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Beeswax in Asante Castings: The Then, Now and the Way Forward

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ABSTRACT

Beeswax used for Asante casting by Krofofrom artisans and the Asantehene gild of metalsmiths in the 1700`s are extracted naturally without further chemical treatment to enhance their workability. Although modelling with this wax is very effective, mass production technique now adopted by local artisans and the inflow of machine made artefacts due to globalization has crippled the sale of locally manufactured artefacts. This research dives into various ways of manipulating the natural beeswax using conventional waxes to help achieve complex and competitive designs suitable for the international feed. Qualitative research design approach was used and the descriptive and experimental research methodologies were employed. A comparative analysis was conducted on the production processes employed in the 1700`s and those practiced by various cultures in Africa and experiment was conducted on beeswax to ascertain a suitable wax formulation for the production of complex shapes and sizes using simple Jewellery technique less employed by local metal artisans for casting. It was found that the addition of various additives to the beeswax improved its workability and also the use of Plaster of Paris in wax modelling should be adapted as used in this research for traditional mass production for maximum yield and less stress.

Keywords: Asante casting, Beeswax, Cement mould, Lost wax casting, Plaster of Paris mould.

1.0 Introduction

Metal Casting is one of the most ancient methods of metal forming. As far back as 5000BC, metal objects in the form of knives, coins, arrows and household articles were being used. The casting process is said to have been practised in early historic times by the craftsmen of Greek and Roman civilizations. The principle for casting in metal is that molten metal is poured into a mould whose cavity conforms to the shape of the desired cast. The metal on solidification, crystallization and cooling acquires certain mechanical and physical service properties. The cast is removed and then subjected to other treatment if necessary. This principle works in almost all the known metal casting methods such as sand casting,

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permanent mould casting, centrifugal casting, plaster casting, pressure die casting, shell casting, malleable casting and lost wax casting (Gupta, 1983, Victor, 1990). In West Africa, countries that practice lost wax casting are: Nigeria (Benin, Ife), Ghana (Ashanti Region) and La Cote d`Ivoire. In Ghana, the craft itself is associated with the Asante kingdom, just as gold weights and lost wax casting are synonymous, hence the name "Asante castings". Until the change of currency from gold dust to paper notes and metal coins many of the craftsmen dwelt at Adum Ensuasi a suburb of Kumasi to practise the lost wax casting technique and upon retiring from active service after the demonetisation of gold dust, the craft later took a different turn with regard to production, when some of the metalsmiths (craftsmen) relocated to Krofofrom, also a suburb of Kumasi (Kissi, 2011). The origin of brass casting at Ampabame Krofofrom coincided with the reign of Nana Prempeh I. It is however, still not known when exactly the art of lost wax casting began in Ashanti nor can it be certain that it was Ife, Benin or Egypt where the technique of lost wax casting was acquired. In spite of the lack of clear evidence as to the origin, brass casting is considered an ancient craft of the Asante (Rattray 1923). During the 1870`s, political upheavals in Asante began to affect the casting art. Sir Garnett Wolseley on behalf of the British colonial administration sacked Kumasi in 1884. This action initiated the decline of art and craft in Asante and in effect stopped trading in gold weights. The use of gold dust was banned as currency by the British in 1889. By 1900, the use of foreign English currency had replaced gold dust. Gold weights production ceased and this nearly destroyed the casting craft (Garrard, 1986). This action drove many of the craftsmen from active business leaving only a few to produce regalia for the Asantehene. As the slogan of the people of Asante states: "Asante never dies, when a thousand dies, a thousand will replace like the porcupine". The craft bounced back after the formation of the Asante kingdom. According to Rattray (1923) the art of casting in brass and bronze did not reach any high state of development in Ashanti until after the foundation of the Ashanti kingdom. Descendants of some of the remnants are still producing regalia for the Asantehene and are resident at Ensuasi in Adum, Kumasi. However, lost wax casting as practiced in Asante now cannot be compared to the castings of the 1700`s in terms of quality of craftsmanship and finishing as made known by Ross (1977), who commented on the fineness of the gold weights, and other castings saying: They weigh between one half and one kilogram, but based on a comparison with other Akan gold work, their actual gold content is probably low (between six and ten carats). These hollow castings are relatively thin walled (0.3-1.5 centimetres) yet casting flaws are rare, all referring to the 1700`s castings. This research is significant in that it will help improve the standard of traditional lost wax cast items at Krofofrom in particular to meet global market standard and increase patronage in the sale of cast works from Ghana. It will also help eradicate the negative assumptions made against lost wax cast artefacts from Krofofrom in terms of lack of mastery of the craft and finishing as commented by Rattray (1927): The metal workers who were collected around me to make the series of castings were sadly out of practice. Faulty castings were numerous and failures were costly; the results too were not comparable with the castings of the former times. This research used the experimental and descriptive research approach. Detail description of the casting procedures used around the 1700`s and currently practiced in Ghana were analysed as well as how the craft is practised in some countries. Investigations were conducted into beeswax to ascertain any further working qualities that can improve wax modelling in Ghana. The experimentation of the beeswax was in line with current mode of production in Krofofrom being mass production (Waters, 1993). As per the mode of production, much attention is not given to the treatment and handling of wax properly resulting in undesirable outcomes as revealed by Ehrlich (1989), who opined that much of the wax thread was blurred or was frequently smoothened away in nineteenth and twentieth century Ashanti brass work, indicating a recent lack of care in the handling of the wax components. It was found that the addition of paraffin, candle and kerosene at different proportions to beeswax served to improve the working properties of beeswax. The research also brings to light the use of Plaster of Paris moulds for casting solid and hollow wax models in traditional casting. Modelling processes such as piercing, wax build up and wax carving helped to achieve intricate desirable patterns as well as finishing techniques employed in this research can preserve surface finish quality of locally cast items. This research adds on to the various known casting processes and gives a traditional approach to how Asante casting has been practised in times past and suggest various methods of improving the quality of present day casting done in Ghana under mass production method without losing site on the quality of finishes and craftsmanship. The Asante brass casting differ slightly from what Gupta (1983) and

Sias (2005), opines that there are two methods of investment application: these are solid investment and shell investment. In solid investment, a primary coat (pre-coating) is applied to the pattern which, complete with gating, is then placed in a metal flask and is then surrounded by refractory slurry usually composed of Plaster of Paris and conditioning additives. The shell investment also called "*Ceramic shell*" or "*Cronning process*" uses no flask. A shell investment mould is made by alternately coating the pattern with a thin ceramic slurry then adding a layer of ceramic sand, that is pre-coated then alternately dipping it in a coating slurry with granulated refractory sprinkling or by suspending it in a fluidized bed, until a shell is built up to the desired thickness. This research therefore seeks to give a detailed account of the production processes of the Asante casting used in the 1700`s, those being practiced at Krofofrom with various improvements and suggest a way forward with works produce using the two known methods. Materials and methods for casting used by other countries and those used for Asante casting as well as experimental procedures used in beeswax investigation, various wax modelling techniques and finishing methods have all been detailed in the rest of the text.

2.0 Materials and methods

This research made use of the descriptive and experimental research approach. This part of the research gives descriptive detail of how Asante casting was practiced around the 1700, and how it is done now at Krofofrom, how some African cultures practice lost wax casting as well as India and some experiment conducted by the researcher on bees wax for lost wax casting. It is however not known exactly how lost wax casting was introduced or developed in Africa, as it was practised by West African brass sculptors centuries before the arrival of the first Portuguese explorers in the late 15th century, 1484.

2.1 Benin, Ife and Yoruba

The Yoruba tribe populates cities and kingdoms such as Ife, Benin and Oyo. Ife was the first of all Yoruba cities and the traditions of the Yoruba people began here. The people at Benin also called Bini are descendants from Ife. Benin and Oyo are said to have been founded by Ife rulers or their descendants. The Yoruba Kingdom is remarkable for its brass and bronze lost wax casting. If sculpture is the physical manifestation of three dimensional form conceived in a sculptor`s mind, then the African continent has produced many of the greatest sculptors of all time, even though no single name has ever been passed down. According to Alice (2000), Benin derived its knowledge of brass casting directly from Ife and throughout the entire Yoruba speaking kingdom. The style of Benin and methods of casting are the same as those of Ife. Yoruba people are also known not only for solid and three dimensional hollow (full figure) forms but also for pictorial plaques which are also cast in either copper or brass. In casting hollow objects, the core is produced in clay with all the details and then wax is used to coat the core. Further working is done on the wax to bring out all the details. Fine clay and charcoal composition was used to coat the wax as the first coat to capture the details in the mould. Further coating of coarse composite of clay was applied. Spruing was done and a crucible with brass, copper or bronze scraps was fixed on the gate of the mould. The mould and the crucible were then covered with coarse clay slurry and then left to dry. The entire mould was placed in a heath and fired until the metal melted; by then the wax would have already burnt out. The mould was then turned upside down so that the molten metal flowed to fill the mould cavity. The cast was then taken out and core removed.

2.2 Baule

The Baule tribe of Ivory Coast are well known for their lost wax casting techniques. They are famous for their bronze and brass bead castings. It is believed that the craft was introduced to Ivory Coast by some Akan goldsmiths from Ghana. According to Alice (2009):

> The art of making this jewellery was introduced to Cote d'Ivoire by the Akan goldsmiths from Ghana centuries ago.

These Akan goldsmiths worked for Nana Kofi Adinkra of Gyaman in Ivory Coast who was the chief of the Akan society in Cote d`Ivoire. All the working processes and procedures as well as motifs such as the crescent form, human heads, leopard and other symbols currently used in Baule cast objects are all said to be of Akan influence. The Baule make use of a core in their cast hollow objects. The composition of the core material is finely ground powdered charcoal and clay. Alice (2000) again mentioned that:

> Many of the brasses are actually a thin sculpture of hollow metal. In this case, the wax sculpture is formed over a clay core.

As is the case of the Krofofrom process, wax was formed over the core and the modelling tool was used over it to bring out desired details and effects. Fine clay slurry was then used to coat the work as the first coat to capture the detail in the wax, and the coarse clay layers were applied subsequently to provide strength. The two parts, that is, the core and the moulding materials over the wax were held together by means of spikes whose melting point was higher than the temperature for de-waxing as well as the melting point of the molten metal to be used. Solid castings did not make use of spikes. After the required thickness or layers of mould was acquired, the entire work was allowed to dry and then placed over a heat source to melt out the wax. After de-waxing of the mould, the temperature of the furnace was raised to release any waxy residue. Subsequently molten metal was poured into the mould cavity.

2.3 India

Dhokra casting is one of the oldest techniques of lost wax casting which has been used for over 4000 years and is still in use today. One of India's lost wax cast artefact is the Dancing Girl of the Mohenjor Daro, which dates to 2500BC.

As published by the University of Missouri's Museum of Anthropology (2011), there are two main processes of lost wax casting. The first: solid casting, which is predominant in the south of India, and the second: hollow casting, which is common in central and eastern India. Casting hollow objects is the most traditional method. In the Dhokra process cores were made of clay to the actual size of the work to be cast, taking into consideration shrinkage. The clay core was then covered with a layer composed of pure bees wax, resin from the *Damara orientalis* tree and nut oil. Clay slurry was applied to the wax to cover it. According to Norman (2007), finely ground clay with charred paddy husk mixed with cow dung was used by the metalsmiths in South India for the first coat. Further clay slurries were applied subsequently in different grain sizes from fine to coarse. De-waxing was done over heat. Norman (2007), reports that the south Indians heated the completed mould in an open ground oven using cow dung cakes as fuel for the de-waxing. Molten metal was poured into the cavity thus created, and the metal on cooling was removed followed by other treatments such as cutting of the sprues and polishing.

3.0 Fabrication processes used in Asante casting as practiced then, now and by the researcher

In Krofofrom, metalsmiths developed ideas or took inspiration from natural and artificial objects, from myths, proverbs and daily activities. There were no preliminary sketches made. Whatever idea the metalsmith had was first tried out in wax as sample work. Designs brought in by customers to Krofofrom craftsmen for production were first modelled in wax for the customer's approval before execution, whereas, artisans around the 1700`s explored their creative abilities and did not mostly relay on customer dictatorship and demands.

The craftsman in traditional Asante's community was respected for his creative ability and his command over fire and metal and not necessarily for the money that accrued to him as a result of his profession as a metalsmith. Currently, the craftsman of Krofofrom is respected for the money realised from his products and not necessarily for his creative ability, hence the mass production being seen today based on supply and demand.

The researcher on the other hand developed his ideas from artificial and natural objects such as snail shell, tree barks, maize, Adinkra symbols (Sankofa bird) and geometric forms. These were used to create preliminary sketches and further developments were carried out as shown in Figures 1 and 2.

From the numerous sketches, the researcher selected one and developed it further by twisting, stretching or enlarging until a desired effect was achieved. It was then rendered using a computer aided design (CAD) programme, in this case Rhino and 3D Max, to bring out details in the selected designs, as shown in figure 3.

Figure 1: Preliminary designs from Adinkra symbols and geometric forms

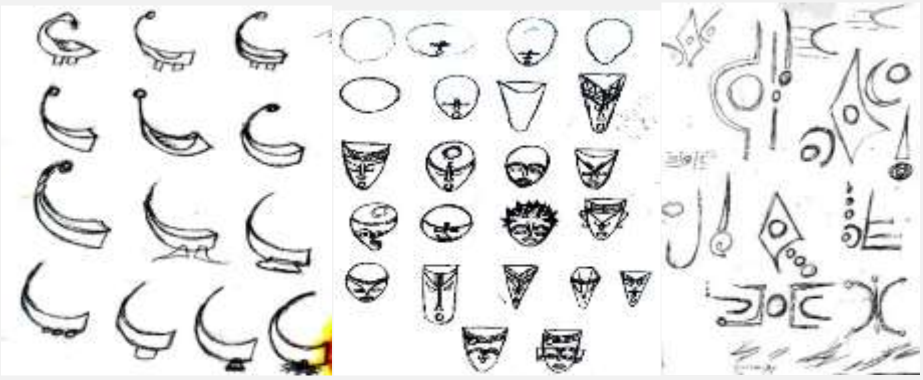


Figure 2: Preliminary designs from natural source

Figure 3: various views of a (CAD) rendered designs

3.1 Material preparation

These are the processes for the preparation of core materials, mould materials and beeswax as was practised then by the Asante craftsmen of old, now by Krofofrom craftsmen and the researcher. Clay, charcoal and fresh cow dung are the three materials prepared and used by the Krofofrom metalsmiths for the production of cores. Initially, core composition used for Asante castings were made up of a composition of only 2 parts clay and 3 parts charcoal. The introduction of fresh cow dung to the core mixture became necessary when the craftsmen of today begun mass production and needed a core that can disintegrate easily after casting to help them meet demand. 2 parts Clay and 3 parts charcoal mixture are still used as moulding materials till today. Charcoal was pounded in a metal mortar with wooden pestle into powder. It was sieved with 120 mesh sieve when fine grains were required and 60-80 mesh sieves when coarse grains were required.

Clay was either prepared in powder form in the same way that charcoal was prepared or lumps of clay were soaked in water to produce clay slip. The clay slip was later sieved with 80 mesh sieve to remove stone particles and other debris that might be present. Fresh Cow dung was collected using shovel and wheel barrow. Stones and sticks were then taken out of the dung. Beeswax is used for producing wax patterns. The wax is drawn out either in wire or sheet form. Beeswax usually contained sand particles due to improper handling by beeswax collectors. There are two ways of getting impurities out of beeswax; first, by keeping the lump of wax in the sun for about 15-30 minutes. A sharp knife was then used to skim the dirty surface away. The second method was to melt the wax over a heat source until it was completely melted. It was then poured through an 80 mesh sieve into a bowl full of water. The wax on cooling and hardening was kneaded for use.

3.2 Wax experiment

Various experiments were conducted to produce a variety of waxes from a combination of beeswax, paraffin, candle wax and kerosene to help improve Asante casting being practised today. Aluminium container and spoon were used because wax does not wet and stick to aluminium surface. Digital scale was used to weigh the molten waxes in grams. The wax mixture samples were labelled as group C (C1, C2, C3, and C4), comprising beeswax and candle. Group P (P1, P2, P3, and P4), comprised mixtures of beeswax and paraffin wax, while group K consisted of beeswax and kerosene. The last group CP1consisted of mixtures of beeswax, candle and paraffin wax. Details of these experiments are as follows:

Table 3.1: *Wax compositions and physical characteristics*

	Composition	Solidification	Weldability	Hardness	Elasticity	Bending
C1	6grams of beeswax to 1gram of candle wax.	Long time to solidify (10-18 min)	Good weld ability	Hard	Excellent	Excellent
C2	2grams beeswax to 1gram candle wax.	Solidifies easily (7-10 min)	Good weld ability	Hard	Excellent	Excellent
C3	2grams candle wax to 1gram beeswax.	Solidifies easily (7-10 min)	Good weld ability	Hard	Good	Poor
C4	3grams of candle wax to 3grams beeswax	Solidifies easily (7-10 min)	Good weld ability	Hard	Good	Good
P1	6grams beeswax to 1 gram paraffin wax.	Longer time to solidify (15-20 min)	Good weld ability	Hard	Very good	Excellent
P2	2grams beeswax to 1gram paraffin wax	Much longer time to solidify (20-25 min)	Poor weld ability	Very hard	Poor	Poor
P3	2grams paraffin to 1gram beeswax	Much longer time to solidify (20-25 min)	Poor weld ability	Very hard	Poor	Poor
CP1	2grams beeswax to 1gram paraffin wax to 1gram candle wax	Longer time to solidify (15-20 min)	Good weld ability	Hard	Very good	Poor
K1	3grams beeswax to 1gram kerosene	Longer time to solidify (15-20 min)	Good weld ability property	Soft	Breaks when stretched	Breaks when bent

3.3 Wax modelling

Lawrence (1981) gives several ways of producing wax patterns. According to him, pattern making is the essential aspect of wax casting and the outcome of a pattern has much influence on the outcome of the cast object. There are several methods of making patterns in wax. They can be produced from direct source: as print from either natural or man-made designs, by carving the design from a block of wax, by wax build up and by forming or wax build up around a core. There are two main types of wax patterns: hollow and solid.

The following are the procedures used by Krofofrom metalsmiths and the researcher in making such wax patterns: First, a natural or an existing pattern was coated with soap solutions and then placed on a flat wooden or an aluminium surface. The design was then covered with cement mortar (mixture of cement and water).It was left overnight. The soap solution was used to coat the pattern to prevent the mortar from sticking to the surface. The design was removed from the cement leaving a negative imprint of the design in the cement mortar. Alternatively, P.O.P could be used in the same way. Thousands of designs could be produced in wax from the imprint in the cement mould. After the design was obtained in the cement mould, wax was softened using a heat source, the cavity in the mould was coated with soap solution and then the wax pressed into the design. A sharp knife was used for smoothening the back of the wax pattern. It was then removed from the cement mould (figure 4). This method is used by majority of Krofofrom metalsmiths.

Figure 4: Pattern after pressing

In cases where the design to be reproduced was in the round, cement mortar was prepared in an enclosed space such as in a box whose four sides could be easily dismantled. The pattern, coated with the appropriate parting solution was set in cement mortar or P.O.P slurry half way of the model. The surface of the concrete after setting was covered with soap solution or oil; another mixture of concrete was used to cover the other half of the design. The solution used to coat the surface of the concrete prevented the two parts of the mould from sticking together. Gating was made in the mould (cement or P.O.P) if molten wax was to be used. In cases where sheet wax was used, gating was not always necessary. In producing a wax pattern from molten wax using cement or P.O.P mould, the wax was heated to its melting point. It is advisable to melt wax in an aluminium saucepan. Wax does not wet and does not stubbornly stick to aluminium surface. The wax should not be heated beyond its melting temperature. Burning alters the consistency and introduces bubbles. The best way to prevent these catastrophes is to watch the melting constantly (Lawrence, 1981). One option is to cut the wax into smaller bits before melting, to ensure a homogenous melting of all the wax. According to Lawrence (1981), another way to be doubly sure of the melt is to check the temperature with a candy thermometer. The temperature should not exceed the flow point of the wax. The wax must be extremely fluid to run into all the crevices of the mould. Before pouring the molten wax into the P.O.P mould, the mould was first coated (figure 6) with a parting solution comprising 70 grams of soap (say, key soap) dissolved in 30 grams of hot cooking oil; this solution, upon cooling turned into a cheese-like mass. After assembling the mould (figure 7), molten wax was poured into it. If a hollow wax pattern was required, the molten wax was left to set for about 5-7 minutes. Setting of the wax could be checked by inspecting the gate of the mould for solidification (figure 8). The mould was then turned upside down to drain out the excess wax in the centre of the pattern (figure 9). If a solid wax pattern was desired, the wax was left for about 30-45 minutes. Wax close to the inner walls of the mould begins to solidify first. So when the mould was turned or flipped over after 5-7 minutes, only the unsolidified wax in the central portion came out through the gate, leaving the solidified wax against the wall of the mould. The wax and mould were left for another 15-20 minutes after which the mould was opened to remove the wax pattern carefully with a small metal rod (figure 10). The wax pattern was later dressed and finished. Casting of the wax pattern should be done in the morning or at room temperature to avoid delay in wax solidification and also the solidification time is much dependant on the size of the wax model desired.

Figure 5: Melting of wax

Figure 6: Coating of mould

Figure 7: Assembling mould

Figure 8: Wax ready for pouring

Figure 9: Pouring wax from mould

Figure 10: Model after casting

Another method of a making wax pattern is by carving the design from a block of wax. This method of wax pattern-making was used only for solid patterns. The wax used for this form of pattern making should be strong enough to withstand cracking. Wax sample that contained paraffin or candle wax was ideal for this method of pattern-making and carved well at room temperature. The design to be carved was transferred to a block of wax. This could be done by drawing directly on the wax with a pointed tool or the design could be traced onto the wax by using a flat tool or coin to press the paper with the design onto the wax. With the artwork thus mounted onto the wax block, a pointed tool or say an empty ball-point pen was used to trace the design (figure 11).

After transferring the design, the paper was removed from the wax block leaving the transferred (pressed) design only on the wax. In cases where the design was to be pierced with a jewellers saw (figure 12), piercing was done with the design mounted on the wax.

Piercing was done by first inserting saw blade into a jewellers saw frame as usual with the teeth of the blade pointing downwards towards the handle of the frame and then tightened, piercing proper then began the shape was carved out by cutting away excess wax with the aid of wax carving tools. Further refinement was done to bring out the desired details using wax modelling tools. Figure 13 and 14 shows carved and pierced wax models.

Figure 11: Transferring design unto wax

Figure 12: Piercing model

Figure 13: Carved model

Figure 14: Pierced model

Figure 15: Built-up pattern

Figure 16: Another built-up pattern

Figure 17: Model around core

Wax build up is another method of making patterns in wax. This method of pattern making makes use of natural wax without additives or with kerosene as additive. In this method, bits of wax were welded together to form a complete whole. The surface of the pattern was smoothened with pattern making tools and a heat source say, candle flame. This method could be used to produce both solid and hollow patterns as exemplified in figure 15 and figure 16.

Another method of wax pattern making is by forming either a wax sheet or wax wire around a core, the core in this case can either be just wax or refractory material. For the sample, the core (refractory material) was shaped to take the form of the object without any embellishment, then a wax pattern formed around it (figure 17). In the case where wax was used as core, the wax was shaped into the core and then was coated with soap solution. Sheet wax was then formed around it; the wax sheet was cut open and the wax core taken out. Further detailing was done on the wax sheet.

3.3.1 Forming of wax wire and wax sheet

Wax wire can be formed by using any of the three methods described below. The first: soft wax is rolled on a flat surface such as on a wooden or glass surface which has been coated with a soap solution (Figure 18). The solution prevents the wax from sticking to the surface.

Figure 18: Rolling wax	**Figure 19:** Extruding wax wire

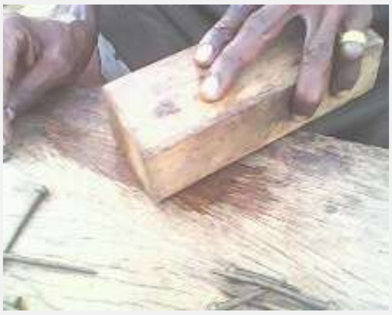
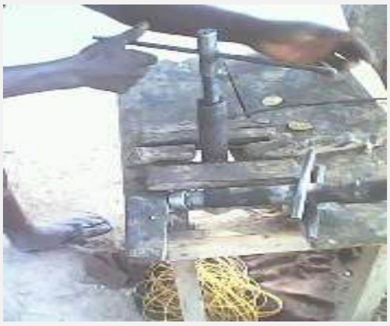
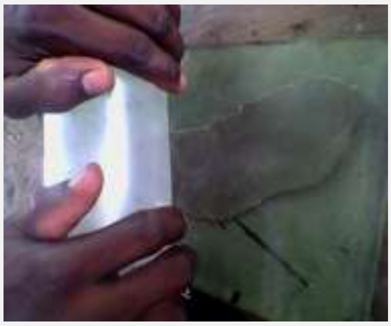



Figure 20: Turning machine handle	**Figure 21:** Pressing to form sheet wax
	

The second method is by softening the wax with heat and inserting the soft wax into a syringe. The wax was then extruded out of the syringe through its nozzle (figure 19). Any size of wire can be produced by altering the diameter of the plastic nozzle which can be subjected to heat and then pressed to close to the desired size. The third method is the use of the wax extruding machine. The machine has two threaded parts but with one outlet, a cup and a handle. It works just like the syringe. The wax can be softened with a heat source, warm water or can be left in the sun for some time. A thick bar of wax was formed from the softened wax. The cup side of the machine was opened and the bar of wax inserted into it. A hole corresponding to the desired size of the wire was drilled in a flat metal disc, that was then slotted into the cup. The cup was subsequently screwed onto the open end of the machine. The threaded plunger was turned by means of a handle to push the wax out through the orifice in the flat disc (figure 20). A continuous perfect size of wax wire was produced by this method.

To produce sheet wax, the wax was first softened by heat. A flat surface such as wood or glass was coated with soap solution; a smooth surfaced bottle was also coated with soap solution. The wax placed on the flat surface was pressed down using glass bottle as a roller until the required thickness of sheet wax was achieved (figure 21).

4.0 Results

4.1 Evaluation of Beeswax

The mode of producing wax patterns by the metalsmiths at Krofofrom has not changed in generations. One wonders whether this is due to the fact that clients are dictating the production process or it is because the craftsmen themselves do not want to move away from the old method of doing things. Any of the assumptions may be true but the question can still be asked as to whether the metalsmiths are meeting the demand of customers or clients are accepting cast objects as they are because that is what the metalsmiths can produce? In the researcher`s discussions with some Krofofrom metalsmiths, it was found out that they have no skills of carving and piercing and the process of providing a good finish for their cast objects was not factored into the production process.

The main techniques of making wax pattern are wax build-up and wax pressing. Some designs are such that when pierced with jewellers saw or carved with the proper wax carving tools, fine edges and an accurate duplicate of the original can be achieved. In this part of the research a series of patterns were developed, cast and finished in an attempt to demonstrate alternative methods of wax pattern making. Beeswax is obtained from the honey comb of bees (Apis mellifera) after the removal of honey; the comb is melted with hot water, steam or solar heat. After removing impurities, the liquid wax is cast into cakes.

The two main beeswaxes that are marketed are yellow beeswax and white beeswax. White beeswax is obtained by bleaching yellow beeswax with hydrogen peroxide, sulphuric acid or sunlight. Beeswax primarily consists of five component groups of a mixture of esters of fatty acids and fatty alcohols, paraffinic hydrocarbons, and free fatty acids; minor amount of fatty alcohols are also present. These five groups amplified below are: free fatty acids (typically 12-14%), most of which are saturated (Ca. 85%) and have a chain length of C24-C32. Secondly, free primary fatty alcohols (Ca. 1%) with a chain length of C28-C35. Thirdly, linear wax monoesters and hydroxyl monoesters (35-45%) with chain lengths generally of C40-C48. The esters are derived almost exclusively from palmitic acid, 15-hydroxypalmitic acid, and Oleic acid. Fourthly, complex wax esters (15-27%) containing 15-hydroxypalmitic acid which through their hydroxyl group are linked to another fatty-acid molecule. In addition to such di-esters, tri- and higher esters are also found. Lastly, odd-numbered straight chain hydrocarbons (12-16%) with a predominant chain length of C27-C33. The composition of beeswax is said to depend to some extent, on the subspecies of the bees, the age of the wax, and the climatic circumstances of its production.

However, the variation in composition occurs mainly in the relative amounts of the different components present, rather than in their chemical identity (Aichholz and Lorbeer, 1996).

Various additives were mixed with beeswax in order to formulate different mixtures suitable for various kinds of designs as well as help give the wax compositions certain desirable properties (see Table 3.1 for details) to facilitate wax working under various ambient temperatures.

A composition that contains paraffin wax took much longer time to solidify when compared to either candle compositions or just beeswax. Candle wax solidifies faster than beeswax and therefore it is advisable to mix candle wax into beeswax and not beeswax into candle wax. Candle wax when molten is colourless and does not give out any smoke until it is introduced to excess heat which in most cases produces smoke. Paraffin when introduced to excess heat makes cracking noise and produces smoke. Beeswax when introduced to excess heat makes a cracking noise and sometimes catches fire. Molten beeswax produces a sweet smell and turns chocolate or brown colour when introduced to excess heat: discolouration occurs when beeswax is introduced to heat above 80-85 degrees Celsius

4.2 Evaluation of castings made in the 1700`s and that of Krofofrom

Castings produced at Krofofrom cannot be compared to those produced by the Asantehene`s guild of metalsmiths at Ensuasi during the 1700s. This is evident in the trial casting organised by Rattray in 1927 about which he commented:

> The metal workers who were collected around me to make the series of castings were sadly out of practice. Faulty castings were numerous and failures were costly; the results too were not comparable with the castings of the former times.

This opinion was also confirmed by Ehrlich (1989), who said:

> The precise workmanship and almost total lack of European inspired motifs in these early pieces are in line with late fine work from the Baule, these characteristics of high creativity and perfection are in sharp contrast to some very late nineteenth and early twentieth century Asante gold works.

The castings that were made in the 1700`s were characterised by high creativity and perfection. The craftsmen's means of production in the 1700`s was not in any way near the mass production processes used by the current crop of metalsmiths. The current mode of production at Krofofrom is mass production which ensures that large numbers of similar objects are produced for the market. The very idea of producing these items for a larger market implies that production is driven by demand from their marketing agents.

With regard to mass production, very similar articles are produced with very little to differentiate between them. The shift from a creative art to a customer-dictated mass production system has had profound effect on the items themselves. Proper finishing is not a priority of the Krofofrom metalsmiths; all that is important to them is getting the job done on time. The change in the core composition has also adversely affected the quality of work as well as the improper handling of wax thread for cast hollow objects.

The mishandling of wax thread is confirmed by Ehrlich (1989) who opined that

> Much of the wax thread work was blurred or was frequently smoothened away in nineteenth and twentieth century Ashanti brass work.

Indicating a recent lack of care in the handling of the wax components. The presence of pinholes has now become a primary characteristic of cast objects from Krofofrom. Devising new ways to produce objects quickly is good but making a conscious effort to attain a standard matching that of the 1700's is obviously desirable.

There is still the desire, among some craftsmen, to attain such a level of perfection in the Asante kingdom as exemplified by Ensuasi metalsmiths. That this desire is not out of reach is confirmed by Silverman (1990) who remarked that:

> Examples of contemporary West African metal work that are every bit as fine as those produced one or two hundred years ago exist.

Hopefully, the findings of this research can help improve the quality of casting under such a mass production system at Krofofrom

4.3 Sample works produced from the research outcome

The **"AKUABA" (fertility doll) from wax containing Kerosene (K1),** was inspired by the Akan fertility doll of the same name. This work measures approximately 13cm high. Both the Asantes and the Fantis have versions of the doll. The Asante version is characterised by a round or oval head, extended arms and rigid form while the Fanti version is characterised by its boxy headed shape.

Features of the derived "AKUABA" include the typical feminine body captured in the roundness of its form. A depiction of movement is visible in this sculpture and which was also developed to show flexibility and dynamism of the feminine form.

It is believed that the doll helps in child bearing and adult women who were childless have been known to carry such a doll on their backs in the past, hoping that the magical properties embodied in this doll would help them to conceive and have a child of their own.

Figure 22: Front view of Akuaba

Figure 23: Back view of Akuaba

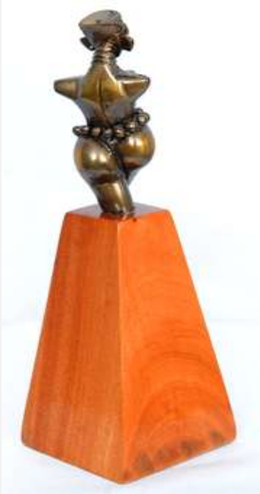


Figure 24: Sample from wax K1

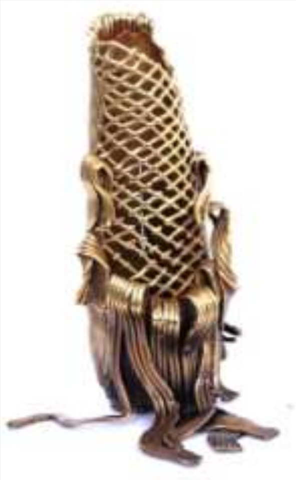
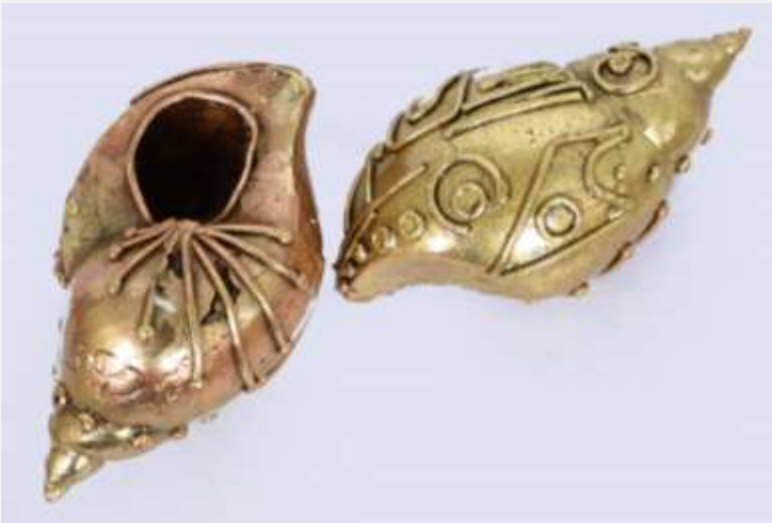


Figure 25: Ball Gecko

The art work was named "**Ball Gecko" from wax sample (CP1) containing paraffin and candle** because it was formed from wax balls and inspired by the lizard wall gecko. The Gecko is a member of a family of small, harmless lizards, found mainly in tropical regions. Certain species of this family make a loud clicking noise that sounds like "gecko". Geckos are said to be the only lizards that make any sound other than hissing. In Akan communities, Geckos are seen as sacred animals that protect humans at night from bad spirits and are not to be killed hence the name "Efie wura". Also because of their harmless nature they are seen as a sign of good luck or hope, for instance, if Gecko falls on a woman unawares, it is believed that the woman will get pregnant.

Figure 27. Kae da bi (to reminisce)	Figure 28. Harmony
	

Figure 29. Nwheso (to preserve/ Example)



The artefact was named **"Kae Dabi"** (to reminisce) because its basic form was developed from the Sankofa bird which traditionally symbolises reaching back for old memories. It measures approximately 37cm tall and about 21cm at its widest point. The use of small wax wires is to demonstrate the feasibility of using such small sized wires seldom used by Krofofrom casters for large objects.

Symbolically, the form depicts the Sankofa bird and the wings on the sides are formed from a group of Adinkrahene symbols representing completion or closure which also can be extended to represent parental guidance.

The art work (fig.28) is named "**Harmony"** because it was designed from two musical instruments; the xylophone and "Konon" which are commonly used by the Northern tribes of Ghana. "Harmony" measures approximately 18cm long, 15cm high and 9cm wide. The work was inspired by the recent instabilities in the northern part of Ghana. It was composed from two important local musical instruments which produce different sounds. Wood and calabash are the main materials used for these instruments. The two musical instruments have different shapes in terms of construction. The strings on

the xylophone and that on the "Konon" perform different functions and produces different melodies. The two musical instruments, without the calabash, cannot produce the sweet melodies that emanates from them. These instruments together with the "Dondo" are easily and readily associated with native Northern music just as the "Atumpan" traditional drum is easily identified with the Akan group of the South. No matter the difference in how these instruments are used, the skilful combination of the two is able to produce melodies that everyone appreciates, both those from the North and South of Ghana. This shows that with all our differences aside we are one people, and as 2016 is an election year in Ghana and African elections are characterized by war, no matter our differences we are one Ghana.
"Nwheso" is an Akan word which literally means "to Preserve". It can also mean "an Example" (Fig 29).

5.0 Conclusion and Policy Implementation

In conclusion:

- Without the addition of wax additives such as paraffin, candle and kerosene in various proportions to the beeswax, various complex designs and modelling methods will not be achievable and lost wax cast objects made at Krofofrom will still be characterised by pinholes and improper wax handling defects under the mass production method.
- Piercing and carving are useful for creating quality wax pattern.
- A better hollow wax pattern can be produced by using the molten-wax-in-Plaster of Paris-method.
- The application of steel wool can in some situations erase file marks and scratches to improve the final surface finish.
- Without the use of metal lacquer and kerosene as surface preservatives, brass cast articles will succumb to the atmospheric effect of tarnishing.

As part of policy implementation:

- Periodic workshops should be organized or if possible, a working studio should be built at Krofofrom in order to have a venue for disseminating research findings for the benefit of craftsmen. It is hoped that this workshop would be sponsored by the Ghana Tourist Board, Export Promotion Council as well as other donor agencies and stakeholders who may be interested in upgrading the skills of Ghanaian metal artisans.
- In producing cast hollow or solid artefacts, metalsmiths at Krofofrom should adopt the use of wax additives such as paraffin, candle and kerosene as beeswax additives to improve the workability of the wax as well as the various wax modelling techniques and finishing methods as was used in this research in order to eliminate pinholes and step up the creativity ability of good craftsmanship in their cast objects.

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