

Crucible Production in Orrefors

Susann Johannisson

Kalmar läns museum
2015



Crucible Production in Orrefors

Text Susann Johannisson, Kalmar läns museum
Translation Tillie Burden, from Swedish to (British) English
Photographs Susann Johannisson unless otherwise stated
Layout Stefan Siverud, Kalmar läns museum
Publisher Kalmar läns museum (Kalmar County Museum) 2020
ISBN 978-91-85926-91-6

Financing This documentation has been made possible by contributions from Länsstyrelsen i Kalmar län (the Kalmar County Administrative Board), issue number 434-7599-14.

Contents

Introduction	7
History.....	9
Crucible production in the Kingdom of Crystal	9
German clay and English technique – How to make crucibles in Orrefors 2015	11
The clay is mixed, processed and rested	11
The crucible is thumbed by hand and polished with "grandmother's pancake spatula"	16
Rings on the glass	28
Moisture chamber and drying attic	30
Different types of crucibles	35
The crucible in the glass workshop before it can be used	36
The crucible workshop, the pot chamber, the building	37
What is it like working as a crucible maker?	40
The future of the handmade crucible	41
Sources	42
Interviewees	42
Bibliography	42



The crucible is subjected to great stress within the glass oven, where the glass mass can be heated to almost 1500 degrees Celsius. Photo: Peter Meinking/Per-Eric Deckert.

Introduction

Over the years, Kalmar läns museum (Kalmar County Museum) has worked with different kinds of cultural heritage and cultural environments within the Kingdom of Crystal. One of the age-old phenomena that has almost disappeared is crucible production. There has been little documentation on how it works and what it looks like. Therefore, the initiative was taken for this documentation. Thanks to subsidies from Länsstyrelsen i Kalmar län (the County Administrative Board of Kalmar County), documentation work was started in April 2015. As luck would have it, the crucible production in Orrefors had just restarted, after being closed for two years. By a fortunate coincidence, the documentation work coincided within the period between having been closed, but before the production moved from Orrefors to Kosta. The documentation has been possible to the present degree thanks to the help of the active crucible maker Peter Meinking. The work has also been enriched thanks to older documentation work done by Gunnel Holmér, of Kulturparken Småland/Smålands Museum, in the form of an interview with former crucible maker Per-Eric Deckert.

Glass is made of fine-grained white sand that is melted in glass ovens to 1460 degrees Celsius. Because the glass mass reaches such high tempera-

tures, it sets extremely high requirements for the vessels containing the molten glass. The hand-made clay pot is the container which works best. In the past, all glassworks made their own crucibles in special rooms known as crucible chambers or pot chambers. The crucible was called a pot and the crucible maker a potter, in the same way as the word ceramist is used both in Southern Sweden and Denmark, as well as in the English word pottery.

The crucible workshop in Orrefors was the only one in operation in the Nordic region in 2015. The crucibles manufactured here by hand are of significantly higher quality than machine-made crucibles. The machine-made ones are often vacuum-pressed, which makes the clay too dense, which in turn means they have much shorter durability than the handmade ones.

The whole process of making a new crucible takes at least 12 ½ months, but often longer. Once installed in the glass workshop, the crucible needs to be heated from room temperature to 1300 degrees Celsius when it has been installed in the glass workshop. This takes a week. The crucible must also be fire sealed and glazed on the inside before it can be used. The working life then varies between four months and one year.



The crucible mill in Gullaskruv.

History

Crucible production in the Kingdom of Crystal

In the past, all glassworks made their own crucibles. When a crucible was worked, the young boys at the factory often got the job to prise off all residual glass pieces that were stuck to the inside of the crucible. Then the fired crucible parts were pulverised at a mill (crucible mill, stone mill, clay mill). The clay powder was then used in the clay mixture when new crucibles were manufactured. At Boda glassworks there is a well-preserved

unique old-fashioned water-powered mill. Crushing mills of various kinds and ages are still found today in Gullaskruv, Skruv, Björkshult, Pukeberg, Rydefors, Strömbergshyttan, Hovmantorp (today a historical museum) as well as in Rosdala. In the past, the clay was trampled in large vessels before the crucible maker could “work” it. This required a special walking technique. The clay for the crucibles was previously taken from many different small local quarries in Småland, but in later years was imported from Germany.

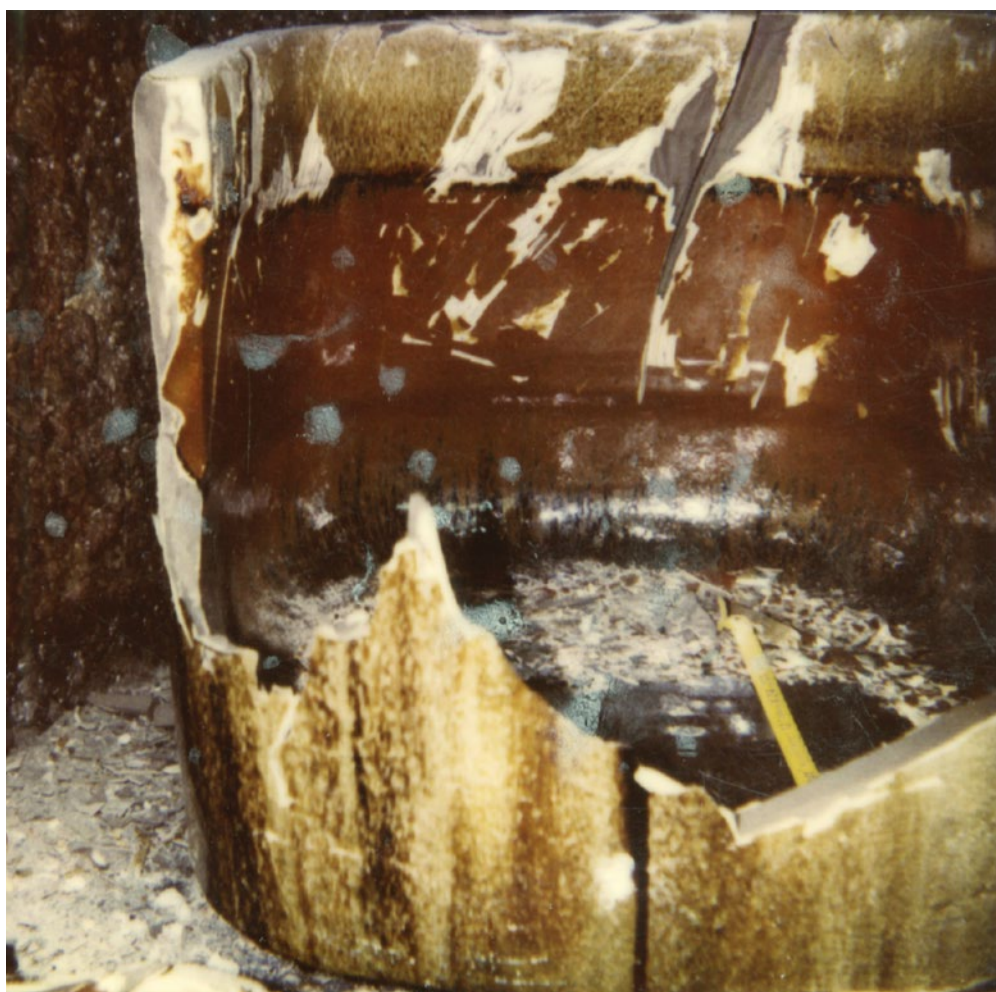


Trampling of clay in the past. Image from The Glass Factory's archive.

The crucible manufacture at Orrefors glassworks has existed since the glassworks started in 1898. When glassblowing was shut down in July 2013 the crucible production was also shut down. At the time, two people were working there: Ulf Nordgren and Peter Meinking. It turned out, however, the machine-made crucibles that were purchased from Europe did not have the desired quality. Therefore production was resumed in Orrefors in December 2014, with a lone man in the workshop. The crucibles manufactured in Orrefors today are not only used in Kosta but are also sold to other glassworks. Each glassworks has different preferences for different types of crucibles; varying sizes, open or closed at the top, or so-called trunk cruci-

bles. In glass production, the molten glass can also be heated in large tank furnaces. These are built on site with refractory blocks. These furnaces are used to manufacture more mass-produced glass, usually for solid glass-intensive products, such as bowls and candlesticks, while the clay crucibles are used for the manufacture of finer, handmade glass.

A crucible used for soda glass can be used for about a year. At Kosta glassworks, where in 2015 production has been 5 days a week, with up to 80 melts, a crucible can last for about four months. Optimal sustainability is achieved by melting new glass mass before the crucible has been completely emptied.



A crucible has a fairly short life, sometimes only 4 months, sometimes longer.
Photo: Peter Meinking/Per-Eric Deckert.

German clay and English technique – How to make crucibles in Orrefors 2015

The clay is mixed, processed and rested

The clay is supplied as a powder in sacks. The clay mainly used is called Grossalmerode clay, extracted close to Grossalmerode near Kassel in Germany. It is taken from a depth of 80 meters below ground level and is of high quality. Both France and England use their own domestic and cheaper clay, but in Orrefors it is judged to be of inferior quality. In Orrefors, two kinds of mixtures are common-

ly made. One is called Sandvik. It consists of 50% chamotte, which is fired clay (in the past this was equivalent to old crushed crucibles) and 50% raw material. The second mixture is called Orrefors and is used for crucibles for crystal glass production. The mixture of clay also contains some phelt-stone (an alkaline clay). The clay used in crucibles for half crystal is said to be acidic and the clay for solid crystal crucibles is alkaline.



The clay from Germany is delivered dried in sacks.



Sack emptying machine.



Clay extruder.

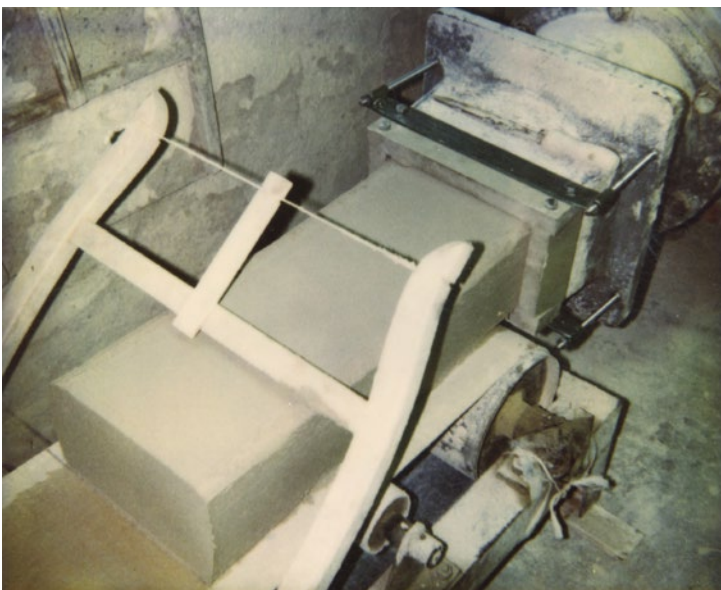


Clay extruder. The clay is pushed out in square lengths, which are stored on pallets in so-called casts.





Four casts with clay lie under plastic against the outer wall to mature. In total, these rest at least eight weeks but usually more, sometimes for several years.



The clay is cut using a wire.
Photo: Peter Meinking/Per-Eric Deckert.



The clay is cut into square pieces, where each piece is a good-sized handful before it is used.

The bags with the clay powder are placed in a sack emptying machine and transported to a clay extruder press, about 200 kg at a time. The clay extruder in Orrefors originally comes from Flygsfors glassworks. The Sandvik mix consists of two sacks of each kind plus 40–45 litres of water. The amount of water depends on the humidity. This needs experience and a feeling to see and feel what is appropriate because it can vary. From the clay extruder, the clay is pressed into a square block that is then cut into approximately 50 cm long blocks. The blocks are stacked on pallets. The pallets are assembled in a so-called cast (stöpa), which holds a total of about 5000 kg of clay. Making a cast takes 1–1 ½ days. The first casting may rest under plastic for at least 2–3 weeks. The storage in Orrefors is unique in that it also rests against one of the building's exterior walls. The moisture is drawn into the wall, thanks to the construction of the building. In this way, the building itself helps to keep the clay at the right humidity level. Whether this was intentional or a lucky coincidence is unknown today. After at least 2 weeks of rest on the first stack, the cast,

the same clay is run through the extruder again. If needed, more water is added. This process – resting and working in the press – is repeated at least four times before the clay has reached the right consistency. This process causes the clay to “stabilize” or “mature”. When the clay on the first pallet has been run through the extruder again, the pallet is moved one step and a fresh pallet is placed at the beginning of the row. There is space for four pallets. The first time, the clay is sandy. When finished, it should be tough and elastic but still possible to break. Again, experience and the right touch is required. The clay needs to go through this process with a rest for at least 2–3 weeks and is mixed again in the clay extruder four times before it is ready to use. In total it takes at least 8 weeks, but usually it takes several months, depending on consumption. The longer the clay rests, the better the clay. After the last rest cycle, the clay is again run through the extruder to make blocks. These are cut into small square pieces, where each piece is a good handful. Now the clay is ready to be used for the production of the crucible.



Peter Meinking shows the round shape used for the base of the crucible. The wire saw hangs on the cupboard in the background.

The crucible is thumbed by hand and polished with "grandmother's pancake spatula"

To make the crucible's base, a round mould is used. The clay is pressed, stretched and scraped out into the mould in thin layers, a total of about 10 cm. It takes about 3 hours to make a base. The extra clay is cut off with a wire saw. The surface is smoothed with masonite or plastic board. Afterwards, the mould with the base plate is turned using a crane and is placed on a gravel bed on a pallet. This means that the clay can move slightly as it dries and makes it easier to transport. The mould is cut loose, smoothed and allowed to rest overnight.

The wall of the crucible made be done in one go. Creating the wall for a crucible takes about 9 hours for one person, if you are two substituting each other it can take about 8 hours. 300–450 kg of clay is needed for a crucible. It is said that the walls of the crucible are thumbed, but they are actually pressed by hand. A sheet metal template is placed 9 cm inside of the base's outer edge. The exterior of the template is covered with a damp cotton cloth, pulled as tightly as possible against the template. A rectangle of clay, cut into handfuls, is placed on a pedestal in the centre of the crucible to be close at hand. Then the clay is worked up, one layer at a time all the way around and all

A base that is being finished, placed on a lifting table. Photo: Peter Meinking.



The finished base is turned upside down on a bed of gravel. Photo: Peter Meinking.





Peter Meinking shows how the wire saw is used when the base is finished.



Gravel is used under the crucibles so that they do not get stuck.



Moulds for bases.



The sheet metal template is removed when the ten layers of the crucible are finished.



The crucible is "thumbed" by hand in 10 layers, according to the English method taught here by an Englishman, Mr Totel, 1947. The work has to be done in one go and takes 9 hours for a single man.

the way up. The crucible becomes more solid if the first two layers are worked all the way up. The crucible construction should cone upwards. On the top edge, a ring template is added to check the thickness. Excess clay is cut with a wire saw. The exterior of the crucible is smoothed and visible blisters are closed. When finished, the wall of the crucible will have 10 layers of hand-pressed clay. Every layer is 1–1.5 cm thick. Thicker layers also occur, as do only eight layers. Thinner walls can be made faster, but the crucible has considerably

lower durability. When working up a crucible you want a looser clay at the bottom and harder clay the further up you get. The outside surface must be pricked and polished to remove cavities. As long as there's pre-prepared clay, the workshop at Orrefors can make roughly one crucible a week. However, the rate of production depends on how many people work in the crucible workshop. If there are several working, various preparations required for the clay's processing can be done, so that the workflow is better. Several people in the



Zvonko Kulianać working with a crucible in 2006. On the wall is a pair of long pliers that can be used if you drop a cloth or knife in the crucible when it is almost finished.

workshop also mean that the staff can be rotated. Furthermore, the crucible makers are often responsible for repair work related to the crucibles in the glassworks.

The method used in Orrefors is an English method, taught by a travelling Englishman, Mr Totel, in 1947. He is said to have visited Kosta as well as other factories around this time. This method can be compared with the so-called German method where the template is on the outside and

the clay is pressed onto the walls of the template from the inside. Being a crucible maker is hard work. It requires a special touch and resolve. *“It helps to be tall, so you can reach down and plaster the inside...”* (P-E Deckert, 1997). The lifting table is an aid that helps to reach better, which is especially necessary when the high trunk crucibles are made. Before the modern lifting table, the crucible maker built a platform on blocks. If any object is dropped, such as a cloth or knife, long pliers are used to reach the bottom and pick up the object.



A started crucible. Photo: Peter Meinking.

The smoothing of the outside of the crucible is done with a knife or a “pancake spatula”. The best knives and shovels are made of old Swedish steel. The tool wears hard. After 2–3 years a tool is at its best. Then they last for another 5–6 years before the blade is completely worn out. As the cotton cloth dries faster than the clay, the mould

and cloth are lifted when the walls of the crucible are finished. Then the pot is allowed to rest overnight. On day two, the joint between the base and the wall is strengthened. With more clay, the 90° angle is rounded off between the base and the wall. The inside is polished.



Peter Meinking shows how a piece of clay from the clump in the centre is used. The clay is on a pedestal in the middle to be close at hand. The clay is struck and pressed into the wall of the crucible, according to an English method.



Working on a crucible in the 1990s. Photo: Peter Meinking/Per-Eric Deckert.



A modern lifting table, which makes it easier to access the upper parts of the crucible, especially when a trunk crucible is being built.

If the crucible is to become a trunk crucible then the top is made. This takes 4–5 hours to do. Then the crucible is allowed to rest overnight. Finally, the crucible is smoothed on the inside and eventually closed. The trunk is made freehand, but the various glassworks' dimensions of gathering holes and desired designs are available as templates. For example, the Kosta crucibles have an extended ledge at the lower edge of the door. Reijmyre does not have this edge, but rather they wall up a similar edge themselves. There is also a can of oil on the workbench, which is used to oil moulds and templates so that they will release more easily (formerly engine oil was used, today chainsaw oil).

When the crucible is finished, it is marked with a crucible number between 1 and 1000, the date of manufacture, the dimensions of the crucible and the type of clay mixture it is made of. SV (Sandvik) means a clay mixture suitable for half crystal and OF (Orrefors) solid crystal. The marking is done with the help of stamps in wood, manufactured in the wood mould workshop at the glass factory. The data is then entered into a journal. There has always been one, so you can go back and see the statistics on production. In modern times, the journal is also used to find out why a certain crucible broke prematurely, to improve production.



The ring template shows how thick the crucible will become.



A knife, or most preferably "grandmother's old pancake spatula" in Swedish steel, is used to polish the outside and prick cavities. After several years of use, the spatulas are characteristically worn down.



Different templates are used as guidelines to get the desired dimensions, which vary between different glass factories. A dimension is drawn on the wall.



Various types of rings that will lie and float on the molten glass are also manufactured in the crucible workshop. This clay does not need to rest for long, and can be made from the first cast.

Rings on the glass

In larger crucibles, clay rings that float on the glass mass inside the crucible are used. Gathering glass mass is done inside of the ring, meaning a smaller area has to be kept clean. The ring is made of the same clay as the crucible, but directly from the first cast. It is made by knocking out a smaller square lump of clay, rolling it out, and hitting it with wooden batons to the same dimensions as two blocks used as a measuring stick. The ring is smoothed, placed on its edge and laid around a round wooden shape. Then the ends are knotted together. On day two the ring is turned and the heels are made. The rings do not need to dry in the humidity chamber but dry as a first stage on shelves on carts in the crucible workshop, for about 14 days. They are then stored together with the crucibles in the attic. The rings are labelled,

because they are made of different types of clay mixture. The rings can be made as whole or openable rings. The disadvantage of an openable ring is that contaminated glass mass can creep into the middle of the ring, which results in poorer quality. However, they have the advantage of that you can change the ring in a trunk crucible during ongoing use if the first ring breaks, thus expanding the lifespan of the crucible. Reijmyre glassworks have used openable rings exclusively, while other glassworks have added them when the first ring has been used up. The rings have different dimensions and can also be round or oval depending on what is to be produced. Support rings are also needed to hold the rings in place in the centre of the crucible when in use. The support rings lie between the crucible wall and the ring and keeps it centered.



The rings are marked with numbers and the clay mixture. Here are rings made of Sandvik mix.



The rings do not need to rest in the humidity chamber but can dry directly in the crucible chamber before being allowed to rest in the attic alongside the crucibles.



An openable ring is easier to put in the crucible but does not work as well.



The humidity chamber in Orrefors is particularly well suited, with asbestos cement ceilings and walls that do not drop water on the crucibles. The inside is heated with the help of lamps to allow the crucible to dry evenly on the outside and inside. One wall has a plastic sheeting that conveys water to a chute so it can be collected in a barrel.

Moisture chamber and drying attic

After production, the crucible is slowly dried in the moisture chamber. In here, the temperature is 30–35° Celsius and RHb 60–65%. A light bulb is also placed inside each crucible so that it will dry more evenly and so that cold air does not remain stationary inside the crucibles. It is crucial to keep moisture from dripping on the crucibles. If that happens, the pot will be ruined and must be re-done. Therefore, the room here in Orrefors is particularly well suited. The part of the wall and ceil-

ing where the crucibles sit is covered with asbestos cement, which absorbs moisture and does not emit or leak water. Another wall is covered with plastic sheeting that collects the moisture and lets it drip into a gutter. The gutter leads the water to a barrel. In this way, the moisture circulates in the room, without leaking water directly on the sensitive clay walls. The various materials and methods in this room have been tested through time to arrive at the present, well-functioning solution. The crucible should be kept in the humidity chamber for at least 5–6 weeks, but preferably longer.



The hatch in the ceiling (in the upper left corner of the picture) and the stairs up to the drying attic, as well as various aids.



Up on the long drying attic, many different crucibles are stored.



The door to the humidity chamber.

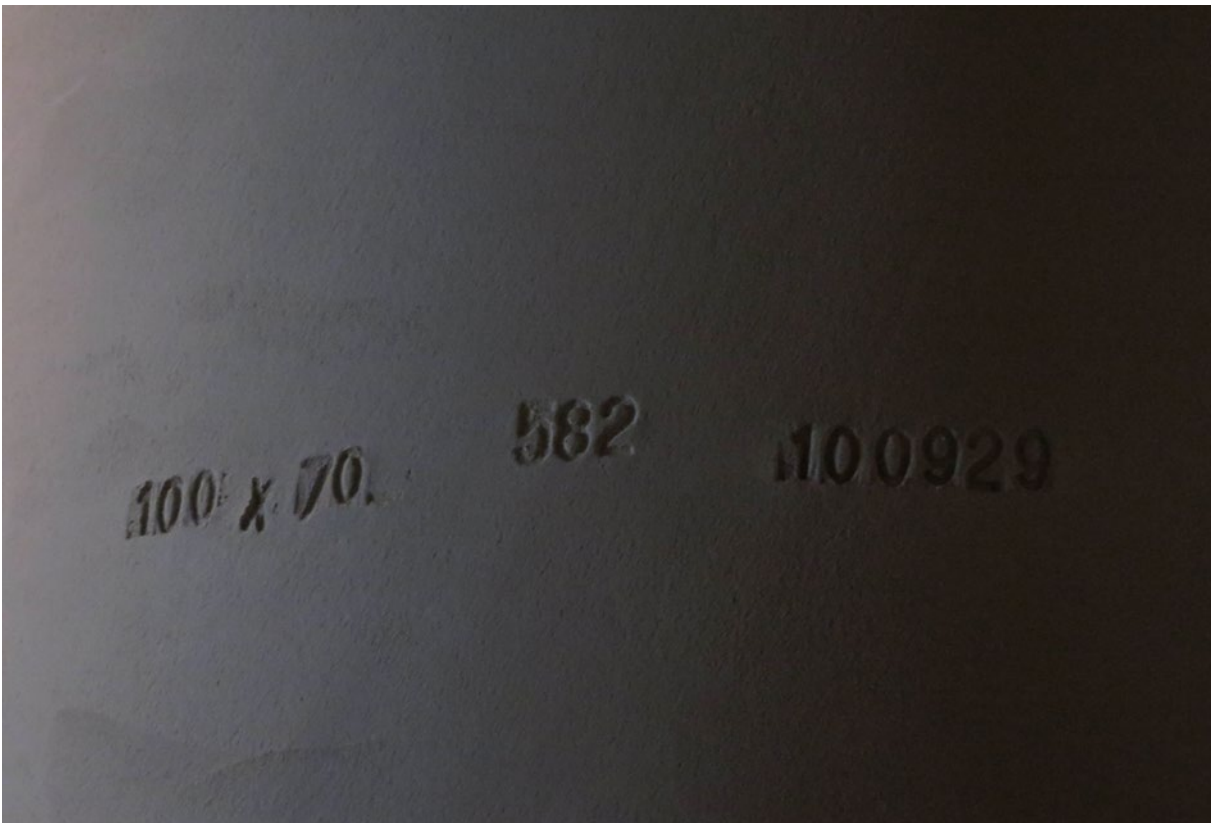


The lifting device to the drying attic.

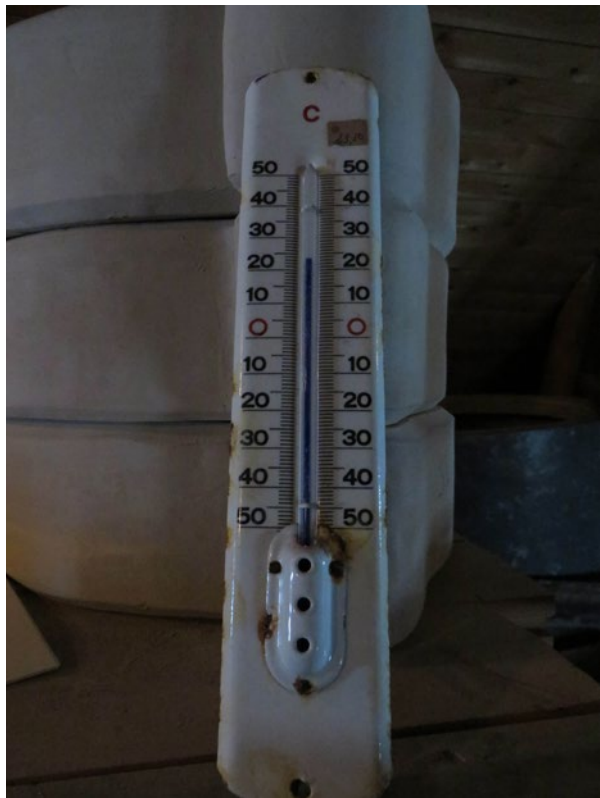
The longer the time spent in the moisture chamber, the better the crucible. In the past, there were no temperature and humidity-controlled rooms. At that time, a crucible held for about 20 melts. After drying in a humidity chamber, a crucible can hold for about 80 melts.

After the time in the humidity chamber, the crucible is removed and placed on so-called grid pallets or ordinary pallets. Then they are hoisted up into the crucible shop's drying attic. There are about 250 crucibles if the attic is at full capacity. Radiators heat the attic to 30–35 degrees or more (in the summer the building is heated by the sun). Open crucibles should be dried for at

least 8–9 months while dome crucibles are dried for at least 12 months. However, they become better and more durable the longer they rest, and so can benefit from being left for 2–3 years. Resting for longer does not damage them, but lets the clay stabilize even more and reduces internal tensions. The rings are also dried in the attic. In the past, there was a corridor between the crucible attic and the glass workshop, for direct delivery of the crucibles, but *“rumour has it that there was too much running here”* so that this entrance had to be closed (P-E Deckert 1997). Short delivery distances are an advantage, and crucibles are not delivered if it is below freezing outside.



The crucibles on the drying attic are stamped with size and date of manufacture.



Temperature and humidity are important in the drying attic. The crucibles should dry evenly.



Trunk crucible.



Open crucibles, photo from 2006.

Different types of crucibles

Crucibles can either be open at the top or closed. The open pots usually have the dimensions 70x100 (diameter x height) or 90x70, the closed ones 105x70. As the clay dries, the crucible shrinks slightly, so a certain shrinkage is calculated in the dimensions. The open crucibles used at Kosta Glassworks 2015 are 105 cm in diameter and 70 cm high. The largest crucibles hold 500–700 kg of

glass. Crucibles are not usually measured in litres. There are also much smaller crucibles used in studio glass workshops. The size is often stated as, for example, “90-crucible”, which means that the outer diameter of the crucible at the top is 90 cm. A 90-pot holds about 125 litres and a 105-pot 305 litres. A special model is the so-called trunk crucible. When Sandvik’s glass mill was closed down, much of the equipment moved to Kosta.

The crucible in the glass workshop before it can be used

The whole process of making a new crucible from clay in sacks to delivery to the glass workshop takes a total of at least 12.5 months (for open crucibles), but preferably longer. In addition, when the crucible arrives at the workshop, it must be kept in a dry, dark, preferably warm, room for further drying. If it is kept in cold and damp conditions, the clay will be damaged and the crucible must be transported back to the crucible workshop and remade. When the crucible is to be used, it must be heated in a controlled manner. This process, an up-tempering with a gradual increase of the temperature from room temperature up to 1300 degrees Celsius, takes seven days (at 100 degrees the unbound moisture evaporates, at 250 degrees the bound water is released, at 500 degrees crystals are converted). The crucible is then transported to the furnace. This must be done quickly, to prevent the crucible from cooling down to less than 650 degrees Celsius, which would have a significant impact on its strength and service life. Once in the melting furnace, the crucible must be fired inside the glass furnace. This is done by raising the temperature to at least 1430–1480 degrees Celsius over a period of 6–12 hours. This decreases the porosity of the clay and makes the surface more resistant to the hot, molten glass. After firing, the crucible is glazed with cullet (recycled glass shards), which are thrown into the crucible, melted and smeared onto the inside of the crucible. Only then can the first melt be made and the crucible used.

The clay's path to a finished crucible

The clay is kneaded and matures	8–16 weeks
The crucible is thumbled by hand	2 ½ days
Rest in the humidity chamber	6–16 weeks
Drying in the attic	9–16 months
Heating at room temperature	8 days
Total	At least 12.5 months

The crucible workshop, the pot chamber, the building



The crucible workshop in Orrefors functions well. It is built with load-bearing brick walls and is located in the utility area behind the old glassworks.

The rooms used as a crucible workshop here in Orrefors have been particularly well suited for their purpose. The walls consist of load-bearing brick walls, which on the inside are lined with a reed mat and plastered. These walls allow the movement of moisture through the walls and therefore help to stabilize and keep the moisture at an even level during the period when the clay rests in the cast. The humidity chamber is covered with asbestos tiles on the walls and ceilings where the crucibles sit. This means that moisture is not able to drip onto the crucibles. If water were

to drip onto the crucibles they would inevitably be damaged and the process must begin again. Part of the moisture chamber has plastic sheeting clamped along the wall. This collects moisture and lets it drip into a gutter that collects the water in a barrel. In this way, the moisture is kept at the correct level in the humidity chamber. The attic is well-suited for the drying and storage required. Lifting the crucibles into the attic isn't easy, but possible using a crane and an interior hatch. The floor of the attic has been covered with sheet metal because the old floorboards were so worn.





The brick walls of the house with plaster on reed mat interiors are particularly well suited for storing the clay, as moisture is transported through the wall.

What is it like working as a crucible maker?

Peter Meinking has worked with crucible manufacturing and repair jobs relating to furnaces for over 20 years. It is not ideal to be alone in this production because a person must then do all the steps. It does not flow as well, with constant stops in production. It is also not ideal to be by yourself when the wall of the crucible is to be thumbed, since it takes 9 hours. This work must be carefully planned. It is important to stay healthy the three days in a row that it takes to make a crucible. It is also physically heavy. "The work is strenuous," says Peter.

The crucible maker also has several other responsibilities, such as various maintenance work on furnaces, castings, stone chamber operations and more. In the past, several people worked in the crucible workshop. Theo Deckert and his son Per-Eric have also worked here.

Both in terms of status and salary, crucible production is both historically and today lower than that of glassblowers. This was also evident in the past as the homes that the crucibles makers got were smaller than, for example, the glassblowing masters.

The future of the handmade crucible

In 2015, two years after Orrefors was closed, Kosta Glassworks is doing well. Several glassblowers have been re-installed in the glass workshop there. After a few years using the imported machine-made crucibles, which were found to be of inferior quality, production was resumed in Orrefors in 2014. It is gratifying that their handmade crucibles are of significantly higher quality than the machine-made crucibles. Therefore, the

locally produces ones are both cheaper to make and last longer. Transport is another problem, which increases with the imported crucibles and which is an advantage when the crucibles are made in Småland. The plan is to move production to Kosta. This way, it will be allowed to continue. Målerås glassworks have placed orders, as well as several other studio glass workshops.

Sources

Interviewees

Peter Meinking, Orrefors Kosta Boda AB,
interviewed by Magdalena Jonsson and
Susann Johannisson, Kalmar läns museum,
2014

Per-Eric Deckert, interviewed by Gunnel
Holmér, Kulturparken Småland/Smålands
museum, 1997

Bibliography

Boken om glas, Glasfo, 2005

KUL-projektet i Glasriket, slutrapport,
Länsstyrelsen i Kalmar län, 2006

Glasbrukens byggnadskultur, Länsstyrelsen i
Kronobergs län, 1998



Adress Box 104,
S-392 21 Kalmar

Telefon 0480-45 13 00

E-post info@kalmarlansmuseum.se
Webb kalmarlansmuseum.se

