Making glass beads from the past

The article describes experiments testing manufacturing methods of glass beads in the Scandinavian Iron Age.

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Beads have decorated people in all times. They have been used as pure decorations but also as amulets. These were believed to protect their owner from diseases and evil thoughts. Beads have been made of materials such as amber, animal bones, seashells, animal teeth and glass (*Sode 1996:7*). While most materials were transformed into beads by polishing, there were at least three ways of making glass beads. Glass could be turned into beads by being polished. Glass beads were also made by pouring melted glass into forms (*Crona 1998:3*). A third bead making technique was the winding technique. In this technique melted glass is wound around an iron rod (a mandrel). Today we know that the predominant technique used for prehistoric glass bead manufacturing was the winding technique (*Callmer and Henderson 1991:146*). This knowledge is based on visual analyses of prehistoric beads as well as finds of equipment used for making winded beads. (**Fig. 1, 2**)

When using the winding technique many bead makers today prefer to use separators on the mandrels to get the beads off more easily and so did many in the past. Today the bead makers use salt or kaolin clay as separators. The big question is then: what separators did the prehistoric bead makers use if any?

Another central question considering bead manufacturing is: is it possible for one person to make reticella rods, reticella beads and beads with advanced patterns, or are more persons needed? Callmer and Henderson write: *"It takes two people to draw rods and the turning of reticella rods is best done by two. These two artisans must have been served by one or two helpers who tended the oven"* (*Callmer and Henderson 1991:147*). (**Fig. 5**)

I agree that one person has to handle the bellows, but is it possible for me alone to produce twisted rods and beads with advanced patterns as eye beads and reticella beads?

Many of the bead makers in the Viking Age went to markets and sold beads that they produced there at the markets (*Dominic 1990:23*). As a mobile bead maker you would prefer as few tools as possible. Therefore, I wanted to see if it is possible to produce melon formed beads, segmented beads, eye beads and reticella beads with the help of pointed rods, mandrels, a knife and a pair of tongs? Or are additional tools needed for such work?

Archaeological evidence for beadmaking in Scandinavia

In Scandinavian Iron Age trading-centres archaeologists have found bead workshops containing glass waste, broken beads and tools used in the beadmakingprocess. In Sweden, Paviken, Helgö and Åhus are examples of such trading sites while Ribe and Sorte Muld are Danish sites. If we put the finds from these sites together we will have the following picture of how bead making was carried out in Scandinavia during the Iron Age:

- Burnt and unburnt layers of clay from Ribe and fragments of furnaces from Åhus strongly indicate the use of hearths and furnaces in the bead making process. However, the appearances of the hearths and the furnaces are uncertain.
- Fragments of glass and mosaic pieces reveal the appearance of the raw material used for glass beads.
- Iron pans, together with "punty-glass",prove the use of puntyrods.
- Iron pans from Ribe, Armagh in Northern Ireland, Garryduff and Lagore Crannog in Ireland, prove that the bead makers at these places preheated their glass fragments on the pans before pressing them onto the punty rods (*Sode 2004*:86).The pans might also have been used for cooling down the beads.
- Mandrels from Ribe and Paviken prove, together with visual analyses of beads, the use of the winding technique.
- Broken and unbroken discarded beads prove that the Scandinavian bead makers mastered advanced bead patterns such as reticella and millefiori.
- Analyses of "non-glass" rests in the bead holes of beads from Ribe prove the use of separators.

With the above given evidence of tools and materials used for bead making in Iron Age Scandinavia, I wanted to answer some of my questions by making glass beads with as authentic tools and materials as possible.

Raw materials for the experiments

The Scandinavian glass bead maker used glass rods, tesserae (mosaic cubes), fragments of glass and glass ingots as raw materials for producing the glass beads (*Dominic 1990:27*). The trade with glass fragments is extensive in the Mediterranean area during the Iron Age. We know this thanks to written sources as well as trading ships full of glass fragments found on the bottom of the Mediterranean Sea (*Sode 2004:87*). From the Mediterranean area the glass was then transported onwards to Scandinavia.

Tesserae were also used for glass bead making in Iron Age Scandinavia. In Ribe (Denmark) the archaeologists excavated 762 pieces (*Sode 2004:88*). The mosaic cubes could be looted goods from abandoned Roman villas. They could, however, also come from glass workshops in northern Italy. Large quantities of tesserae were produced here at the same time as Ribe flourished as a market place (*Jensen 1991:37*). In my experiments I chose to use fragments of glass as well as tesserae as raw materials.

Fig. 1 Ironpan from Konstmuseets have, Ribe

Fig. 2 A mandrel with a handle from Dommerhaven, Ribe

Fig. 3 Millefiori beads from Ribe.

Fig. 4 A beautiful bead made in reticella technique, from Ribe. Photo 1-4: Torben Sode

■ **Fig. 5** Eye bead from Borg, Lofoten

■ **Fig. 7** The melon formed beads got their appearence when making impressions into them with a knife while they were still warm

■ **Fig. 14** Completed reticella rods. The yellow-red and the blue-yellow rods were used in the experiments

My experiments

For my experiments at the Lofotr Borg Viking Museum in Lofoten, I chose to build a furnace. The reasons for this were to gain a greater control of the heat and to use less fuel than in comparison to a hearth. Since there is no knowledge about what the prehistoric furnaces looked like, I was quite free when it came to the appearance of my furnace. I therefore chose to construct a dome furnace with windows according to a model the skilful bead maker Brian Fransson showed me. This resulted in not using iron pans for preheating the glass fragments. Instead I put them in the window of the furnace. (**Fig. 5, 6**)

In the Chieftain's house at the Lofotr Viking Museum at Borg I placed a flat stone, half a meter by half a meter in area, in the middle of the hearth. On this stone I started to build up the furnace.

I built up a dome furnace and used pointed rods and mandrels in my experiments. I used a knife to make impressions in the beads, while a pair of tongs were used for making monochrome and polychrome glass rods. Since I chose to build up a furnace instead of a hearth, I had to preheat the glass fragments in the window of the furnace instead of using an iron pan.

Constructing a dome furnace

Red clay, mixed with 40 % chamotte was used for constructing the dome furnace. The burning-point of the clay was 1000-1280 °C. However the clay had to be mixed with other materials to be able to cope with high temperatures over time.

I chose to mix the clay with large quantities of sand. Previous furnace constructions have proved that the sand gives the furnace stability and gives the constructor the possibility to build up the furnace while the clay is wet without risking that the walls of the furnace collapse or change shape. However, I also wanted to mix the clay with an organic material to gain better insulation of the heat in the furnace. Therefore, I mixed one part clay with one part sand/horse manure (one third horse manure two thirds of sand). The sand was collected from the beach at Borg (Norway) and was then passed through a three millimetre sieve.

Since glass shrinks when it cools, it is important that the cooling procedure is very slow. Therefore I made vessels for cooling the beads and placed these in a hearth beside the furnace. The vessels were made with the same mixture as the furnace.

■ **Fig. 6** The furnace is built up in the Chieftain´s house at the Viking Museum of Lofotr, and is burnt for a couple of hours, until it is completely dry

■ **Fig. 12** The glass lump with four monochrome glass rods is heated up in the oven

Melon formed beads

Making melon formed beads demanded rapid and precise movements. The bead was first heated up until it turned orange, then patterns were pressed into the bead with a knife. The melon formed bead found at Borg could have been made in a similar way. The bead is somewhat asymmetrical which indicates free-hand production rather than use of a ribbed tool. (**Fig. 7/8**)

Segmented beads

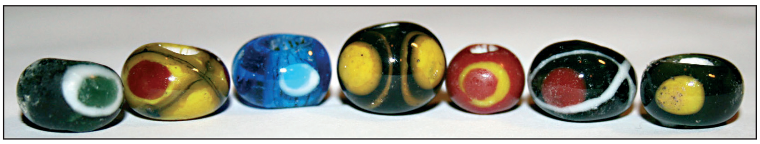
The segmented beads were also made by making impressions. Two-segmented beads, i.e. beads with one impression in the middle, are the kind of segmented bead found in Borg. (**Fig. 9,10**)

Eye beads

I used punty rods with different coloured glasses to make eye beads. I did not need to work fast, but I needed to be very precise when putting the dots on the beads in order to obtain symmetrical patterns. In antiquity in the Mediterranean area the eye beads were used as amulets. They protected their owners from diseases, envy and evil thoughts (*Sciama et al. 2001:15*). (**Fig. 11**)

Reticella rods and reticella beads

Reticella beads are made from twisted glass rods and are made of multiple colours of glass. In order to make a reticella bead you need a reticella rod. To make such a rod a large amount of glass fragments, all of the same colour, were pressed onto the punty rod until a big, oval glass lump was formed. Next, four monochrome glass rods were placed in the window and pressed onto the lump. The lump of glass was reheated until it turned orange. Tongs were inserted into the end of the lump and then used to pull the punty rod and twist it at the same time. (**Fig. 12/13**)



■ **Fig. 11** Eye beads made in the project. The second and the sixth bead from the left are examples of eye bead-types found in Borg

■ **Fig. 15** Completed reticella beads

■ **Fig. 16** – Group 1 Bead with a grey separator, from Eketorp II.

■ **Fig. 18** Group 3 Transparent bead from Eketorp II. No visual traces of separator.

The reticella rods were broken into to the required length. Two were placed in the window. After making a bead, the reticella rods were pressed onto the bead. Finally, a thin string of glass was placed in the middle of the bead. (**Fig. 14/15**)

Conclusions

According to Callmer and Henderson three or four people are needed to produce monochrome glass rods and twisted rods. My work shows that, on the contrary, one person can make plain glass rods or twisted rods. It is also possible for one person to make eye beads and reticella beads.

My work also shows that you just need punty rods, mandrels, a knife and a pair of tongs to produce melon formed beads, segmented beads, eye beads, reticella rods and reticella beads. No further equipment has been used in the experiments and no further equipment is necessary.

Separators

Analysis of the remains from the bead holes on beads found in Ribe, show that prehistoric bead makers may have used separators in the bead making process. The main question is 'what materials were used as separators during the Iron Age?'

Previous experiments

In the late 1980´s Tine Gam carried out bead experiments in Denmark. In her experiments different separators were tried out with various results. One of the beads found in Ribe was analysed regarding the rests in the bead hole. The analysis shows that these rests consisted of large amounts of silicium and small amounts of aluminium, kalium potassium, calcium and titanium (*Gam 1991:167*). The mixture was at first interpreted as ground quartz. Based on this conclusion experiments with quartz as a separator were conducted, but with a negative result. Not even agents such as water, egg whites or buttermilk improved the quality of the quartz as a separator. Experiments with clay as a separator were also done, with a better result. Gam believes the analysis could have been clay since many clay types contain minerals as quartz, feldspar and mica (*Gam 1991:168*). As we can see, not even analysis together with experiments can give a definitive answer. However, with more analysis of beads and more experiments we might get more precise answers in the future.

My experiments

In order to give suggestions as to what materials were used as separators in the Iron Age, I decided to make experiments with separators when making glass beads at the fortress of Eketorp, Öland (Sweden). In my experiments I had no help from chemical analysis of the Eketorp beads. I conducted experiments with various materials to see if they worked satisfyingly as separators and if they left remains in the bead holes, similar to the separators of the Eketorp beads.

At first I visually analysed beads found in the fortress. These analyses resulted in three groups of beads:

Group 1. The first group contains beads with light grey, clay-like rests in the bead holes. (**Fig. 16**)

Group 2. The second group contains beads with black, metallic-like separators in the bead holes. (**Fig. 17**)

Group 3. The third group contains beads with no visual traces of separators in the bead holes. (**Fig. 18**)

The beads from Eketorp seemed to have been made with different separators. Most of the beads belong to group 1. A small amount of the beads belong to group 2 while just a few belong to group 3.

Is the choice of separator due to individual or even cultural preferences? Or did access to certain separators decide the choice? Today we know that bead makers in Turkey use salt as a separator while bead makers in India do not use separators at all (*written information from Torben Sode*).

Clay as a separator

How did different clays work out as separators? Well, local clay from the surroundings of Eketorp, Öland, did not work at all. The problem was that the clay did not come loose from the mandrel when I tried to get the bead off. I tried many times, with the same result. I got the same result with red clay, mixed with 40% chamotte and having a burning-point of 1000 °C - 1280 °C. Unfortunately, none of these clays have been analysed to determine their components. (**Fig. 19**)

Tine Gam has conducted experiments with blue and red clays as separators, with a satisfying result. However these clays are not as good separators as kaolin clay. She considers the low contents of aluminium in these clays to be the main reason for their success (*Gam 1991:168*). Kaolin clay is often used as a separator among present-day bead makers. This clay has a high percentage of aluminium and can be found in Scania, in Southern Sweden, and in Denmark. There is however no evidence of use of

■ **Fig. 8** Melon formed bead from Borg.

■ **Fig. 9** The segmented beads were formed with a knife.

■ **Fig. 10** A segmented bead found in Borg.

■ **Fig. 13** The glass lump with the four monochrome rods is pulled out and twisted until a long "peppermint stick like" rod is created.

■ **Fig. 17** Bead with a black, metallic-like separator from Eketorp II

■ **Fig. 21** Local clay from the surroundings of Eketorp, Öland did not work well as a separator. The clay stuck to the mandrel and thus made it impossible for me to get the bead off

■ **Fig. 22** The kaolin clay left a white layer in the hole of the bead

■ **Fig. 23** Salt from a saltstone worked very well as a separator. The salt reacted with the iron of the mandrel and left black metallic-like rests in the beadhole

kaolin clay as a separator during the Iron Ages. Perhaps more chemical analyses of prehistoric separators can change that statement.

An interesting question is what the separators from Ribe and kaolin clay have in common, since they both work well as separators. One thing is that their melting points are higher than art glassware. Silicium, the main substance in the Ribe separator, melts at a temperature of 1410 °C while kaolin melts above 1600 °C. Another thing is they both contain aluminium.

Salt-and-water solution as a separator

A mixture of 50% fine salt and 50% water was used as a separator. The mandrels were dipped into the mixture, were dried and burnt in the furnace. The mixture did not work very well; the beads became soft and sticky and were very difficult to remove from the mandrels.

Salt from a salt stone as a separator

A third separator was used- salt from a salt stone. This stone contained more than 99% NaCl. In addition there were trace elements of manganese, zinc, copper, iodine, selenium and cobalt. The mandrel was thoroughly rubbed with the salt stone and was put inside the furnace 10-20 seconds before being used. It was very easy for the beads to come loose. I estimate that salt has as good "separator qualities" as kaolin clay. (**Fig. 20**)

Conclusions

The best separators were salt from the salt stone and kaolin clay. The local clay and the red clay refused to come loose from the mandrel while the salt-and-water-solution made the beads soft and sticky when they were about to be removed from the mandrel.

After comparing the Eketorp beads with my beads, I noticed that the kaolin clay is similar to the separators in bead group 1. The separators in group 1 are somewhat greyer than the kaolin clay. However, except for this colour difference, the separators from group 1 and my beads were very similar in appearance. The separators in bead group 1 seem to be clay. (**Fig. 21, 22**)

When it comes to the separators of bead group 2, these resemble the beads made with the salt stone as separator, and indeed the separators look almost identical! (**Fig. 17, 23**)

However a bead made without any separator can leave the same traces as the salt. Here it is impossible to determine whether salt was used or not. A chemical analysis may be able to identify whether salt was used.

In the third bead group, where no traces of separators could be observed, the holes of the beads must have been polished thoroughly. According to my experience, it is impossible to make beads using the winding technique without leaving any traces in the bead holes.

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Written information from Torben Sode

Summary

Reconstituer des perles de verre anciennes

Pendant la Préhistoire, les perles de verre étaient principalement confectionnées par soufflage. La plupart des artisans verriers de l'Age Viking étaient itinérants et vendaient des perles directement réalisées sur les marchés.

L'expérience menée par l'auteur visait à savoir s'il était possible pour une personne seule de produire des perles aux motifs complexes, avec un ensemble d'outils simples. Les résultats démontrent que, malgré les idées reçues, cela est tout à fait possible.

La deuxième série d'expérimentations portait sur les matériaux avec une mise en parallèle avec les découvertes archéologiques. D'autres travaux restent à mener, mais les premières conclusions montrent que le Kaolin, l'argile et le sel issu de pierres de sel sont d'une apparence très similaire à celle des vestiges.

Zur Herstellung historischer Glasperlen

Die vorherrschende prähistorische Herstellungstechnik von Glasperlen war die „Wickeltechnik". Viele Perlenmacher der Wikingerzeit waren „mobil" und verkauften auf den Märkten vor Ort gefertigte Perlen. Die Autorin überprüfte deshalb, ob es für eine einzelne Person möglich wäre, Perlen mit kunstfertigen Mustern herzustellen, und ob dies mit einem einfachen Werkzeugsortiment durchführbar wäre. Die Experimente bestätigten entgegen vorherrschender Meinung, dass dies möglich ist. Die zweite Reihe von Experimenten widmete sich dem Testen von Trennstoffen aus verschiedenen Materialien, wobei die Ergebnisse mit Stoffnachweisen in archäologischen Funden verglichen wurden. Obwohl hier noch weitere Untersuchungen notwendig sind, zeigten die ersten Experimente, dass Kaolinton und aus Salzsteinen gewonnenes Salz gut geeignete Stoffe sind, die auch in derzeit bekannten und analysierten Funden nachweisbar sind.

■ **Jannika Grimbe** is an archaeologist and has specialized on prehistoric glass bead making. She studied archaeology at the Universities of Lund and Umeå. She also studied prehistoric techniques at the college of Bäckedal, Sveg where she started to specialize on glass bead making.

■ **Fig. 20** The mandrels were provided with salt from a saltstone. The salt reacted with the iron and worked excellent as a separator