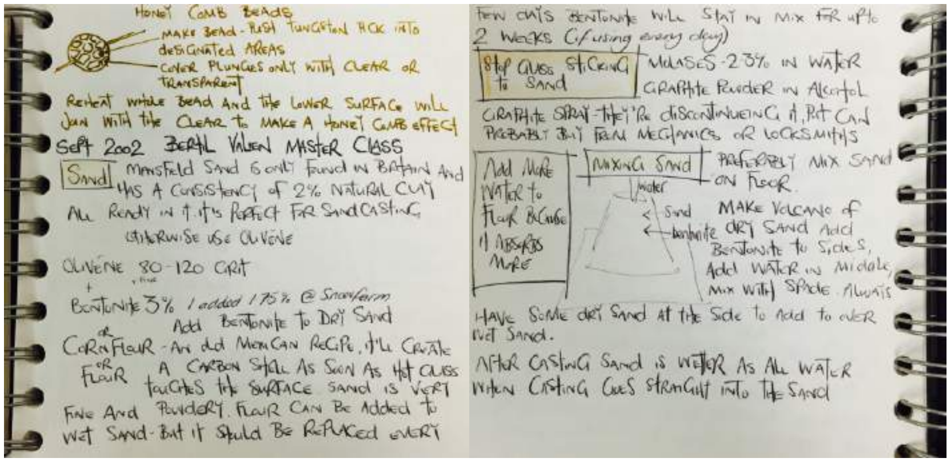
The glass used is a combination of sheet and cullet, along with powders, frit and stringers.

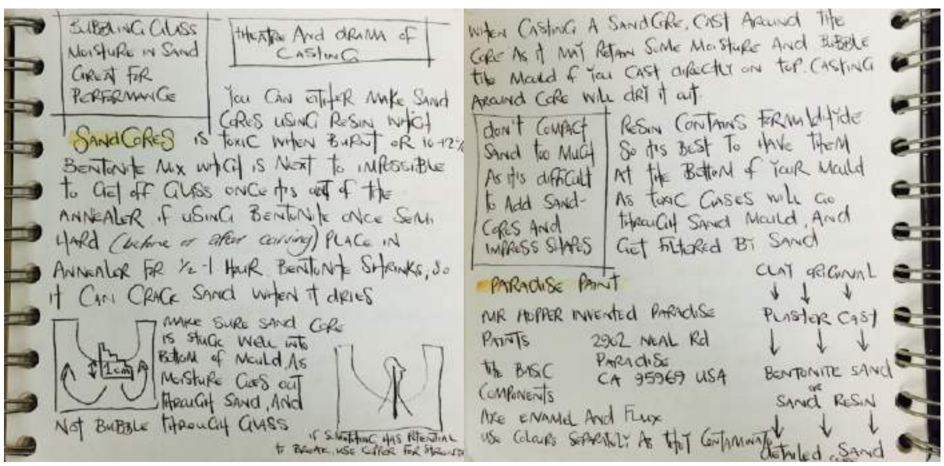
Just out of the mould… Cleaning and de-molding was tricky as there were fine details hidden in hard sand blocks. I used a very strong lime stone cleaner to help destroy the bond of the plaster and bentonite.

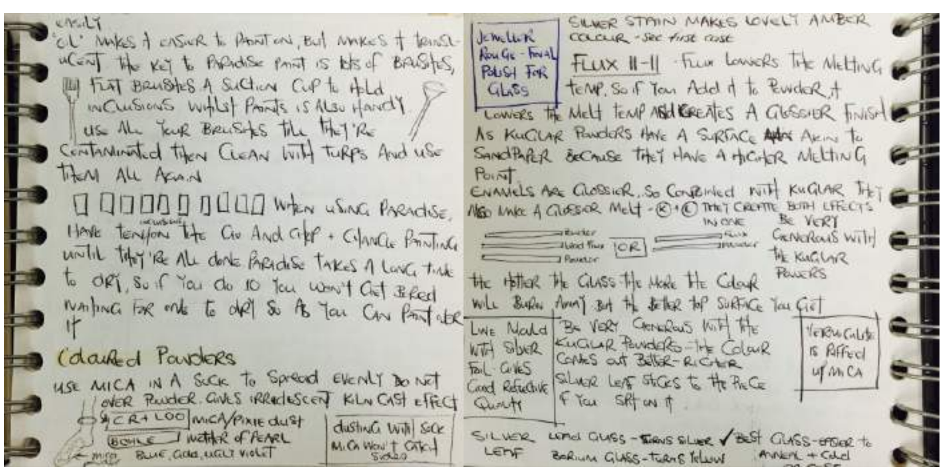


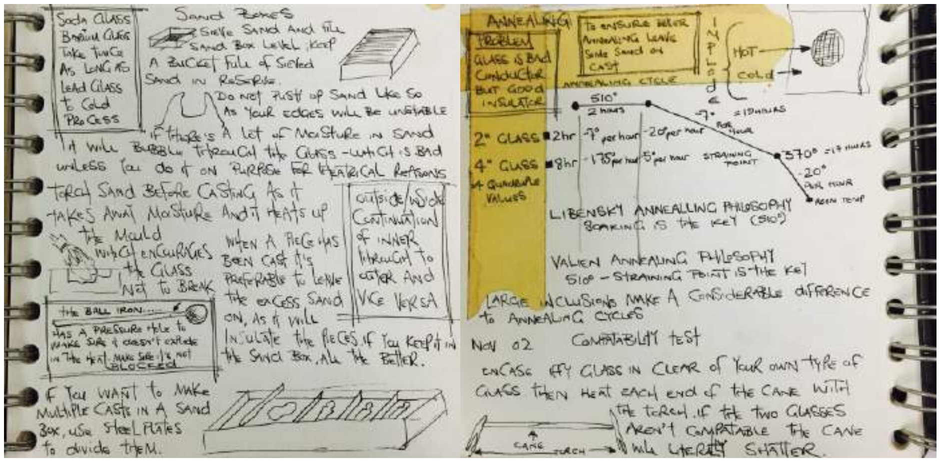
…and after 3 weeks of cold work

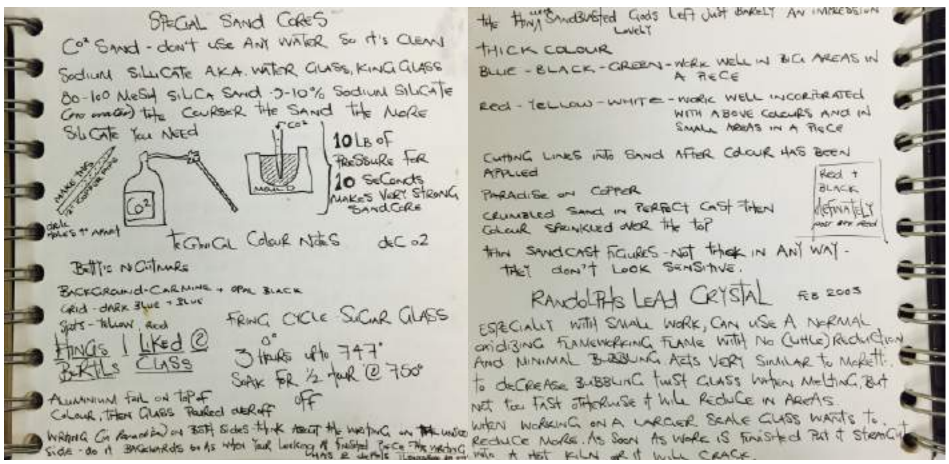
# Appendix 4 – Bertil Vallien masterclass notes


HONEY COMB BEADS
MAKE BEAD - PUSH TUNGSTEN ROD INTO DESIGNATED AREAS
COVER PLUNGES ONLY WITH CLEAR OR TRANSPARENT
REHEAT WHOLE BEAD AND THE LOWER SURFACE WILL JOIN WITH THE CLEAR TO MAKE A HONEY COMB EFFECT
SEPT 2002 BERTIL VALLIEN MASTER CLASS
SAND MANSFIELD SAND IS ONLY FOUND IN BRITAIN AND HAS A CONSISTENCY OF 2% NATURAL CLAY
ALL READY IN IT IT'S PERFECT FOR SAND CASTING
OTHERWISE USE OLIVENE
OLIVENE 80-120 GRIT
BENTONITE 3% I added 1.75% @ Snowfarm
ADD BENTONITE TO DRY SAND
CORN FLOUR - AN OLD MEXICAN RECIPE, IT'LL CREATE A CARBON SHELL AS SOON AS HOT GLASS TOUCHES THE SURFACE SAND IS VERY FINE AND POWDERY. FLOUR CAN BE ADDED TO WET SAND - BUT IT SHOULD BE REPLACED EVERY
FEW DAYS BENTONITE WILL STAY IN MIX FOR UP TO 2 WEEKS (if using every day)
STOP GLASS STICKING TO SAND
MOLASSES - 2-3% IN WATER
GRAPHITE POWDER IN ALCOHOL
GRAPHITE SPRAY - THEY'RE DISCONTINUING IT, BUT CAN PROBABLY BUY FROM MECHANICS OR LOCKSMITHS
ADD MORE WATER TO FLOUR BECAUSE IT ABSORBS MORE
MIXING SAND PREFERABLY MIX SAND ON FLOOR
MAKE VOLCANO OF DRY SAND ADD BENTONITE TO SIDES, ADD WATER IN MIDDLE, MIX WITH SPADE. ALWAYS HAVE SOME DRY SAND AT THE SIDE TO ADD TO OVER WET SAND.
AFTER CASTING SAND IS WETTER AS ALL WATER WHEN CASTING GOES STRAIGHT INTO THE SAND


SUBDUING GLASS MOISTURE IN SAND GREAT FOR PERFORMANCE
THEATRE AND DRAMA OF CASTING
YOU CAN EITHER MAKE SAND CORES USING RESIN WHICH IS TOXIC WHEN BURNT OR 10-12% BENTONITE MIX WHICH IS NEXT TO IMPOSSIBLE TO GET OFF GLASS ONCE ITS OUT OF THE ANNEALER. IF USING BENTONITE ONCE SEMI HARD (before or after carving) PLACE IN ANNEALER FOR ½-1 HOUR. BENTONITE SHRINKS, SO IT CAN CRACK SAND WHEN IT DRIES
MAKE SURE SAND CORE IS STUCK WELL INTO BOTTOM OF MOULD AS MOISTURE GOES OUT THROUGH SAND, AND NOT BUBBLE THROUGH GLASS
WHEN CASTING A SAND CORE, CAST AROUND THE CORE AS IT MAY RETAIN SOME MOISTURE AND BUBBLE THE MOULD IF YOU CAST DIRECTLY ON TOP. CASTING AROUND CORE WILL DRY IT OUT.
DON'T COMPACT SAND TOO MUCH AS IT'S DIFFICULT TO ADD SAND CORES AND IMPRESS SHAPES
RESIN CONTAINS FORMALDEHYDE SO IT'S BEST TO HAVE THEM AT THE BOTTOM OF YOUR MOULD AS TOXIC GASES WILL GO THROUGH SAND MOULD, AND GET FILTERED BY SAND
PARADISE PAINT
MR HOPPER INVENTED PARADISE PAINTS 2902 NEAL RD PARADISE CA 95969 USA
THE BASIC COMPONENTS ARE ENAMEL AND FLUX
USE COLOURS SEPARATELY AS THEY CONTAMINATE
CLAY ORIGINAL → PLASTER CAST → BENTONITE SAND OR SAND RESIN → detailed sand


'CL' MAKES IT EASIER TO PAINT ON, BUT MAKES IT TRANSLUCENT. THE KEY TO PARADISE PAINT IS LOTS OF BRUSHES, FLAT BRUSHES A SUCTION CUP TO HOLD INCLUSIONS WHILST PAINTS IS ALSO HANDY
USE ALL YOUR BRUSHES TILL THEY'RE CONTAMINATED THEN CLEAN WITH TURPS AND USE THEM ALL AGAIN
WHEN USING PARADISE, HAVE TENSION THE GO AND GLOP + GLANCE PAINTING UNTIL THEY'RE ALL DONE. PARADISE TAKES A LONG TIME TO DRY, SO IF YOU DO 10 YOU WON'T GET BORED WAITING FOR ONE TO DRY SO AS YOU CAN PAINT OVER IT
COLOURED POWDERS
USE MICA IN A SOCK TO SPREAD EVENLY DO NOT OVER POWDER. GIVES IRRIDESCENT KILN CAST EFFECT
MICA/PIXIE DUST WATER OF PEARL BLUE, GOLD, UGLY VIOLET
DUSTING WITH SOCK MICA WON'T STICK
SILVER STAIN MAKES LOVELY AMBER COLOUR
JEWELLER ROUGE - FINAL POLISH FOR GLASS
FLUX II-II FLUX LOWERS THE MELTING TEMP, SO IF YOU ADD IT TO POWDER IT LOWERS THE MELT TEMP AND CREATES A GLOSSIER FINISH
AS KUGLAR POWDERS HAVE A SURFACE AKIN TO SANDPAPER BECAUSE THEY HAVE A HIGHER MELTING POINT
ENAMELS ARE GLOSSIER, SO COMBINED WITH KUGLAR THEY ALSO MAKE A GLOSSIER MELT
BE VERY GENEROUS WITH THE KUGLAR POWERS
THE HOTTER THE GLASS THE MORE THE COLOUR WILL BURN AWAY BUT THE BETTER TOP SURFACE YOU GET
LINE MOULD WITH SILVER FOIL - GIVES GOOD REFLECTIVE QUALITY
BE VERY GENEROUS WITH THE KUGLAR POWDERS - THE COLOUR COMES OUT BETTER - RICHER
SILVER LEAF STICKS TO THE PIECE IF YOU SPIT ON IT
VERMICULITE IS PUFFED UP MICA
SILVER LEAF
LEAD GLASS - TURNS SILVER ✓ BEST
BARIUM GLASS - TURNS YELLOW


Sand Boxes
A Bucket full of Sieved Sand in Reserve
Do not push up sand like so as your edges will be unstable
If there's a lot of moisture in sand it will bubble through the glass - which is bad unless you do it on purpose for aesthetical reasons
Torch sand before casting as it takes away moisture and it heats up the mould
When a piece has been cast it's preferable to leave the excess sand on, as it will insulate the pieces. If you keep it in the sand box, all the better.
If you want to make multiple casts in a sand box, use steel plates to divide them.
Annealing
Problem
Glass is bad conductor but good insulator
Annealing Cycle
510°
2° Glass 2hr
4° Glass 8hr
Libensky Annealing Philosophy
Soaking is the key (510°)
Valien Annealing Philosophy
510° - Straining point is the key
Large inclusions make a considerable difference to annealing cycles
Nov 02 Compatability test
Encase cfy glass in clear of your own type of glass then heat each end of the cane with the torch. If the two glasses aren't compatable the cane will literally shatter.


Special Sand Cores
Co² Sand - don't use any water so it's clean
Sodium Silicate a.k.a. Water Glass, King Glass
80-100 Mesh Silica Sand 3-10% Sodium Silicate
The courser the sand the more silicate you need
10 lb of pressure for 10 seconds makes very strong sand core
Techical Colour Notes dec 02
Thick Colour
Blue - Black - Green - work well in big areas in a piece
Red - Yellow - White - work well incorporated with above colours and in small areas in a piece
Cutting lines into sand after colour has been applied
Paradise on copper
Crumbled sand in perfect cast then colour sprinkled over the top
Thin sandcast figures - not thick in any way - they don't look sensitive.
Randolph's Lead Crystal Feb 2003

## Appendix 5 – Scale

A query arose regarding scale; visually and conceptually speaking how large or small should a form be in order to give the necessary gravitas to the concept? This was a pertinent question as it is often thought that bigger means better. Take for example Anthony Gormleys 'Angel of the North', it is big but a landmark must be big in order to have an impact on the region in which it stands.

Written in the 4th century BC the Greek text 'Poetics' by Aristotle was concerned primarily with dramatic theory and is still used as a manual in Hollywood screenwriting courses in the 21st century (Hobbs, Halliwell, Lowe, & Morris, 2011).This manuscript endeavoured to critically account for and construct success in the art of imitation, namely theatre and poetry. Parts of this text can be ascribed to aspects of painting and sculpture.[38] In relation to scale Aristotle put forth a pertinent argument concerning the correct scale for any one piece of work. *'A beautiful object… must not only have an orderly arrangement of parts, but must also be of a certain magnitude; for beauty depends on magnitude and order. Hence a very small animal organism cannot be beautiful; for the view of it is confused… Nor, again, can one of vast size be beautiful; for as the eye cannot take it all in at once, the unity and sense of the whole is lost for the spectator'* (Aristotle, Poetics, 1996, p. Book VII). Aristotle was also an esteemed biologist, which accounts for his references to organisms.

Therefore works must not be large simply because it is possible, nor should they be so small that the essence could be lost. They should be exactly the correct size in relation to the component parts of the theme and where they are placed for observation by others in the future. Whilst chapter 4 demonstrates the satisfaction of aim 3 which was to *produce a body of artworks in glass that develop and demonstrate the potential of incorporating flameworked glass components into sandcast glass forms from one artist's perspective as a critical study which others may adapt and build on in the*

[38] The Ancient Greeks at this time did not attribute greatness to art or sculpture, for them this was an occupation for Artisans and not considered an intellectual undertaking, as opposed to philosophy, mathematics, poetry and the like.

*future*, the works created during this PhD were approached with these Aristotelian ideas in mind. Creating pieces exactly as large as they should be in order to create the best visual impact on the viewer and relative to the space in which they are viewed.

# Appendix 6 – Example published article



# Viking beads re-born

Julie Anne Denton

## Making and demonstrating with an ancient glass bead furnace

The following practice-led research involved building and using an ancient bead furnace at the Luxembourg glass symposium. In 2007 I created a replica of a 92-bead Viking necklace in glass, amber, jet and faience. It was found in the 1980s during an archaeological dig conducted at Peel Castle in the Isle of Man (Fig 2). The archaeologists also unearthed the remains of a female buried with a number of grave goods. This woman, who is now referred to as the Pagan Lady, is considered important due to her burial position, and the quality of the goods interred with her. The necklace is conjectured to have been hers. As Manx National Heritage were creating their new Viking gallery in the Manx Museum, they had all the articles of significance remade. This included swords, jewellery and clothing. My role in the project took three months of careful measuring, colour matching every bead and creating the replicas whilst developing a new technique to age the beads using modern equipment.

Later the project progressed further in the form of disseminating these newly acquired techniques through teaching to glass enthusiasts and archaeologists. The bead shown in Fig 1 was excavated by Per Lundström between 1958-1973 at Paviken, Gotland, Sweden. Paviken was a Viking seasonal trade settlement which has had further excavations between 2013-2015 (Burchell, 2015). Its characteristics are so similar to one of the Pagan Lady necklace beads; this suggests that the two beads were made in the same region. Little formal research has been made concerning the origins of the Pagan Lady beads (which is where my interest lies), excepting the work of Dr Carole Morris who argues that one of the beads – the 'string bead' – originated in Ireland (Morris 2001).

I travelled to Denizli in Turkey to meet Dr Önder Küçükerman, who wrote the definitive text on ancient techniques of Mediterranean glass beadmakers (Küçükerman 1988). Previously, I met and observed Torben Sode (Fig 3) as he was creating an ancient Viking bead furnace at the International Festival of Glass in Stourbridge in 2008. When I met Dr Küçükerman he revealed that he and Torben had worked closely together for a number of years.

Since then I have reached the final stages of my PhD researching the combination of sandcasting with flameworked glass inclusions. As part of my research I was invited to attend the International Glass Symposium in Luxembourg 17–21 August 2015, to help build and fire an ancient furnace created by Ed van Dijk (Netherlands). I wanted to undertake this opportunity to give me a fuller understanding of the old furnace and glass making processes. I felt this would increase my knowledge of lampworking in accordance with the initial research of my PhD studies, providing information I could later disseminate and build upon through academic papers and classes.

I arrived in Anselborn, Luxembourg a number of days before the symposium began, in order to create a furnace made of clay and straw, ready for demonstration to the wider glass community and interested public during the symposium. The structure (as in Fig 5) consisted of an inner chamber which housed two separate areas. The upper component of the chamber was designed to house three small ceramic crucibles which were packed with soft glass cullet. The lower area formed a combustible chamber to heat the glass above. Wood was fed through an outlet from the main structure resembling a funnel. Generating a high enough temperature using only wood and air to melt the glass (between 1000°C and 1100°C) was a time-consuming process. It took 48 hours of adding fuel day and night, to generate the necessary heat.

After two days of close observation the furnace had reached the desired temperature of 1050°C and Ed van Dijk created a core vessel. Ed van Dijk's furnace was not specifically based on the Viking furnace, therefore he decided it was more appropriate to make ancient Egyptian core vessels.

The three crucibles consisted of two separate glass colours and a clear batch. Afterwards I was able to create some beads. Earlier I made my own bead release from bentonite, graphite and kaolin clay and transferred this paste onto the end of the 800mm x 6mm steel tapered rod.

Creating a bead consisted of using one 'mandrel' to gather a small amount of glass and then use this gather to transfer molten glass onto the other mandrel coated in bead release using a coiling technique. →



Fig 1 Opaque polychrome annular yellow wound glass bead with brown symmetrically formed lines. Diameter 7.8mm x 6.1mm, hole diameter 2.8mm. (Photo: Alan Burchell)

Fig 2 The original Viking period necklace from the Pagan Lady's grave, Peel Castle, Isle of Man, now in the Manx National Heritage Museum in Douglas. (Photo: Manx National Heritage)

Fig 3 Historic flameworking in 2008 with Torben Sode at the International Glass Festival, Stourbridge, West Midlands, England. Torben has worked for a long time on re-creating Viking age beads and his book on Anatolian beads and furnaces contains much valuable information (Sode 1997). (Photo: International Festival of Glass)

Fig 4 Furnace diagram by Prof O. Küçükerman

Fig 5 Diagram of ancient furnace. There were a series of openings towards the bottom of the inner chamber. These openings were bunged and alternately opened and closed from the outside to increase or decrease the oxygen flow to the fire pit at the bottom of the internal chamber. There was also a large flue leading from the main chamber which acted as chimney.





Fig 6 Making a bead in an ancient furnace at the International Glass Symposium in Luxembourg (Photo: Vanzo Danov)

Fig 7 The bead made in the ancient furnace shown in Fig 6 (after annealing). (Photo: Dr Andrew Cluney)

Once the bead was made and centred, a third rod was used to gather molten glass from the colour crucible which was transferred to the bead as a twist design. I had the chance to make a series of different types of bead using ancient techniques and my understanding of the process has been enhanced greatly on a practical level (Figs 6 & 7).

Whilst at the festival I delivered a paper detailing the technical concerns relating to the hot combination of lampworking and sandcasting, and demonstrated these new discoveries with Lachezar Dochev (Bulgaria) and Torsten Rötzsch (Germany). The artists and researchers involved in this symposium came from 17 different countries with a concentration on the Eastern European glass scene.

This successful and enjoyable research would not have been possible without the help of the Association for the History of Glass who awarded me a small travel grant. I would like to give them my thanks for this wonderful opportunity.

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# Appendix 7 – Contribution of previous artwork

To assist in unraveling the themes of the current artwork made during this research period, it was important to analyse some of the artworks created prior to the research. The use of rudimentary psychoanalytical concepts have been put in place here to aid the process of categorisation. This is not meant to be a definitive discussion of psychological principles through the medium of art; it is merely a way to aid comprehension of themes.

Figure 106 By JA Denton 'Urban Ancestor' Flameworked borosilicate glass 2005, 600x50x150mm, photography credit: The artist

At first glance figure 106 above can appear to be dark and demonic. The common themes of pain and infection, inflicted by blood colored spikes or fiery extensions of the limbs seem toxic and shocking but a deeper meaning can be constructed and explained through simple critical psychological investigation.

Nietzsche (Kauffman, 1974) provides a valid insight into the darker themes in previous work through perspectivism, which in part says that the ‘ultimate’ death of god (through advances in science and western belief) would lead to people individually reevaluating morals and philosophies and would ultimately leave some feeling that life is meaningless. Figure 106 is a reflection of the perceived lack of meaning in the world and exemplifies a desire to highlight pain.

Sigmund Freud (Wollheim, 1971) born 12 years after Nietzsche devoted his career to developing a theorem to explain the reasoning behind human behavior which to this day is nowhere near comprehensive. An integral part of current psychoanalysis stems from his hypothesis that the conscious mind is in constant conflict with the unconscious mind. This conflict can result in the materialisation of repressed thoughts and feelings which lead to abnormal behaviour. Abnormal being defined as a smaller percentage of the population displaying said characteristic. (Kevin Dutton, 2014)

Freud stated that the subject can free themselves from these disturbances by recognising the unconscious material and bringing it forward to the conscious mind. ‘Urban Ancestor’ shown in figure 106 (p. 267) reflects unconscious observances of the world, the potential or actual pain the world could inflict, and ultimately of mortality exemplified in the form of the devil – A mythical figure related to life after death.

This artwork uses glass as the sculptural conduit to bring forth unconscious thoughts, but many artists their chosen medium in the same manner. There are a number of artists to choose from as an example of unconscious thought revealed,  but Salvador Dali is a prime case in point. Although he created the painting in figure 107, p. 269 for an exhibition with what can only be described as a perceivable amount of tongue and cheek. When viewing his later paintings, it is clear that he struggled with Catholic attitudes towards sex, and the social taboo of finding his female relatives sexually attractive.

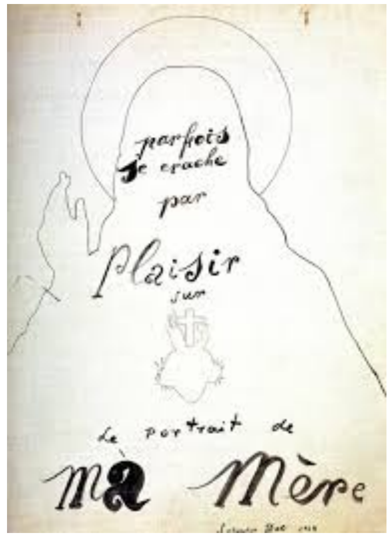


Figure 107 By Salvador Dali 'Sometimes I spit with pleasure on the Portrait of my Mother (The Sacred Heart)' 1929, cardboard and ink, 683 x 511 mm, photo credit Musée National d'Art Moderne, Paris, France

The work of Swiss psychoanalyst Jung (Lawson, 2008), a contemporary of Freud and later an arch rival, was an extension of the foundations of psychoanalysis, Freud's' foundations. Jung's main development was the theory of individuation - the method of self-realisation. Individuation states that for the first half of our lives, humans are undergoing a selfish development that is separated from humanity. During this time man establishes himself as an individual with a focus mainly on materialism and sexuality.

In Venetian flameworking as well as in wider Italian art, the devil is a common archetypal theme (Lorenzi, 1997). Creating a human form is a complex and technically challenging task in any art form, not least flameworking. This is because the observer possesses the innate ability to critically comprehend the human form in terms of proportion and scale. Many flameworkers in the Venetian tradition have used the devil motif both as a cultural icon due to the prevalence of Catholicism in the country, and also as a demonstration of virtuosity. This subject and the series of techniques associated with it have been passed down from generation to generation. Emilio Santini (see section 1.3) taught me how to produce devils during my twelve month apprenticeship with him in 2001, which (in part) contributes to a preoccupation with repeatedly representing the devil or effigies loosely based around this subject in glass form. This repeated representation of the red devil evokes the first aspect of Jung's theory of individuation. Using this form visually describes the narcissistic and hedonistic element of the human animal, as a result of the developing ego.a

Urban Ancestor (Figure 106, p. 267) epitomises Jungs first stage of individuation both in the subject matter and by its consistent use of the colour red (Eckstut, 2014, p. 32) which in relation to colour theory is associated with energy, war, danger, strength, power, determination as well as passion, desire, and love.


Figure 108 Pan represented as the devil in tarot

Not only the colour but the theme as a self-portrait portrays the individual as an interpretation of the mythical god Pan widely depicted with horns and cloven hooves, lustful, energetic and merry, but by definition this creature also represents the pastoral spirit of the hills and woods (Underwood, Dictionary of the occult & supernatural, 1979, p. 259). By referencing Baudelaire, the philosopher accredited with coining the term

'Modernity' theories on modernity (the fleeting, ephemeral experience of life in an urban metropolis which must be captured especially through the use of art) through its glossy, individual and contemporary stance, this Pan figure strolls through the age of disenchantment (Weber, The Protestant ethic and the spirit of capitalism) fated to grow ever nihilistic by capitalism and industrialisation. Dualistically by its nature, as an ancient being 'Urban Ancestor' is positively equipped with the authentic (Taylor, 1995) collective knowledge of generations past making this piece both nihilistic and optimistic at the same time, much in the spirit of Nietzche the optimistic Nihilist (Mulhall, Hughes, & Ansell-Pearson, 2017). The ancestor figure is a wistful, yet strong piece which in relation to the candidate is centered wholly on self.

Figure 109 JA Denton 'Dryad – Spirit of the tree' 2005 flameworked borosilicate glass 400 x 250 x 70mm photocredit Ian Pilbeam

Individuation theory states that in the second part of our lives man reaches a second puberty at around 35-40 years of age. After this time ones focus is shifted to the collective consciousness of community, family and spirituality (Schmidt, 2005). Currently nearing the end of the stage of egotism and hedonism the artworks are mostly 'transitioning' to reflect a more spiritual approach to the themes the artwork deals with during this research period (see figure 109, p. 271 & figure 85, p. 175).

In the artwork 'Dryad – Spirit of the Tree' (see figure 109) attention is drawn to what could be considered a 'collective heritage' - There being more than just the individual. In this artwork the woman is a small fraction of the tree and greater world of which she is part. In the Anima Mundi Rectifier detail (see figure 85, p. 175), the theme of the tree remains but the bold colours of sexuality have morphed into a calmer blue. The **transitional inclusion** technique (see section 3.6.1) has helped to recreate an earthy quality to the piece, giving rise to the second puberty of the artist.

This component of the chapter was devised to give a fuller understanding to the reader of the following themes which will analysed in the next three case studies. It is a remit of this research to place the work created in its correct position in the world of sandcasting, flameworking and/or paperweight making. Section 2.11 examines the most popular living contemporary artists relevant to this field, and this chapter gives a brief prehistory to the artworks and a context of the derivation of possible themes during the research period. The artworks created during the research period are then broken down in the case studies to establish successes and failures both technically and visually. This has been undertaken to finally to compare the resultant final artworks with the relevant artists from the contextual review.

# Appendix 8 – Interpretation

The following quote from ‘Objectivity in social science’ was chosen to indicate that the critque in this chapter is open to interpretation and consequent reinterpretation in the future. *‘There is no absolutely "objective" scientific analysis of culture... All knowledge of cultural reality... is always knowledge from particular points of view. ... an "objective" analysis of cultural events, which proceeds according to the thesis that the ideal of science is the reduction of empirical reality to "laws," is meaningless... [because]... the knowledge of social laws is not knowledge of social reality but is rather one of the various aids used by our minds for attaining this end.’* (Weber, 1904, p. 26) This investigation focused on the use of common motifs from an individuals palette of imagery derived from a life lived. This chapter concentrated on the use of inclusions within a solid glass mass and how successful this combination of techniques were as a tool for the artist in terms of visual expression and technical possibility.

The word success can be used quantitively in terms of the technical investigation, but when used in terms of aesthetics, one can speak merely about success as a generic premise or as a qualitative term. It is not in the remit of this research to define the meaning of aesthetic succes or to make beautiful objects. Paul Dikker who was sited in section 0 claimed that art must be “beautiful”, but in the book ‘Artists with PhDs’, an essay entitled ‘The Future of the Doctorate in the Arts’ counters that Dikkers definition of the relationship between art and beauty raised problems. The following paragraph defines those problems. *‘The traditional standard of beauty in art has been questioned so fundamentally since the nineteenth century that for most critics it can no longer be used as a valid criterion in the appreciation of works of art. To put it mildly there is no longer any consensus on the meaning of beauty in contemporary art. And many observers will rightly assert that the car of the future with its flashy design and exciting new materials, is aesthetically much more satisfying than most specimens of contemporary art’* (Gelder & Baetens, 2009, p. 98)

This chapter of the thesis is not only a technical overview of new and old techniques, but it is also an initial stepping stone from one artists' perspective concerning the task of breaking down into words and refining through contemplation, technique driven research examining the language of the artist. The text in this chapter aims to act as a catalyst for debate and later as a platform for other researchers and/or critics to expand upon.

# Appendix 9 – Kiln firing cycle and Bead release ingredients

**Bringing up to temp – short cycle**

Bungs out due to water evaporation from sand

| | | | | |
|---|---|---|---|---|
| 80°C | -(3.5hrs)- | 380 °C - | 30mins | |
| 110 °C | -(1.5hrs)- | 530 °C - | 2hrs (120mins) | 5hr warming cycle |
| Full | -(10mins)- | 560 °C - | 90mins | |

**Cooling Cycle – 3 day cycle**

| | | | | |
|---|---|---|---|---|
| 10°C | -(4hrs)- | 510°C - | 5hrs (300mins) | |
| 4 °C | -(9hrs)- | 475 °C - | 3.5hrs (210mins) | |
| 4 °C | -(24hrs)- | 380 °C - | 3hrs | |
| 10°C | -(10hrs)- | 280°C | skip | |
| 20°C | -(9hrs)- | 100°C | end | 67.5hr cooling cycle |

**Bead release recipe**

360grams - Kaolin Clay
500grams - Aluminium Oxide
130grams - Bentonite
30grams - Graphite powder

Mix together dry and then add water until a thick cream consistency.

# Appendix 10 – Dissemination through exhibition

Contribution of practice has been recognised in the following institutions and here is a list of relevant exhibitions I have taken part in during the research period:

2017 ‘Collect’ Saatchi Gallery, London, UK

2017 ‘Denizli glass festival exhibition’ Denizli, Turkey

2017 ‘Glas furs Leben’ Vitromusée, Romont, Switzerland

2016 ‘Glaserotica’ Galerie am museum, Frauenau, Germany

2015 ‘Kunst’ Isle Gallery, Isle of Man

2015 ‘Vitrofestival exhibition’ Vitromusée, Romont, Switzerland

2014 ‘Internationale Glaskunstausstellung 2014’ Waldmuseum, Zweisel, Germany

2011 ‘Remarkable’ – Gallery Konschthaus Beim Engel, Luxembourg City, Luxembourg