RECYCLED GLASS BEAD PRODUCTION IN SELECTED TOWNS IN ASHANTI

(Darbaa, Asuofia Asamang and Akropong)

BY

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CHAPTER ONE

INTRODUCTION

1.1 *Background of the Study*

Glass which is manufactured from naturally occurring materials such as silica (obtained from sand, flint pebbles or quartz), soda ash, lime stone etc have over the years been recycled. In countries like the United States and Great Britain about 80% of all produced glass bottles are recycled (Glass recycling information sheet, 2007). In recycling glass, unlike paper and other products, no loss in purity can be observed provided the glass is well cleaned and sorted by colour.

In the actual manufacturing of the glass, from raw ingredients, an exceptionally high quantity of energy is needed to turn the raw materials into a melted glass batch. The melting temperature for pure silica is 2200°F or 1710°c, obviously this temperature is far above the temperature range of most kilns. That notwithstanding, this high temperature makes glass production uneconomical, environmentally unfriendly (pollution) and capital intensive. Recycling glass, therefore, helps to save energy and thereby reduces cost of production. The glass to be recycled is broken into smaller pieces called cullet and mixed with a quantity of raw ingredients to form a batch which is then introduced into the melting tank. This saves about 40% energy since the batch tends to melt at a lower temperature than the raw ingredients. (Benifit of glass recycling, 2008)

According to the Encarta (2008), when recycled materials are used to produce one new bottle, it saves energy enough to keep a hundred watt bulb illuminated for four

hours. Recycling glass therefore conserves energy and resources, saves money, reduces pollution and polluted related illness such as Silicoses. Recycled glass can be used in manufacturing many products such as beads, kitchen tiles, jars, sports turf, bottles, providing sand for depleted beaches etc. It is also believed that a typical glass container is made up of about 70% recycled glass.

In Ashanti, glass bead producers mainly obtain their raw materials in the form of broken bottles from bottling companies and breweries like Coca Cola Ghana Ltd, Guinness Breweries Ltd and many others. Probably about 80% of all locally produced glass beads are made from recycled glass obtained from the breweries, whiles 20% is obtained from louvre blades.

Recycled glass bottles are preferred by the indigenes of Ashanti because less energy is required to produce the glass beads as compared to melting the raw materials. Locally improvised fire wood kilns are used for their bead production. The afore mentioned ingredients are all soda lime glasses and hence fire at lower temperature due to their high soda content. Addition of various colouring oxides also helps to further lower the melting temperature of the bead and to give the bead the desired colour.

The usage of glass recycled beads in Asante culture can only be traced to antiquity. For it is used in almost all the transitional rituals in Asante culture. Puberty rite or “Bragro” is said to be incomplete without glass beads. Brides are adorned with beads during marriage ceremonies. Newly born babies are also adorned with beads to ward off evil spirits and bad omen that may endanger the child’s life. Beads also play a

central role in the enstoolment of chiefs and queen mothers. It is however sad to note that this hither to buoyant and promising industry which in some instances provided employment for an entire community is gradually collapsing and the act of bead making is gradually fading into obscurity.

These gradual changes could be probably attributed to a number of factors, examples being the low patronage of local glass beads, as a result of stiff competition from foreign imported beads made from glass, plastic, bamboo, seeds, bones, shell, clay, metal etc. The abolitions of some traditional cultural practices which hither to promoted glass bead production and its usage in Ashanti, the slowness of pace by practitioners in the industry to adopt modern innovative techniques and processes can also be cited as a cause for the decline in the bead industry. The narrowness of range of products could also be a contributing factor among others.

In spite of these challenges, if pragmatic steps are taken to study the recycled glass bead industry in Ashanti and new impetus injected into the glass bead industry, these measures are very likely to cause a rejuvenation of this industry and would better position it to contribute its quota in creating jobs, check urban city migration and increase the standard of living of most bead producing communities in Ashanti.

1.2 Statement of the Problem

In the production of traditional glass beads in Ashanti, recycled glass mainly obtained from louver blades, coca cola bottles and fanta bottles are used in making aesthetically attractive decorated beads for both local and foreign markets. However, recent report from the Association of Craftsmen and Artisans at the Kumasi Centre

for National Culture indicate that, patronage of these glass beads seems to have been reduced significantly due to the competition glass beads faces with other types of beads made from plastic, bamboo, seeds, bones, shell, clay, metal etc. Personal observation by the researcher seems to suggest that this competition has contributed to a large extent to the collapse of some of the bead producing industries in Ashanti. These developments are worrying and therefore heighten the desire of the researcher to study the problems in glass beads production in Ashanti.

1.3 Objectives of the Study

The objectives of this research are to:

1. Identify the well known glass beads producing towns in Ashanti.
2. Study and examine the raw materials, tools and equipment as well as the production techniques used for the recycled glass bead industry in Ashanti.
3. Access the major strengths and weaknesses in the development of the industry.
4. Carry out experimentations to innovate and design products using recycled glass beads production techniques.

1.4 Importance of the Study

1. To identify the well known bead producing towns so that selection could be made from them.
2. To know the technology being used and the type of products.
3. To discover the efficiency and effectiveness in the management of the industry.

4. To improve the aesthetic quality of more variety of products to meet market demands.

1.5 Research Questions

1. How many well known glass beads producing towns are still active in Ashanti?
2. What raw materials, tools, equipment and techniques are used for recycling glass beads in Ashanti?
3. What are the major strength and weaknesses associated with the glass beads industry?
4. What innovative techniques could be injected into the recycled glass beads producing industry to rejuvenate the industry?

1.6 Delimitation

The study concentrated solely on recycled glass bead production in Darbaa, Asuofia Asamang and Akropong in Ashanti Region.

1.7 Limitation

The absence of an annealing machine seriously hampered the success of this study; hence glass wares produced in the experimentation were not well annealed and this could lead to a reduction in the lifespan of glass products produced.

1.8 Organisation of Chapters

The research is organised into chapters. Chapter one entails Introduction, Statement of Problem, Objectives of the Study, Research Question, Delimitation, Limitation

and Organisation of Chapters. Review of related literature which highlighted the Historical overview of glass beads as well as bead production and usage was followed in chapter two. Chapter three included the Methodology employed. Chapter four dealt with the main findings of the research that is, the Assembling of Data, Presentation of Data, Analysis and Interpretation of Data. Chapter five was used to tie in the research work; it entailed the Summary, Conclusions and Recommendations. The references were organised in alphabetical order.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Overview

The review of related literature (literature published and unpublished works of other writers) is to bring out new knowledge and new relationships between established facts. The main topics reviewed are Historical overview of glass beads and Bead production and usage.

2.1 Historical overview of recycled glass bead production

Early bead production dates back to antiquity. Many writers have described bead production as an ancient trade which dates back some 1000 years before Christ. The origin of bead making itself is not known. Stokes (1999) believes that early glass beads have its base in Afro-Asian glass technology and bead design in the Middle East (Ca 5000 B.C) as well as Egypt in the old kingdom period (Ca 2705-2155B.C). She further explained that the oldest examples of African –produced glass beads excavated in 1996 from a site Mtwapa, Kenya are now in the field museum and dates back as A.D 1000-1700. About 200 in number, the beads are opaque with flecks in varying shades of red, blue, orange or yellow.

Fish (1992) strongly believes that the earliest glass beads came from western Asia in the 3rd millennium B.C. and only became widespread in Egypt around 1400 B.C. In the history of beads by Dubin (1987), the evolution of beads and bead making has been discussed from 3000B.C. This depicts that bead making started about 3000years before Christ. Saitowitz (1993) in her essay, explained that evidence of a well ordered glass making industry has been found in Egypt and dates back to the eight

dynasty (1559-1531 B.C). She also emphasized that coloured glass rods designed to be manufactured into beads have been discovered.

From Stokes (1999), Saitowitz (1993) and Fish (1992) explanation about the origin of glass beads, it could be explained that glass bead production began in Asia and the Middle East and spread through Egypt where various types of beads were made for special functions. The bead making in Egypt later spread to other parts of Africa such as the Western, Eastern and Southern part of Africa. This has been buttressed by most writers. Fagg (1980) explained that there was a great bead making industry at Ife, south western Nigeria during the classical period that was around 1000-1500 A.D. Lamb (1969) also emphasized that glass beads were in use in Ghana long before the Europeans arrived at the Guinea Coast.

In archaeological excavations and historical text, one finds the use and trade in glass beads (Fage 1962; Landewijk 1970; Negri 1964; Posnansky 1970; York 1987). Saitowitz (1993) explained that the earliest known glass bead work has been recorded from an Iron Age excavation in northern Transvaal in South Africa and dates 1150 A.D. Archaeological evidence in Ghana also date Krobo bead to as early as the 16th century (Lamb, 1976). Yoshioka (1966) p 225 concluded that:

> Glass is the oldest manufactured product in the world; thousand of years have passed since the first crude glass beads were made by ancient man. As through the ages glassmaking spread throughout the western world, its products reflected the culture and technological progress of the times. And so today, glass tells the story of man's needs in a world of fast transportation, computers and space exploration.

2.11 Recycled glass

Glass is a substance that could be recycled over and over again without a reduction in its quality. Glass does not naturally decompose and hence recycling it helps in the reduction of land fills in a country. All types of glasses could be recycled and used for the same product of which it was recycled from or to produce alternative products.

This view has been buttressed by Reindl (2003), he states that, glass container manufacturers can theoretically use all colour sorted cullet to make new ones, as such there are no barriers of transportation cost and problems of marketing mixed colours since an electro-mechanical glass sorting equipment could be used in sorting the various types and coloured glasses to get the desired effect. He also emphasised that, in recent times, the use of recycled glass for non container uses such as beads, road markings, sport turfs, road fillings, landscape designs, etc, is on the increase.

Recycled glass which includes waste glass and glass articles rejected because of breakages are crushed to form cullet and added to a glass batch before melting. This fact has been substantiated by many writers. Maloney (1967) explains that, waste glass or cullet of the same type is added to a batch comprising sand, soda ash and lime stone to form a soda lime glass and that the cullet could constitute as much as 75 % of the total batch.

A similar explanation has also been given by Philips (1948) who states that glass batches contains as high as 75% cullet and not less than 25% cullet in every batch.

These are mixed with the raw materials used for glass production. From the two definitions above, it could be seen that recycled glass if well sorted out and added to a batch will not affect the quality of the finished products. It has the potential to reduce cost of production and contribute significantly in checking environmental degradation.

The European Glass Container Federation has also estimated that 90% of cullet collected is recycled back into bottles and container products, (Reindl, 2003). The figure quoted above, is very significant (90%) and Reindl (2003) goes along to emphasis the benefit of recycled glass (cullet) in the glass industry. This also shows the commitment of the countries involved in making judicious use of their natural resources; as such nothing goes waste.

According to Benefit of glass recycling 2008, a typical glass container may consist of as much as 70% recycled glass and that 80% of recycled glass on the whole ends up as new glass containers. It further explained that glass containers are 100% recyclable and as such recovered glass are used as a majority ingredient in the production of new glass containers. From the above explanations given by the various writers, it can be stated categorically that glasses are 100% recyclable and could be added to similar batches to produce new products without any lose in quality or negatively affecting the desired qualities.

In a nutshell, recycling of glass is making use of an already produced glass or glasses to form new products. There are no reduction in the qualities of the resultant glass produced and a significant percentage, as high as 90% of recycled glass could be introduced into a batch without any reduction in the quality of the glass. Some countries have put in place pragmatic measures to recover as much as 70% to 80% of produced glass wares for recycling purposes.

2.12 Definition of glass

Silica which is the main constituent of glass is said to be made up of hexagonal structures. These structures like other solids, when subjected to heat disintegrate at the liquid state. Most liquids when cooled experience a rearrangement of its crystals into a regular structure. Glass however, does not exhibit this character because it is cooled very rapidly within a short time leading to the difficulty in the arrangement of its hexagonal structures. This view has led to varying definitions by most writers for glass.

Yoshioka (1966) refers to glass as a unique material which though looks and feels like a solid is actually a liquid in the frozen state due to its inability to crystallize like most substances do in the solid state and that glass still remains amorphous. He further explains that scientist have not yet understood the precise nature of the inner structure of glass totally but believes it is made up of disordered crystals which are neither purely crystals nor truly liquid, hence the uniqueness of glass.

Another definition has been given by Maloney (1967) that “Glass is a rigid liquid”. He explains that, glass is viscous at room temperature, as such its flow could only be

measured by delicate experiments and when observed on a suitably expanded time scale. Its structure and properties depict that it is a liquid. Maloney further stresses that, most liquids freezes at certain temperatures like the way water freezes to ice but no such thing happen in glass. Glass during its rapid cooling becomes more and more viscous until it stiffens to form an ordinary solid. Most solids have regular crystalline structure but the internal structure of glass is random disordered structures as seen in liquids and the temperature at which it is cooled is too low for devitrification to take place for the glass to form a solid.

Maloney therefore gives another definition to glass as a liquid that has become too cold to freeze. This is because glass cools beyond the temperature at which it could freeze. This claim is not shared by most scholars, they rather attribute the super cooled nature of glass to the rapid or abrupt cooling of the glass and not the temperature.

Glass is an inorganic product of fusion which has cooled to a rigid state without crystallization, is another definition given by Stanworth (1950). This definition applies to numerous substances such as zinc chloride, the nitrates of sodium, potassium, and silver, thallous sulphate, lead chloride, sodium thiosulphate, alums and other hydrated salts which forms glasses on rapid cooling. Stanworth (1950) does not agree to the classification of some inorganic substances like glucose which may be super cooled to the extent that, they become rigid solid without any visible crystallization as it pertains to glass. In his opinion, the word glass should only be applied to inorganic substances.

Glass has been defined by McNamara and Dulberg (1953) as a super cooled liquid which is so viscous that its atoms are in an immobile state, but only becomes mobile and move towards crystallization when subjected to heat. The atomic structure of glass he said is a disorganized arrangement of silica and oxygen tetrahedral. They like most writers also believe that silica has a disorganised structure.

Speaking on the same issue Philips (1948), also defines glass from the chemical point of view as a material resulting from the fusion and cooling of a mixture of certain substances. The writer considers this definition as too basic and simplistic since it did not describe the principal characteristics of a glassy state; hence the mixture of any chemical according to him which fuses and cools to form a material becomes a glass. For example, if sulphuric acid, which is a chemical and liquid when heated and cooled according to the accession above becomes a glass.

Obviously, this definition could only be theoretically and most likely cannot be backed by any empirical experiment. Glasses are ordinary liquids at high temperature but when it cools, it does not devitrify. Even at temperature where they are expected to crystallize they still remain liquid and depict smooth cooling curves when plotted on cooling graphs. It does not indicate the sharp cooling point of liquids that can be easily studied on the cooling curves of most liquids.

Philips (1948) after throwing more light on the nature of glass he finally decided on his definition for glass as an inorganic material which attains a high level of viscosity after being cooled from a fused condition.

From the various definitions from numerous writers, it could be seen that glass is an inorganic material, melted at high temperatures to form liquid, which is cooled rapidly so that their internal structure tend to become irregular.

2.13 Composition of glass

According to Phillips (1948), Silica (SiO_2), which is the major fundamental material for glass production, forms about 60% to 80% of all glass composition. Raw silica fuses at a very high temperature (1710 °C) making it energy consuming and difficult to be fired in most kilns and furnaces. Additionally, it is uneconomical to fire a kiln to this elevated temperature. He further classified soda (Na_2O) usually obtained in the form of sodium carbonate (Na_2CO_3) as the most important glass former after silica. Cool, Jackson and Monaghan (1999) explain that glass is characterised by alkali in its manufacture. This alkali they said acts as a flux and lowers the temperature at which the glass is formed.

Again, some types of glasses need special care and handling during its manufacturing processing and usage. This has led to the addition of other oxides to the silica causing a variation in the compositions of glass. There is no fixed composition for glass in general. The composition of glasses varies from one glass to the other and is dependant on the manufacturer.

Most glass compositions are made based on the kind of product to be manufactured and their uses. Various types of glasses are available with varying compositions. They include Borosilicate glasses (Pyrex), Soda-lime glasses, Pure silica glasses, Aluminosilicate glasses, Borate glasses, Mixed alkali glasses, Phosphate glasses, Flat

glasses, Optical glasses, Scientific glasses and other special glasses. Commenting on the composition of glass, Maloney (1967) stated the following:

> This list gives the appropriate compositions and properties of the main types of glass. The percentages of the main ingredients are only given. The detailed properties depend on the exact composition and may be sensitive to small changes in minor ingredients. The nature and dependence is rather complicated, and therefore the exact compositions of particular glasses and the types of minor ingredients are not given here.

Here Maloney (1967) explains that there are main ingredients and minor ingredients in glass formation and that the percentage range of the main ingredients could be given but that of the minor ingredients are not given. Hence a variation in the minor ingredients leads to variations in the various types of glasses formed. This also depicts that two soda lime glasses may have varying compositions due to the differences in the minor ingredients used.

For instance, one soda lime glass might consist of 70% Silica (SiO_2), 15% soda (Na_2O), 10% lime (CaO) while the other might consist of 65% Silica (SiO_2), 15% soda (Na_2O), 5% potash (K_2O), 10% lime (CaO) and 5% magnesia (MgO). The second formula though quite different from the first one, is also a soda lime glass. The addition of potash and magnesia helps to lower the melting temperature and improve the chemical resistance of the glass. Hence the second formula though a soda lime glass, would have two more special properties than the first formula. The changing of the proportions of different raw materials in the glass batch would affect the relative proportions of the elements within the glass (Smedley and Jackson 2002). Phillips (1948) also emphasised that glass forming oxides are always directly available. The glass manufacturer needs to search for compounds that would yield the desired results after melting. Taking into consideration the advantages and

disadvantages of the oxides to be used. This view is also supported by other writers. This shows that each glass composed has many oxides researched into and the appropriate one chosen based on its special qualities. For instance the main constituent of a soda lime glass is silica, soda and lime but according to Sayre and Smith (1961) the soda lime glass introduced by the early- Islamic group in the 8th - 10th century, after testing was found to have a high concentration of magnesium and potassium.

McNamara and Dulberg (1953) explains that glass forming constituents are varied and a complex one may have no chemical formula but may be composed of sand, soda, lime and other oxides of manganese, aluminium, and boron. They further explained that glass is predominantly a fused mixture of 6 molecules of sand, 1 molecule of alkali and 1molecule of alkaline earth.

Medieval glass manufacture in northern Europe also adds alkaline raw materials like beech, oak and bracken ash alkalis to their silica for their glass production and this is documented in a number of medieval glass-making manuscripts (Smedley and Jackson, 2002). From the explanations above, it could be established that the composition of every glass is a complex one with the glass forming oxides selected based on some special qualities needed, as such glass has no specific formula.

For instance, whiles McNamara and Dulberg (1953) gave a ratio of 6:1:1 for sand, alkali and alkaline earth respectively, Jackson, Booth and Smedley (2005) used a method and adopted a ratio of 2:1 ash: sand by weight in their glass compositions. Varying ratios and compositions also do exist in many books.

One important point made by Maloney (1967) is the fact that glass is made of main and minor ingredients. He further gave the various percentages of the main ingredients and explained that the one for the minor ingredients were varied. McNamara and Dulberg (1953) share a similar view and provide the composition of the main ingredient in glass production. Glass can therefore be said to consist of main ingredients which are usually constant and a minor ingredients that are variable depending on the type and uses of the glass to be produced.

Various books have discussed these main and minor ingredients. Terence (1967) explains that a great number of common glasses are made of silicon dioxide (SiO_2) obtained in the form of quartz, cristobalite and common sand. In addition to the earlier mentioned oxides, inorganic glasses are formed from Boron, Germanium, Phosphorus, vanadium, Arsenic and zirconium.

Pure silica he said, melt at a temperature of 1710ºC which is too high for general purposes hence the addition of certain metallic oxides like soda (Na_2O) and lime (CaO) to lower the viscosity of the SiO_2 to more practical levels. These primary glass formers (main) are mixed with intermediates(minor) such as titanium, zinc, lead, aluminium, thorium, beryllium, and cadmium to form a strongly directional bond that stiffen the glass structure.

McNamara and Dulberg(1953) who explains in their book that glass is composed of 1 molecule of alkali (Na_2O) 1 molecule of alkaline earth (CaO or MgO) and 6 molecules of sand (SiO_2) emphasised that the silica, lowers the thermal expansion of the glass and increases the viscosity and the resistivity of the glass towards acids.

The alkali decreases the viscosity, the resistance to thermal shock and the melting temperature of the glass whiles the alkaline earth serves as a flux and a durability improver.

Other minor oxides are also used to improve the quality and to achieve some special qualities desired. These include Boron oxide (B_2O_3) which produces low expansion and Borosilicate glasses, Aluminium oxide (Al_2O_3) increases the melting temperature, the viscosity, and improves the durability of the glass, Potassium oxide (K_2O) which is used as a partial substitute for soda ash (Na_2CO_3) to increase the viscosity of the glass and Lead oxide (PbO) which gives a clear and lustrous glass. Lead oxides (PbO) are usually combined with silica and some alkalies to produce flint glass.

McNamara and Dulberg (1953) further states that material that make up a glass batch are the glass forming substances, fluxes, refining agents, colouring agents, oxidizing and reducing agents and that the glass making oxides could be subdivided into network formers, network modifiers and intermediates.

According to Wikipedia (2008), the raw materials for glass production are mainly sand, soda ash, limestone, feldspar as well as others. It further explains that other materials and oxides are added to change the colour of the batch and to enhance its aesthetic lustre. They include iron oxide, sulphur, manganese, selenium, tin oxide, copper oxide, sliver, cadmium, nickel and many others.

Since the minor ingredients vary from one glass to the other, only the compositional range of the various types of glasses could be given. There could however, be some variations in the range to pave way for other special qualities needed. Most writers gives the composition of the different types of glasses as Silica (SiO_2), soda (Na_2O), lime (CaO), Magnesium oxide (MgO), Lead oxides (PbO) Potassium oxide (K_2O), Aluminium oxide (Al_2O_3), Boron oxide (B_2O_3) and Titanium oxide (TiO_2). Aside these, other colouring and decolourizing oxides are used.

For instance Howe (1925) explains that, glass is made up of compound as silica or sand, soda ash, potash, lime and the oxides of lead which he claimed were the few mentioned oxides. Concerning the introduction of colour, Howe (1925) explains that colour, could be introduced by certain materials such as gold for ruby, selenium for pale rose, carbon for brown, and chromium for green colours.

According to Philips (1948), the Borosilicate glass produced by the Corning glass works under the trademark “Pyrex” has a composition of 80% Silica (SiO_2), 12.9% Boron oxide (B_2O_3), 3.8% soda (Na_2O), 0.4% Potassium oxide (K_2O) and 2.2% Aluminium oxide (Al_2O_3). In a related publication Stanworth (1950), provides the composition of Borosilicate glass as 80% Silica (SiO_2), 11.9% Boron oxide (B_2O_3), 4.4% soda (Na_2O), 2.0% Aluminium oxide (Al_2O_3), with lime (CaO), Magnesium oxide (MgO) and As_20_3 as 1% whiles Maloney (1967) gives his composition for Borosilicate glass as 60-80% Silica (SiO_2), 10-25% Boron oxide (B_2O_3) and 1-4% Aluminium oxide (Al_2O_3).

From the above compositions, it could be deduced that the silica and boron percentages are very high and this could have probably led to it being given the name 'Borosilicate' glass. Similarly Soda-lime glass has high amount of soda content, hence its name soda-lime glass. Fused silica glasses are also made of 96-99.5 % silica leading to the name fused or pure silica glass. The same also occurs with Aluminoslicate glasses and lead glasses.

The differences in glass composition can therefore be attributed to the differences in the raw materials used and by implication the location of production since the closeness of the glass factory to a particular material can influence the glasses composition (Hunter and Sanderson1, 1982; Barrera and Velde, 1989; Henderson, 1998).

It should also be noted that the compositional data of glass are not only controlled by the nature of the raw materials but also by the choices and the manipulation of the raw materials by the glass makers during the manufacturing process (Jackson, Booth and Smedley 2005). This view has been buttressed by many writers that behavioural variability often affects the final composition and nature of the finished artefact.

2.14 Benefits of recycled glass products

Recycled glass is said to form as high as 75% of the total batch for glass production. This view which has been buttressed by most writers shows that, there are enormous benefits of recycling glass to form similar or new products.

Recycling glass therefore conserves energy and resources, saves money, reduce pollution and polluted related illness such as Silicoses, emphysema and other related illness. Recycling glass also help to save energy and thereby reducing cost of production. It saves about 40% energy since the batch tends to melt at a lower temperature than the raw ingredients. (Benefit of recycling glass 2008)

2.11 Some products derived from recycled glass

Glass when recycled could be used to produce the same product from which it was recycled as well as other products. Owing to this, various products could be made from recycled glass. Such products include container bottles, designer dresses, fibre glass, terrazzo glass, glass tiles, stained glass, blown glass, pressed glassware, jewels, beads, jar, sports turf, road surfacing, bottles, pool sand (glass), foam glass, road mappings, providing sand for depleted beaches as well as building materials.

Glass in its use as building materials for most constructions is seen as it is used for making aggregate for buildings. This is made by crushing cullet into a size mesh of about A32 to B32 after which it is ground in a rotating drum comprising of water, hydrofluoric acid and a grinding agent. After the grinding, the product is used as aggregate for building. Some companies in Japan use contaminated

cullet in making table tops and building tiles. This they do by crushing waste glass into powder and mixing with a special adhesive containing-cement.

Kirim Brewery Company and Shower Glass Company of Japan transform recycled bottles into construction materials such as sound absorption materials and insulating tiles. This they do by pulverizing and baking the glass to produce finer grains of about 0.3-0.5mm and mixing the grains with cement or clay to make the products (Reindl 2003).

Harry Bailey of Lebanon in the late 1940's used glass bottles in building his family home's perimeter walls (Acohido, 1998). Glass bottles (soda lime glasses), could also be recycled and used as foam glasses. This is done by ball milling the glass into very fine powder of 150 – 300 micrometers and mixing it with a specified quantity of mica. This results in the formation of open and close cell structure, producing light weight but relatively weak material with good insulating value (Low, 1980).

The Ovambo tribe of Namibia uses glass bottles instead of wood to build their houses. Lui (1991) explains that ground waste glass could be used in making Mosaic glass for external and internal facing of public buildings. Mosaic glass could be made by mixing ground glass with a binder of 1% by methyl cellulose and sintering the glass at 500°C for 30 minutes followed by calcination at 720°C for 30minutes.

Glass when recycled could also be used as a raw material for road surfacing. Thus they could be used in place of gravels and other stones used in

constructions. Glass slag could also be used directly or recycled and used for road surfacing. For instance the Fly-ash and Slag produced by Delmarva power plant is greatly used in the Delmarva Peninsular as road surfacing material (Frankelman, Milton and Larson, 1976). Sports turfs are also produced from recycled glass using the same technique as the road surfacing. Frankelman, Milton and Larson (1976) also explain that molten slag is sometimes poured into standing pools to form light weight aggregate. The granulated slag when examined at this stage is seen to be spherical with small finer particles containing numerous bubbles.

Samtur (1974) in describing the use of recycled glass for terrazzo explains that, in place of marble, glass cullet could be used. The glass used has 2-3 times the flexural strength of conventional cement terrazzo and has a high abrasion and stain resistance. The products are also relatively cheaper than the cost of terrazzo. This view is shared by most writers, such as Abrahams Jr. (1972), Philips and Cahn (1972). In addition to the above mention products, low firing and low cost wall panels and bricks were made mixing crushed bricks with 6% clay and 13%-94% crushed glass. The bricks formed were seen to be stronger than concrete and less absorbent than concrete (Shutt, Campbell and Abrahams Jr., 1972).

In providing sand for depleted beaches, glass is recycled into beads and poured at the depleted beach. A typical example of this is seen at the beach Chesapeake Bay near Chance, Maryland, where the beach sand is made from two distinctive glass beads. One of the type used is opaque, sub spherical, strongly magnetic with rough surfaces whiles the other type has smooth surfaces, translucent to

transparent and varies in colour from almost colourless to black, with most of the beads having a yellow colour. Glass slag, which is piled waste glass obtained from spilled over mould and batches, are also made use of. The glass during its spilt over, trap air pockets and bubbles which makes them look nicer when broken down and used for beach sand (Frankelman, Milton and Larson, 1976).

Glass is also recycled by crushing and used as landfill. Different coloured cullet could be used to get different effects. Brown and green glasses which have low market prices are used in making glass asphalt. Different coloured cullets are mixed to form the patch material which is then fired at 180°C. The cullet is crushed to the size of the gravel it is replacing and used with regular paving asphalt that has been heated to about 300°C. The result is called Glasphalt which has some advantages over the normal gravel asphalt. Glasphalt produces a pleasing glitter from sunlight and head lights, retains heat longer and dries quicker after precipitation (Day and Schaffer, 1994).

Glass in the form of cullet are used in producing various glass Art products including stained glass, blown glass, pressed glassware, jewels and beads. One interesting use of recycled glass is its use in making designer dresses. Powell (2002) explains that New Mexico Recycling Coalition organised a fashion show where the Glass Packaging Institute of Alexandria, VA, sponsored a dress that had about 12,000 pieces of crushed clear cullet from an Albuquerque sorting plant individually glued onto the dress. From the above discussion, it would be noticed that the products derived from recycled glass are enormous and very beneficial since it could be used as substitutes for other products and are very economical when used.

2.20 Bead production and usage

Various types of beads are produced all over the world. They include beads produced from seeds, grass, shell (cowry, palm kernel, snail and sea shells), teeth, bones, rocks minerals, ceramics and glass etc. Beads produced from the above mentioned sources are produced using a variety of production methods. For instance rocks and minerals such as agate, carnelian, jasper and bauxite, to be used for bead production are shaped roughly with a hammer. A hole is drilled and the rough edges smoothened with sharpening stone, water and an abrasion such as fine sand and clay (Kumekpor, Bredwa-Mensah and Landewijk van, 1995).

Seeds, cowry shells, snail shell, teeth, and bones most of the times do not require any shaping except the making of a hole to enable it function as a bead. Palm kernel shell or hull is easily worked with a knife and a hole is made in with any hard pointed tool. Most of these beads are finished by painting or polishing to make them look brighter. Ceramics and glass beads unlike the above mentioned beads are subjected to heat at high temperatures in kilns, furnaces and oven. After they have been fired using any of the techniques available, the rough edges are rubbed on polishing or grinding stones to make them round and smooth.

In spite of the fact that the above mentioned beads are produced using a variety of production techniques, their production is also characterised by the observation of some taboos, customs and practices in order to get the required products and the desired usage. Like mining, carving, pottery, weaving, blacksmithing and goldsmithing, Bead making during its production in some communities are

associated with a particular gender. They are either exclusively produced by men in some communities or solely done by women in other communities.

Stokes (1999) in talking about South African beadwork explains that the production is exclusively done by women and a strict display of colour pattern is seen. The colours and pattern is used to communicate the age, gender, royalty, marital status as well as group identity in both human and spiritual worlds. The arrangements of the beads usually resemble a loom woven textile in the form of a beaded band with suspended rectangles. The products made include single strand necklaces “love letter” necklaces, bracelets with beads stitched around leather cores, various waist ornaments and beaded snuff boxes.

These products have different uses. For instance, the “love letter” necklaces are given to young women by men, who wish to propose love to them. Upon agreeing to the man’s proposal the women in turn give a special kind of bead to the man to signify her acceptance. Special types of beads worn around the neck, waist, wrist, legs etc are also used to depict the marital status of the women who wear them. In his expedition in Kenya, Akeley (1906) describes Maasai bead production as similar to the South African bead production, in that, it is exclusively done by women and has two dimensional designs usually with a leather backing or an interior leather core. Maasai beads are dominated by colours such as red-orange, white, black, blue and are used to mark gender differences, birth, marriage, initiation into age – grade and clan affiliation.

The Turkana people of Kenya also have their bead work exclusively done by women. Their beads are however used by men who wear them as an essential element of their dresses. The colours used have symbolic meanings and are associated with the various rites of passage. Such colours include red- orange, black, dark blue and white colours (Stokes, 1999). In contrast to the above mentioned bead production, Yoruba beadwork is done solely by men. Various bead forms are made for both social and spiritual purposes. Typical examples are beaded ceremonial dresses that are made for Yoruba chiefs (Stokes, 1999).

In terms of economic wealth and good fortune, spiritual well being, preciousness and auspiciousness, beads are used. Corals are also used as regalia's of chiefs and for Ceremonial dresses. Wood (1996 pp 155) stated that "Beads played an important role in most traditional ceremonies... and were used as currency, not only between Africans and Westerners, but among Africans themselves." This shows that in one time or the other beads served as a legal tender that could be used in the exchange and the purchasing of other goods.

In summing up, it could be seen that beads could be produced from a variety of materials and since the materials vary, various techniques and methods are used in getting a well finished product. Again it would be noted that bead making in some communities are associated with a particular gender and the beads produced in the communities are used for social and spiritual purposes.

2.21 Significance and uses of beads in some cultures in Ghana.

Most western historians, regard beads as a product of cross cultural contact. Writing on the significance of beads, Stoke (1999), stated that, beads are highly significant in shaping the identity of the people who use and display it for commercial purposes. As such whether it is a single strand or beaded embroidery it declares a persons wealth and status which also have spiritual and familiar affiliations. Here Stokes describes beads as a universal artefact that could be used to identify people and to know their status and wealth in a particular society as well as their spiritual and familiar affiliations through the colour and motifs used.

Beads also have a lot of significant features and uses in most culture in Ghana. According to Sackey (1983), beads are used in nearly all ethnic groups in Ghana. Apart from the everyday use of the beads, their use is extensively seen in the rituals and ceremonies that accompany the changes or transition from one stage to the other in the rights of passage (Kumekpor, Bredwa-Mensah and Landewijk, 1995). From birth through puberty, marriage and death beads play a vital role in the lives of the people in a particular society. In describing the everyday use of beads, Fish (1992) explains that the “Bodom” beads of Ghana when worn by people are able to warn the wearer against danger. Thus they are used to protect the wearer of the bead against any misfortune.

Similarly, Cardinall (1924) emphasised that beads are used to determine the rank of a person in a society. In that, the beads of a chief are different from that of his subordinates. This he observed in Gold coast (southern Ghana) those of highest distinction wear on their arms and neck, strings of beads which they called Aigri.

Also among the Ewe people, a person who has distinguished himself by means of great achievement is given a string of precious beads to signify his achievement.

Beads have economic value and were used in exchange of important things. For instance, again Cardinall (1924) recorded that the people of Gold Coast used some special types of beads in slave trading. As such a necklace of these corals with its thickness as the finger and its length of an inch could cost as much as the value of seven Negroes. Meyerowitz (1959) also explains that from the fifteenth century onwards, the Bono people exchanged gold for "Bota" and "Bodom" beads. The people of Aburi tie three strings of precious beads below the knee of officiating priest during their yam festival to signify his priesthood (Opoku, 1970).

Traditional priest are recognised by the manner in which the beads are worn. For instance Akan priest wear a bandolier of tiny red beads whiles Ga priests wear black round beads and white flat beads as their priest symbol (Field, 1961). According to Asante (Akan) oral tradition, beads are usually used in the legal system to discover the truth (Sackey, 1983). An accused person is given a 'Bodom' bead in water to swallow and confess. If the person tells a lie, the beads would choke and kill him. Sarpong (1974) indicates that beads are used to transfer witchcraft from strangers, usually from old women to younger ones in the form of gifts. Once the person wears the beads, the witchcraft is transferred unto him or her.

As mentioned earlier, beads are very significant in the rites of passage since they depict the transition from one stage to another. According to Sackey (1983), during pregnancy beads (charms) are worn by pregnant women on the waist, wrists, ankles

and neck to ward off evil omens in pregnancy and to protect them and their unborn babies. Beads such as “Ahuhuani” and “Egyinamoani” were used for such purposes.

In the Akan tradition, a baby only becomes an eligible human being if it survives and conquers the seven powerful spirits that controls the seven days of the week (Sarpong, 1974). The child is not properly treated and lavishly adorned after birth until the eight day. “Baha” fibres are used as armlets and anklets until the eight day when the baby is given beads such as “Gyinae*ε*, abia, nwansana ti” interspersed with gold nuggets and other charms as a symbol of transition from the spirit world into the human world (Rattray, 1927).

Sackey (1983) explains that whiles the Fante’s use little gold nuggets with little “Bodom” beads (“Bodomba”) or one big genuine bead as a necklace and tie tiny white beads “Mfufua” on the wrist, legs and waist of the child, the mother and other close relatives also put on “Mfufua” to signify their victory and joy. Two strings of red and black beads called “Abrekuni” are tied round the child’s neck to protect and hold the fragile neck from falling back. Among the Akans and Ga’s, twins are regarded as special people who could be influenced by evil spirit to do evil. A charm called “Abam” which is a string of beads consisting of a variety of beads such as red bead “Nenkyerema”, yellow bead “Bodom” or “bota”, the blue bead “Ekuar” and gold nugget are used to tie the left wrist of each twin to protect and help them lead a normal life. Among the Ga’s, the “Bodom” or “Bota” beads in the Abam are replaced by a white flat and black round beads and used for the same purposes.

In performing puberty rites which determine the transition from childhood to adulthood, beads are used as adornment on a young girl to symbolise the visible mark of change in the social status of the girl. Cole and Ross (1977) in describing the puberty rites of the Ga-Adangbe group which the Krobo's belong explains that during "Dipo", young girls are adorn with heavy accumulations of old, genuine beads around the neck, waist, arms and legs. These special beads are used to display the girls' new status as a women as well as the wealth and status of the families. Some precious beads such as the "Bodom" beads are believed to possess fertility qualities as such these beads are worn around the waist to cover the pubic area of the initiates to make them fertile (Sackey, 1983). During marriage, beads form part of the brides dressing and in some societies beads accompany the bride price.

One important use of beads in addition to the above mentioned ones is its use as a stimulant during sexual relations since the rattling of a woman's waist beads is said to stimulate the male partner. Beads put around the waist also help to give the female waist a special Ghanaian shape which makes a significant impact on men (Antubam, 1954). Beads are also very useful during funerals where the dead, no matter their positions, are adorned with beads at the waist, neck and wrist. The type and quality of the bead used may however depict the dead person's position or social status. Among the Akans, whiles orphans wear a special kind of beads to depict their status, widows wear beads called "Gyako" and the mourners wear any kind of dark beads to signify their grief (Rattray, 1927).

From the above discussion, it could be seen that beads are very useful and significant in most Ghanaian cultures since they depict the status of a person in a society, protect

people against bad omen and plays significant roles in the rites of passage of an individual from birth through puberty, Marriage and death. Though its mode of application may differ from one ethnic group to the other, they are all aimed at achieving similar goals and have similar significance.

2.22 Types of beads

There are different types of beads the world over. Beads come in enormous varieties but the few known ones would be discussed in this section. They include seeds, grass, shell (cowry, palm kernel, snail and sea shells), teeth, bones, rocks minerals, wood, ceramics and glass beads.

Seed bead comprises a variety of beads obtained from the seed of a plant or fruits. The seeds could either be used in their dry or fresh state so that holes could easily be made in it for threading. However after threading, they are dried in the sun polished or painted to make them beautiful. Various forms of grasses are also used in making beads. The grasses used could be weaved in bits and threaded to get the beads. Other grass beads are made by threading different coloured and shaped grasses to get a beautiful effect. Grass beads are usually used for making charms and for medicinal purposes. Among the Akan's and the Ga's of Ghana weeds are used as beads and hanged around the neck of the relatives of the dead at funerals to depict their closeness.

Cowry, palm kernel, snail and sea shells are all used in the manufacturing of beads. Their use as beads dates back to antiquity since they are obtained naturally. Most shell have smooth or polished surface and therefore needs little or no polishing.

Some sea shells such as cowries have holes in them already which make their threading easy and those without holes can have their holes drilled in with any hard pointed tool. Some shell beads are used for ritual purposes in the form of talisman, amulets and as well as part of the jewellery of a priest. Teeth and bones as their names imply, are made from the teeth and bones of animals such as elephants, cow, tiger, tortoise, fish, birds etc. Beads formed from teeth and bones of animals hardly need shaping since they have naturally been shaped. Holes are only pierced in these beads which are polished afterwards.

Rocks and mineral beads comprise all beads produced from stones, rocks, gold, bauxite, jasper, agate, Olivine, carnelian etc. Kumekpor et al. (1995) explains that minerals and rocks were in use in Ghana since antiquity. This shows that this type of bead have been in existence for a long time due to the fact that rocks and minerals existed from time immemorial. Olivine which is normally an opaque rock, but as peridot can sometimes be found as translucent stones or crystals. Normally it is associated with either basalt or peridotite. Small crystals form near these rocks and while it cools slowly deep in the earth. The slower this molten rock cools the larger the peridot crystals can grow and this leads to nice beads formed.

Gold which is a very precious mineral is mined, subjected to heat and used in bead and jewellery making. Owing to the hard nature of rocks, they are crushed with a hammer and the holes to be made are drilled with a drill. Arkell (1936) and Trivedi (1964) explained that presently, the city of Mhambhat in western India is one of the largest stone bead working centres of the world, and it has been an important centre for over two thousand years of documented history.

Kenoyer (1986) explains that due to the hard nature of stones such as carnelian and other agates, the people of Khambhat in India uses diamond tipped drills to make holes in them. Kanevor, Vidale and Bhann (1991) in talking about the processing of stone beads explains that they are mined, heated to make them soft before they are chipped roughly. The beads are then heated again and chipped for the second time to make them smooth. They are then polished and threaded for sale.

Wood beads are beads produced from any type of wood. Parts of wood are usually broken, shaped and polished to make beads. A typical example of wood beads is beads made from bamboo. Such beads are made by cutting the bamboo into smaller part and since bamboo's have holes in them already, they are smoothened, polished and threaded for use .Ceramics and glass beads are beads made of clay and glass respectively and subjected to heat at high temperatures.

In conclusion, various types of beads could be seen in the world and they include seeds, grass, cowry, palm kernel, snail shell, sea shells, teeth, bones, rocks, minerals, wood, ceramics and glass beads.

2.23 Types of glass beads

Various glass beads occur in different sizes, shape and quality. Though the major component in all glass beads produced is silica or recycled glass, the different methods of production as well as the designing and finishing of the beads leads to a variation in the beads formed, hence the different types of glass beads available.

The names of the various types of glass beads vary from places to places and are influenced by the people's culture and the usage of the bead. The various types of glass beads discussed here would be based on the production techniques as well as the designing and finishing of the beads. Mention could be made of drawn beads, wound beads, mould- pressed beads, fussed canes or Mosaic beads, fused beads, recycle bottle beads, etc.

Drawn beads consist of all glass beads produced by drawing out a tube of glass from a large hollow tube like drawing out a thread of toffee. The globe might consists of several different coloured layers or adorned with rods of or lumps of coloured glass to form a strip. Usually the decorations on drawn beads are stripes of uniform thickness that run parallel in the direction in which the beads were drawn. The different classifications of drawn beads depend on the number and shape of the different layers of glass. A famous example of a multi-layered drawn bead is the chevron beads known as "*powa"* in Krobo (Wilson, 2003).

These beads are usually star shaped and are usually composed of colours such as white, red and blue. "*Koli*" bead which is another famous beads are reheated such that the air bubbles in the glass burst. One can also talk about Cornaline d'Aleppo , a famous red coloured drawn bead with white heart. Wound beads refer to all beads produced by winding a hot and molten rod of glass or a strand drawn from molten glass around a metal wire. The bead maker heats and winds the bead in front of a flame. During the bead formation whiles it is still hot, it could be decorated or shaped with a metal paddle, stainless steel, graphite or wood. The bead surfaces have swirl

marks that encircle the axis or a myriad of inlays or appliqué designs. They are usually made individually and are very difficult to make (Karklins, 1985).

Mould- pressed beads include all beads that are produced by heating a glass rod and for it to melt and then pressing the melted glass in a tong-like-two piece mould. The mould contains needles or moveable pins that pierces a hole into the glass being formed (Wilson, 2003; Karklins, 1985). Excess glass is removed from the side of the mould. The beads again are rolled in hot sand to remove flashing and soften seam lines. The beads made usually exhibits complex colour pattern but have a high labour cost. Bohemia is noted for its production of a variety of complex and expensive glass beads using the mould method (Jargstoff, 1993).

Fused canes or Mosaic beads comprise all beads produced from sliced glass canes that are heated and fused to a centre core which is usually a black drawn cylinder. Sometimes the entire surface of the centre core is covered with cane slices and at other times they wound glasses are mixed with the sliced glass and fused to the centre core. This method is advantageous since it allows the quick production of highly-patterned beads. Picard and Picard (1991) talk about millefiore beads which are made by covering the entire surface of the centre core with chevron cane slices as a typical example of fused canes or mosaic beads. Cole and Budwig (1993) in writing about the exploration of bead traditions around the world also talk about millefiore beads as an example of mosaic beads.

Beads formed in moulds with their perforation made whiles they are still hot are called fused beads. The colours on the beads could however be made before or after

firing the beads. Three forms of beads are produced under this method. These include fused powder beads, fused painted beads and fused fragment beads. In the production of fused powder beads, glass is pounded into powder, mixed with dyes and poured into moulds for firing.

After firing the entire beads or broken pieces are placed in moulds and fired again for it to soften and fuse together, creating new patterns. With the Fused and painted beads, glass powder beads are formed in moulds. Decorations are then painted on beads after which they are re-fired. The fused fragment beads are however done by arranging different coloured glass fragment in a mould and firing it for them to fuse together in a firewood oven. Example of fused beads are “Bodom”, “ Bota”, “Ntsetsease”, “Nonkyerme”, “Akoso”, “Mfufua” and “Abrekuni” beads among the Asante’s and Krobo people of Ghana. Kiffa beads from Mauritania, Ateyum beads and the Keta awuazi of the Yuroba’s,

Recycled bottle beads unlike the others refer to all beads that are made directly from bottles without fusing. They are made from the thick part of bottles and are hand-drilled to get the hole in them. The holes are carefully drilled from both ends in order to get a straight perforation (Wilson, 2003). Because the bottles to be recycled are broken in order to get the beads, sharp edges are seen and are made smooth with a grinding stone.

It could be noted here that different types of glass beads exits in the world. The grouping of the bead types are however characterized by the method of production of

the bead. The types of beads include drawn beads, wound beads, mould- pressed beads, fussed canes or Mosaic beads, fused beads and recycled bottle beads.

2.24 Various glass bead production techniques

The techniques employed in glass bead productions are enormous. Various production techniques are used by bead producers to get different designs. These techniques vary from places to places but are all aimed at producing nicely decorated perforated beads that could be used to perform a specific functions. The main ingredients for these bead productions is silica, soda and lime or recycled soda lime glasses. The various techniques include winding, drawing, trailing techniques as well as the press mould method and the recycle glass technique.

Bida glass workers make use of the recycled glass in bead production and they employ the winding, drawing and trailing techniques. This they do by heating glass scrap until it is ductile and make the beads with an iron rod using the above mentioned techniques (Lamb 1976). Stokes (1999) also explains the drawing technique in his book. She explains that it is made by drawing out molten glass into hollow tubes as long as 150-300 feet.

The tubes are then cut into canes and the canes are further caught into beads of different sizes. According to Wilson (2003), the winding method could also be made by winding a hot and molten glass or a strand drawn from molten glass around a metal wire called mandrel. The bead worker heats the glass using a flame and wind the bead. The bead whiles still soft could be decorated or pressed with metal to shape

it. This process has also been elaborated by Karklins (1985); Jargstoff (1995) and Trivellato (1998)

Francis (1991) elucidates the drawing technique that they are made by pulling or drawing from a hollow glass gathers. The gather is made hollow by blowing through a blow pipe or manipulating while the end of the gather is attached to an iron rod, pontils or punties or a blow pipe and a punty. The glass is then stretched out by one worker or between two workers. It is then sliced into beads sized segment and are then tumbled over heat to smoothen the ends.

The Krobo's of Ghana uses bead powder to produce their beads (Lamb, 1976). The beads are made by grinding old glass bottles into powder. It is then heated and poured into moulds of varying shapes. With the Krobo bead making parallel strip running design are made to the perforated centre by simply poking holes into the powder filled vertical mould at the edge where the powder meet the side of the mould. It is then fired and a stripe or pattern of strips which look as if it has been trailed into the bead is seen. After firing and cooling, the beads are arranged on strings and polished on a special grinding stone. They also employed the drawing technique in their bead production.

Fish (1992) describe chevron and molefiori mosaic beads as the best known Venetian beads. He explained its manufacturing process as very remarkable in that, a special drawn process is used in producing the chevron beads. In this process, glass is melted into a hollow globe and attached to two metal plates with two men, each holding a rod. The men would then run to the opposite direction stretching the globe into a thin

hollow cane. The canes are sliced to form beautiful chevron beads. The sliced chevron beads formed are heated and fused to a centre core and this leads to the formation of molefiori mosaic beads.

The press mould technique is also made by heating a glass rod over an oil flame until it melts. It then put in a two piece mould and pressed to remove any trapped air from it. Excess glass could then be removed. This results into hollow glass tubes which are then cut into smaller bits to form beads. The Chinese, according Fish (1992) produces highly complex beads which are made by inserting tiny animal motifs into transparent glass and decorating it with wound spirals of blue glass.

2.25 Marketing of glass beads

The marketing of glass beads also refers to the selling of Glass beads has existed since the era of the barter-system. Trading of beads among neighboring tribal groupings as well as between continents that are geographically part has been recorded by historians. Mention could be made of the trans-Saharan trade and European trade among others.

Glass beads after they have been produced are shaped in single units with holes in them. They are threaded into various strands, based on the bead size and quality before they are sold. Orchard (1975) explained that, beads made were threaded depending on the sizes and type of beads produced before it is threaded into strands of about hundred beads. A number of strands are then put together to form a bunch which are then sold. The general aesthetics of the strands are also seriously

considered. More expensive or aesthetically attractive beads are positioned in the middle column of the strands.

The beads after they have been threaded into strand and grouped into bunches are either sold in the market, shops or exported into other countries. The Krobo beads sellers in the early part of the 20th century sold their beads at the Asesewa market which used to be one of the biggest markets in West Africa but currently, they sell their beads in the Koforidua market on Thursdays and at the Agomanya market on Wednesday and Saturday (Wilson, 2003). Ashanti beads are usually sold at a section of the Kumasi Central Market known as "Bola ho" on Mondays. On the said bead market days a huge number of stalls are seen to be packed with in a manner that makes it difficult for a first buyer to choose whom to buy from. The beads are sometimes packaged with a very nice package for sale in shops. Examples of such beads are jewelry set which include beads for the neck, wrist, and the ear together. Beads are also exported to other countries for use. For instance Bohemia in the Czech Republic exports their beads to Ghana (Wilson, 2003). These beads are bought by Ghanaian bead makers who use them as raw materials for making new beads and as colouring oxides.

Owing to the fact that the production of beads is very tedious, most bead producers do not add the marketing to their work especially those who engage in mass production. The producers may either deal directly with wholesaler who purchase the beads in bulk for retailing, or sell the beads directly to some big shops, or export the beads. Usually, after the wholesalers have purchased the threaded beads from the manufacturers, they sell them to retailers who further work on the bead to produce

other artefacts for sale in smaller shops and stalls. Such artefacts include glass bead belts, bags, wall hangings, jewellery set etc.

In conclusion, glass beads before they are marketed are threaded into strands and bunch. These are then sold to wholesalers for sale at organized market centers for retail, export or for sale in shops. Retailers after purchasing the glass beads produce other artefacts from it and package it for sale in shops and stalls.

CHAPTER THREE

METHODOLOGY

3.1 Overview

In this chapter, the researcher finds it appropriate to elaborate further on the research methods used in eliciting, collating and analysing data for the purpose of this research work. The chapter boarders on the following broad areas: research design, library research, population, data collection instruments, interview schedule, validation of instruments, administration of instruments, primary and secondary sources of data, data collection procedures and data analysis plan.

3.2 Research Design

The researcher utilised qualitative research method for the purposes of this research work. Leedy (2002) explains that the term qualitative research encompasses several approaches to research that fairly quite differ from each other. Yet he goes on to elaborate that all qualitative research has two distinguishing features in common. First, they broadly focus on phenomena that ensues in natural settings that is, in the 'real world'. Secondly, they involve studying those phenomena in all of their complexity.

Qualitative research method does not strive on broad simplification of issues; rather, one of its core tenets is to recognise that every issue under study has many dimensions and layers that must be studied and portrayed. Best (1981), explains this tenets much clearer, he explains that qualitative research are those that do not allow the description of observation ordinarily as in the case of quantitative studies.

The type of qualitative research method adopted is descriptive research method. This method proved to be the most ideal for this research work because it aids in the identification of characteristics of observed phenomenon and additionally, explores possible correlation between two or more phenomena. There was no need of changing or influencing the situation under this research, nor was there the intension to determine cause and effect relationship.

Williman (2001 p. 47) state's that `` descriptive research relies on observation as a means of collecting data. It attempts to examine situations in order to establish what the norm is, that is, what could be predicted to happen again under the same circumstances``. Observation could take various forms depending largely on the type of information being sought for. The process was facilitated by interviews, visual as well as audio recordings, etc. Major finding of the interactions were penned down for future referencing, organisation and analysis.

The exact descriptive research method adopted was observation studies. Opoku-Amankwa (2002) stressed that, there are some cultural practises, beliefs, values and social phenomena that cannot be easily researched into by adopting the survey or document analysis methods. He recommended that in such situations, the researcher should rely largely on observation to have an insight into the goings on in social groupings, rituals, techniques, etc, over a given period. He further cited two kinds of observations as participant and non-participant observation.

Participant observation is when the researcher anonymously infiltrates the ranks of a social grouping she is studying and gains acceptance as a member of the group. She

however, does not try to influence the group with her ideas of the world's view and her assumptions of how things ought to be done. She remains anonymous and keeps a low profile whiles observing and documenting her observations.

The researcher preferred the non-participant observation method by being present at the selected glass recycling bead making communities but keeping a low profile and being socially isolated from the communities. The frequent visits by the researcher were largely unnoticed by the larger community. Some elements of experimental research were also used to carry out test on the raw materials and production techniques used by the recycling glass bead producers to compare them with known standards.

3.3 Library Research

The Kwame Nkrumah University of Science and Technology Library (K.N.U.S.T), the Balme library and the Institute of African Studies Library both at the University of Ghana (U.G), Building and Road Research Institute Library (B.R.R.I), and British Council Library constituted the chain of libraries consulted for this research work.

3.4 Population; sampling design; the sample

According to Agyedu, Donkor and Obeng, (1999 p 40), the term population ``refers to the complete set of individuals (subjects), objects or events having common observable characteristics in which the researcher is interested``. Population in this sense does not necessarily refer to people. This view is buttressed by Williman (2001). Population may be finite or infinite.

Osuala (2005) identifies the foremost step in obtaining a sample as the process of defining the population. He explains that this means identifying characteristics which members of the universe have in common and which will identify each unit as being a member of a distinct group. Armed with this information the researcher focused on indigenous recycled glass beads producers, their assistants, recycled beads retailers, traditional leaders in the catchment area and cliental.

The study showed that no officially reliable data on recycled glass bead producers in Ashanti exist. However, according to Madam Theresa Akosei, the leader and coordinator of recycled glass bead producers in Ashanti approximately about fifty members have registered with the Artisan and Craftsmen Association, Ashanti Branch, and have five regular bead producers as members at their monthly meetings.

She could however not state precisely whether all those who were previously in the recycling bead making industry are still in business or have diverted into other professions. She added though that, there may be pockets of recycled bead producers scattered in few households at, Darbaa, Asuofia Asamang and Akropong, who may be alternating or combining bead making with farming.

As can be deduced from the above, the researcher was left with no choice but to adopt the snowball sampling method to sample the respondents. Snowball sampling is a technique for identifying respondents by asking others to identify individuals or groups with special understanding of a phenomenon (Marshall, 1997).

The researcher often asks each accessed participant to suggest others with similar ability which may be of interest to the researcher. For example, the researcher went to the Kumasi Centre for National Culture where interviews the showroom attendant about the recycling glass bead industry in Ashanti. The attendant after the interactions referred the researcher to the leader of the group, who also identified others engaged in the recycling glass bead industry.

Contrary to the perceived current fashion for contemporary middle and upper class, Ghanaian women to decorate themselves with beads, the recycling glass bead industry in Ashanti is drying out. In communities, where recycling glass bead making was the sole occupation of the entire community, recently is only a shadow of its formal glory. Only two or at most five practitioners are likely to be found in such communities still engaged in recycled glass bead production. Recycling glass bead making facilities built under the auspices of Ghana government at Asuofia Asamang to support rural cottage industries are now being converted into hostel facilities.

In total seventy (70) people were sampled, constituting 100% of the population. Out of this figure eight (8) were recycled glass bead producers with nineteen (19) assistants. Retailers identified were twenty two (22). Also, nine clients (9) were sampled, three (3) Traditional Rulers and nine (9) opinion leaders in the sampled communities. The breakdown of the data to show the strength of the industry in the respective communities is indicated in the tables 3.1, 3.2 and 3.3 respectively:

Table 3.1 Population of recycled glass bead industry at Darbaa

Number	Characteristics	Number of respondents
1.	Recycled Glass Bead Producers	3
2.	Assistants/Apprentices	4
3.	Retailers	2
4.	Clients	3
5.	Traditional Rulers	1
6.	Opinion Leaders	3
	Total	16

Table 3. 2 Population of recycled glass bead industry at Asuofia Asamang

Number	Characteristics	Number of respondents
1.	Recycled Glass Bead Producers	2
2.	Assistants/Apprentices	11
3.	Retailers	20
4.	Clients	3
5.	Traditional Rulers	1
6.	Opinion Leaders	3
	Total	40

Table 3.3 Population of recycled glass bead industry in Akropong

Number	Characteristics	Number of respondents
1.	Recycled Glass Bead Producers	3
2.	Assistants/Apprentices	4
3.	Retailers	0
4.	Clients	3
5.	Traditional Rulers	1
6.	Opinion Leaders	3
	Total	14

Beside this sample the researcher interacted with the leadership of Artisan and Craftsmen Association, Kumasi Branch, to know the state of the association and the sort of assistance it is positioned to render to the recycled glass bead producers and retailers. Other agencies like the Aid to Artisan Ghana, Ghana Export Promotions Council, etc, were also interviewed for their stake in the recycling glass bead industry.

3.5 Data collection instrument: interviews and observation

Interview could be viewed as a form of oral questionnaire. It is a commonly used method of collecting information from respondents. Any one-on-one interaction between two or more individuals with a specific purpose in mind is termed an interview. Interview could be structured or unstructured, (Best, 1981).

In structured interviews the researcher asked a set of premeditated questions that she has written down. The same wording and sequence of questioning are written down

in what is called an interview schedule. This set of questions' is repeated throughout to all respondents to respond to in an interview.

Unstructured interview was preferred by the researcher. They were found to be more flexible, free flowing and having the possibility of resulting in more insightful information to the researcher. It also yields varying perspectives of the same or similar information from varying sources that the researcher analyses to enrich her work. A summary of the broad areas of questions asked are presented below:

- **a.** Historic background of the recycling glass bead making industry in the catchment area.
- **b.** Types of raw materials and their sources.
- **c.** Tools and equipment used
- **d.** Production processes and techniques
- **e.** Finishing
- **f.** Types of recycled glass beads produced
- **g.** Distribution Channels/marketing
- **h.** Prospects and challenges confronting the industry
- **i.** Anticipated government policy direction and interventions

3.5.1 Observation

Observation according to Schram (2003) in qualitative research is unstructured and free flowing. This allows the researcher to focus her attention on one particular thing and only shifting her attention when she has thorough by examined the thing that held her attention. This approach brings to mind certain details that are of primary

importance to the researcher which may have escaped her memory in the preparatory stages or she may be totally oblivious of.

3.5.2 Content analysis

Documented materials obtained from numerous sources like letters, memos, association's meeting minutes, dairies, memoranda, books published and unpublished, etc, were analysed into mutual exclusive and comprehensive sub-headings.

3.6 Interview schedule, observation format and experimental research

The researcher interviewed recycling glass bead producers, their assistants, retailers, clients, traditional rulers and opinion leaders in recycling glass bead producing communities. As stated earlier, the interviews were conducted in Asante Twi at a pre-arranged time convenient to the prospective interviewees. An interview schedule was designed to last not more than thirty minutes. However, some respondents were quite chatty and prolonged some of the interviewing section to as much as two hours.

On the spot observation were carried out in all the three recycling glass bead production communities. Meticulously, observing and recording the goings on with a digital camera and intermittently taking short notes. Special attention was paid to tools and materials, production processes and techniques, finishing techniques (aesthetics), safety measures taken, general working conditions and health implications.

Some element of experimental research was also carried out. Clay samples for making moulds recycled glass beads were brought to the laboratory and analysed and

compared with two different kinds of clays to asses their uniqueness and characteristics.

3.7 Validation of Instruments

Data compiled and used in this research work to a significantly large extent are very liable, precise and consistent. Gathered data were from very credible sources and pilot surveys were conducted prior to the commencement of the actual research work.

3.8 Administration of Instruments

Owning to the fact that most of the sampled population assessable to the researcher were illiterates, the interviews were conducted in Asante Twi and recorded in English. The interviewing schedule was self administered.

3.9 Data Collection Procedures

Primary data was collected from recycled glass bead producing communities by holding discussions and interacting with the producers, retailers, clients, opinion leaders and generally, engaged stakeholders in the recycling bead making industries at Darbaa, Asuofia Asamang and Akropong. Data was collected through interview, discussions, opinionnaire (translated) and on the spot observation.

Secondary data were collected from books and unpublished thesis, magazines, articles, officially filed records and lecture notes. The researcher also utilised information from the internet.

3.10 Data Analysis Plan

Gathered data were thoroughly presented, synthesized, analysed, interpreted and conclusions drawn from it. These were further supported with tables, plates and write-ups in chapter four.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Overview

Chapter four entails a systematic presentation of the data gathered from interviews, on the spot observations, laboratory experiments and deductions from documented information obtained in the course of this research work. The data were collated and synthesised based on the following objectives: one, to identify the well known glass beads producing towns in Ashanti; two, to study and examine the raw materials, tools and equipment as well as the production techniques used in the recycled glass bead industry in Ashanti; three, to assess the major strengths and weaknesses in the development of the industry; four, to carry out experimentations to innovate and design products using recycled glass beads production techniques.

The chapter has further been subdivided according to the following subheadings: Assembling of data, analyzing and interpreting of data and validity of research questions. Statistical tables, charts, figures and plates were used to compile the data. The deduced findings have been interpreted using descriptive analysis.

4.2 Assembling the Data

4.2.1 Demographics

Through interviews and interactions with respondents three prominent recycled glass bead producing centres were identified in Ashanti Region. They are Darbaa, Asuofia Asamang and Akropong. These centres have attained many successes as far as the recycling glass bead industry is concerned and in the process attained international fame and recognition. The Ashanti region is the administrative region of central Ghana. The region's capital and largest city is Kumasi. Ashanti's major commercial

products include coffee, timber, gold and bauxite. The region contributes significantly also to the non traditional export. It is predominant in the production of indigenous textiles (*kente, brisi, kuntunkuni,adinkra printed cloth, tie and dye*, etc), wood carvings, furniture and beads. In recent times the region is noted for its brisk trading and merchandise.

Figure 4.1 Map of Ashanti Region

4.2.2 Sample Size

The total population sampled for this research work was seventy (70) representing hundred percent (100%) of the sampled population. (Refer to Table 4.1 and Figure 4.2).

Table 4.1 Population distributions

Characteristics	Number of Respondents	Percentage %
Recycled Glass bead Producers	8	11.4
Assistants/Apprentice	19	27.1
Retailers	22	31.4
Clients	9	12.9
Traditional Rulers	3	4.3
Opinion Leaders	9	12.9
Total	70	100

Figure 4. 2 Respondents in percentages

According to the survey conducted by the researcher in the three selected towns, it was made known by most people that Ashanti bead production was initiated by Agya Osei who hailed from Darbaa. History has it that, Agya Osei travelled into a foreign land where he learnt the art of fused powder glass bead making and started its production at Darbaa upon his return. Soon after he had started most people in Darbaa as well as people from neighbouring villages learnt it and that led to the spread of recycled glass bead making in Ashanti. The recycled glass bead industry in

Ashanti is dominated by females, particularly in Asuofia Asamang. However, at Darbaa and Akropong a significant proportion of males are engaged in the industry.

The glass bead industry was previously a communal indigenous industry that engaged the services of both sexes and age groupings in the community. Despite of the fact that the person who is accredited for the introduction of recycled glass bead production in Ashanti is a male (Agya Osei), the industry has been dominated by women with men only entering the industry after it proved to be profitable. The women in these communities wash and clean broken bottles obtained from predominately brewing companies and small purchases made available by private individuals who go round communities in search of used bottles to buy. Additionally, they pound the glass bottles to various particle size distributions and sell to glass bead producers. Elderly women are equally not left out of the industry; theirs is the designing and making of moulds for forming the glass beads. Children also, have the responsibility of cutting cassava stalks into the required size and fixing them into the socket in the moulds to serve as the perforation in the finished glass bead. Previously, almost every household was involved in the industry one way or the other.

The level of education of the sampled population was very low with the highest level of education attained by respondents being middle school standard seven, now Junior High School form three. There were no fees charged for learning the trade. Children as well as neighbours assisted producers and in the process learnt the art of recycled glass bead making. They also trained others who showed interest in the profession. With the passing of time the glass bead industry spread to neighbouring villages and

towns. This explains why the industry is prevalent at Akropong, Darbaa and Asuofia Asamang, all of which are neighbouring communities.

4.2.3 Materials, Tools and Equipment

4.2.3.1 Materials

Glass bottles and louver blades

Broken Glass bottles examples being, Sprite bottles, Coca Cola bottles, Fanta bottles, Star beer bottles and occasionally Louver blades, form the bedrock of the sources of glass bottles recycled for the sole purpose of glass bead production in Ashanti. (Refer to Plates 4.1and 4.2)

Plate 4.1 Broken Glass bottles

Plate 4.2 Broken louver blades

Colouring oxides

Colouring oxides like, iron, sulphur, manganese, selenium, tin oxide, copper oxide, silver, cadmium, nickel and many others are purchased commercially and mixed with recycled powdered glass to produce glass beads of assorted shades. (Refer to Plates 4.3a and b)

Plate 4.3a Colouring Oxide **Plate 4.3b Colouring Oxide**

Sedimentary clay

Sedimentary clays mostly found near the vicinity of the glass bead producing centre is usually utilised to produce the moulds for glass bead making. (Refer to Plates 4.4 a and b)

Plate 4.4 a Sedimentary clay **Plate 4.4 b Sedimentary clay**

Fire wood

Fire wood is obtained from fallen down trees from the forest in surrounding communities. However the most widely used sources of fire wood are bamboo and orange trees. Bamboo because it is readily available, burns readily in fire whiles orange trees is preferred because of its hardness and ability to generate intense heat over a protracted time period. (Refer to Plates 4.5a and b)

Plate 4.5 a Firewood **Plate 4.5 b Firewood**

Cassava stalk

Cassava stalks are plucked from the leaves of the plant and dried before being stuck into moulds to be filled with powdered glass prior to firing. (Refer to plate 4.6)

Plate 4.6 Cassava stalks

4.3.2.2Tools

In the broadest sense, the tools observed to be utilised by glass bead producers are all improvised locally made tools, made from wood, metals, stones and plants. The following tools caught the attention of the researcher:

Knife

A sharp knife is used to cut out moulds after a ball of clay has been shaped into the desired thickness and size. (Refer to Plate 4.7)

Plate 4.7 Pen Knife

Plate 4.8 Nose Mask

Nose Mask

It is used to cover the nose and to prevent dust and other powdery contaminants from getting into the nose to cause lung related illnesses. (Refer to Plate 4.8)

Foa

Foa is a wooden stick fashioned in the likeness of a sprigging tool. It is used to create openings in the mould where the powdered recycled glass would be poured into, prior to firing. The tool could be shaped in various shapes to create glass beads of varying shapes and sizes. (Refer to Plate 4.9)

Plate 4.9 *Foa*

Plate 4.10 Scissors

Scissors

A pair of Scissors is used to cut the cassava stalk into the desired height after it has been stuck into the mould. (Refer to Plate 4.10)

Pestle

Pestles are used in recycling broken bottles into powder. Pestles used for glass bead making are usually in the form of metal parts of broken down vehicles with a wooden handle. (Refer to Plate 4.11)

Plate 4.11 Pestle

Plate 4.12 Mortar

Mortar

Metal receptacles are used to hold broken down bottles that are pounded into powdered glass. The powdered glass is subsequently mixed with colouring oxides to produce glass beads of varying colours and shades. (Refer to Plate 4.12)

Mesh/sieve

Mesh and sieves of varying sizes were found to be used by these glass bead producers. The sizes ranges from 60 to 120 sieve mesh. They are used to sieve the pounded glass into finer particles. (Refer to plate 4.13)

Plate 4.13 Mesh/Sieve

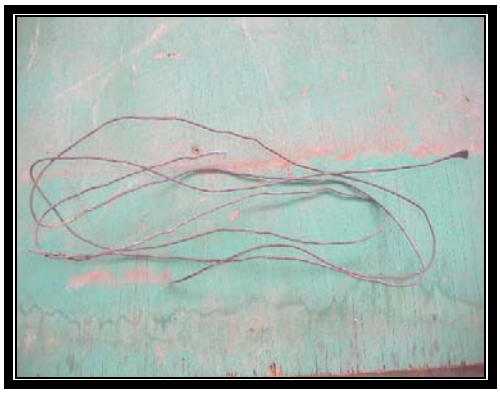

Plate 4.14 Cutting wire

Cutting wire

Copper wire is used as a cutting wire to cut clay meant for the making of moulds into two halves to remove stone pebbles and other foreign materials trapped in the clay. (Refer to Plate 4.14)

Chisel and hammer

Chisel and hammer are used to split fire wood into managable pieces that would fit well into the fire boxes of the kiln without much difficulty. (Refer to Plate 4.15)

Plate 4.15 Chisel and Hammer

Plate 4.16 Grinding stone

Grinding stone

Grinding stone are also utilised to polish fired glass beads for it for lustre and sparkle when it reflects light. (Refer to Plate 4.16)

Spade

Spade is used to collect and mix clay used in producing moulds into a homogenous mixture. (Refer to plate 4.17)

Plate 4.17 Spade

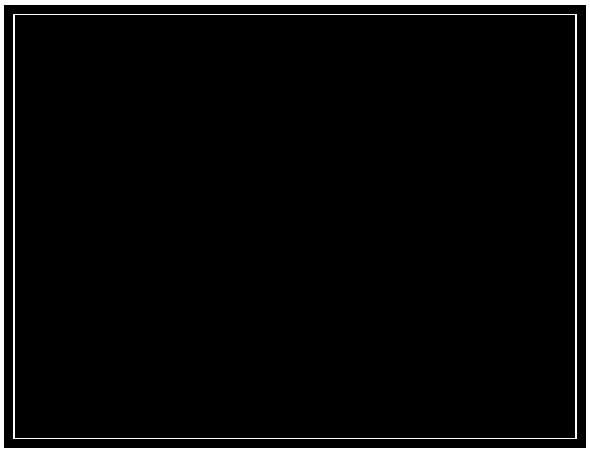

Plate4.18 Woeɛ

Woeɛ

It is used to make holes in the powder filled moulds to create various designs. There are two types of Woeɛ**.** The round and the flat type. (Refer to plate 4.18)

Nwohon

Nwohon is a small metal receptacle in which colouring oxides are placed and used to create designs on glass beads. (Refer to plate: 4.19)

Plate 4.19 *Nwohon*

Plate 4.20 ɛn*kekay*ɛ

ɛnkekayɛ

It is used to test hot beads to see whether they are well fired. It is also used to remove stucked beads from the mould. (Refer to plate 4.20)

Spatula

This is a wooden tool used to smoothen the surface of mould after it has been shaped and also for defining the shapes created. (Refer to Plate 4.21)

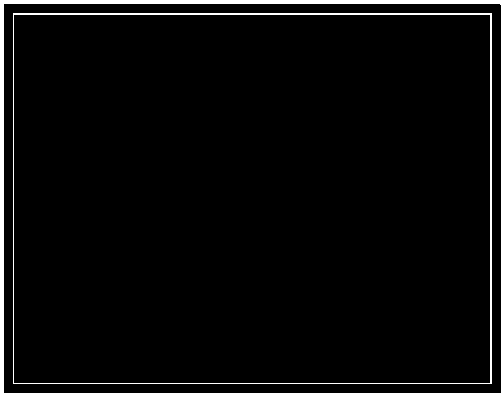

Plate 4.21 Spatula

Turning tools

These are used to scoop away excess clay from the mould and for creating designs on the mould.

4.3.2.3 Equipment

Potters wheel

Hand powered potters' wheel is used in producing moulds by some glass bead producers. (Refer to Plate 4.22)

Plate 4. 22 Potters' wheel

Plate 4.23 Grinding Machine

Grinding Machine

Electric grinding machine, similar to the one used for the sharpening of knives and other agricultural implements are used in polishing glass beads. (Refer to Plate 4.23)

Disc grinder

A machine used for grinding broken bottles into fine powder.

Kiln

Plate 4.24 Updraft firewood Kiln

Plate 4.25 Downdraft gas kiln

Two types of kilns' were utilised by glass bead producers. The most popular as well as the most patronised kiln was a locally improvised up-draft fire wood kiln that is designed with two rings on the walls to serve as support for preheating glass moulds prior to their introduction into the kiln chamber. (Refer to Plate 4.24)

The next is a downdraft gas kiln, built with a combination of insulating bricks, refractory bricks and common bricks. The down draft kiln is obviously relatively expensive than the up-draft kiln. However, it is user and environmentally friendly, fires evenly and faster than the up-draft kiln. (Refer to Plate 4.25)

4.2.4 Techniques in recycled glass bead production

After months of meticulous study and interaction with recycled glass practitioners the following is the researcher's account of the techniques employed by recycled glass bead producers:

Type of production technique

The fused bead production technique was prevalent in the recycled glass bead producing communities visited. This is a process of recycled glass bead making process, where powdered glass mixed with colouring oxides, is poured into specially designed impressed moulds and fired to produce a cast of the impressions in the moulds.

Raw materials preparation

Raw materials for bead production come in the form of clays, colouring oxides and broken soda lime glass fragments.

Clay processing for recycled glass bead mould making

Sedimentary clay or secondary clays is chiefly used in making the moulds recycled glass bead production. Sedimentary clays are usually located around river banks, tributaries, swampy areas, valleys, etc. These are clays that have been transported away from their parent rock and are relatively abound in every geographical area. Almost every recycled glass bead producing community visited had prospected and found sedimentary clay that is suitable for making glass moulds and also for kiln construction. Upon a physical examination by the researcher, these clays were found

to be greenish in colour, non-plastic, coarse and contains some amount of mica. These physical properties have the tendency to make the resultant mould have some refractory as well as insulating properties.

These physical properties could probably be attributed to the fact that these special clays suitable for mould making have not travelled far away from their parent rock, but have been contaminated with a lot of organic matter resulting in its greenish colour. The clay is dug with simple implements like hoes, cutlass, spade, etc. It is then transported to the production site in pans and carried on the head. (Refer to plate 4.26 and plate 4.27)

Plate 4.26 Prospecting for sedimentary clay

Plate 4.27 clay being transported to Production site

When the clay is brought to the production site, it is left in the open and exposed to the regencies of the weather. The sun shines on it and the rain falls on it. This period is known as seasoning. Some of the carbonaceous materials and organic salts in the clay are leached out. The season period can go on for days, weeks and even months, based on the availability of clay and the practice of the producer.

When this period elapses, water is sprinkled over the clay and allowed to saturate overnight. The next morning, a spade is used to mix the clay into a consistent homogenous mixture (Refer to plate 4.28). A wooden frame is placed on a concrete

floor and a pestle is used to pound the clay inside the frame. This breaks down hard lumps still present in the clay and renders the clay workable. (Refer to plate 4.29)

Plate 4.28 Saturated clay

Plate 4.29 Clay being pounded for mould Making

A sizable quantity of clay is taken from the bigger pounded chunk and formed into a round ball (refer to plate 4.30). Preferably, a white polythene sheet is spread on a working table and the ball of clay placed on it. The ball of clay is then beaten down to flatten it. When the ball of clay is flattened to the desired thickness, a lid of a saucepan is place on top of the clay and marked out with a pointed tool. A spatula or a sharp knife is used to cut out the mould and to define the edges of the mould. The edges, as well as the surface of the mould are smoothened with the same spatula (see plate 4.31)

Plate 4.30 A ball of clay for making a mould

Plate 4.31 Defining the shape of the mould

The next step after defining the shape of the mould is pressing of a wooden sprigging tool known in local parlance as *foa* on the mould to take a print of it. The impressed

design would define the shape of the bead and its size (refer to plate 4.32). The designed mould is allowed to dry under a shade, prior to firing. The moulds are first fired before filled with the mixture of powdery glass and colouring oxides for the second firing (Refer to plate: 4.33)

Plate 4.32Mould making using *foa*

Plate 4.33 A collection of fired glass bead mould

Processing of broken glass bottles for glass bead production

As stated earlier, the predominante raw materials used in the recycled glass bead industry are broken bottles, obtained from the Breweries. Louver blade, Fanta and coca cola bottles are the most preferred bottles, owing to their ability to be coloured with any colouring oxide and low maturing temperature. Additionally, the introduction of even little quantity of colouring oxide would result in a change of colour. However, Sprite and Star beer bottles possess a limitation to the producers because it is only economical to use such coloured glasses for green glass beads only. These glass bottles are sold to the (recycled glass bead producers) in sacks.

When these practitioners obtain these bottles, they contain some amount of foreign materials like crown corks, stone pebbles, leaves, dirt, etc that has to be washed

away. Two large containers may be utilised for this purpose. One container is half way filled with water and the broken bottles are emptied into the container to the brim. Glass producers use their bare hands to wash the glass bottles. After cleaning the broken glass bottles are placed in the other container placed at a distance from the first one. The clean bottles are later spread out on sacks in the sun for proper drying.

When the glass is thoroughly dried, it is poured in batches into a metal mortar and pounded to fine powder with a pestle. Glass bead producers had some knowledge on the health hazards of their profession and so some covered their noses with nose masks. Nevertheless, some complain of uneasiness in wearing the nose mask and worked without it. The powdered glass is subsequently sieved with an 80 to 120 sieve mesh based on the type of glass used and the calorific value of the fuel. Previously, when the industries were quite lucrative, middle men purchased the broken bottles, clean the glass fragment and pounded it into fine powder for onward sales to glass bead producers. Hundred cups (small size milk tins) of recycled glass was selling around five Ghana cedis (GH¢5.00p).

After the desired particle size distribution of the powdered glass has been attained, the producers mixed the powdered glass with imported colouring oxides sold on the commercial markets. The colouring oxides which they refer to as ɛ*duro* (literally meaning medicine) is priced based on the rarity of the oxide. Iron Oxide and manganese oxide are the most abundant and hence cheaper than cobalt oxide and antimony that are scarce and relatively expensive.

These colouring oxides give the glass bead its colour and also act as a flux in the firing process. The introduction of the following oxides produces these

corresponding colours: Iron Oxide (FeO) - Red and Brown, Manganese Oxide (MnO) – Black, Cobalt Oxide (CoO) – Blue, Tin oxide (SnO) – White, Copper Oxide (CuO) – Green, Chromium (Cr_2O_3) – Green, Rutile (T_iO_2) – Brown, Zirconia (Z_iO_2) – White, Zinc Oxide (ZnO) – milky White, Zircopax (Z_iO_2 – 64.88, T_iO_2 – 0.22, S_iO_2 – 34.28) - white, etc.

The colouring oxides are sold in powdery form. A kilogram of colouring oxide was sold for forty Ghana cedis (GH¢40.00p). However, a spoon full of colouring oxide is sold in some other markets for three Ghana cedis (GH¢ 3.00p) and a tin of tomatoes can (small size) full of colouring oxide is estimated to cost about five Ghana cedis (GH¢ 5.00p). The extensively used ratio for mixing powdery glass to colouring oxide is 1: 6 that is, one cup of colouring oxide to six cups of powdered glass. However, 1:7 and 1:8 ratios' were also observed by some practitioners.

They explain that, some colouring oxides are heavier than others but in the candid opinion of the researcher these differences may probably be attributed to the intensity of the hue of the colouring oxide and not the weight. Light hues like yellow, light blue, etc, may not register as prominently as desired, if the ratio of colouring oxide to powdered glass is disproportionately wide. The generally recommended percentage of colouring oxides in a powdered glass batch is a minimum of five percent (5%) to a maximum of eight percent (8%). While darker hues like dark blue, red, dark green, etc. may register more prominently regardless of the ratio used.

After deciding on the ratio of powered glass to colouring oxide to use, the materials are dry mixed in a bowl or a pan. A sizable quantity is mixed at a given time since a repetition of the same process may not necessary result in obtaining the same desired

colour. Any slight variations in the weighing process may result in a different colour or other undesired properties. Dried cassava stalks are painstakingly fixed into the sockets of the fired mould. A pair of scissors is used to cut the stalks to be in alignment with the height of the mould.

Designing of glass beads

Two methods of designing recycled glass beads were observed by the researcher. The first method was the layer method. In this method, powdery glass is mixed with different colouring oxides for example, red, blue and white. A layer of blue glass could be poured into the mould, followed by a white layer and then the red. When the moulds are stocked into the kiln and fired, it will produce nicely coloured layered beads. Examples of layered beads common in these areas include; *Bodom, kente, Bota, Ntsetsease, Nonkyerme, Akoso, Mfufua and Abrekuni.*

The second method is known in local dialect as *woeɛ.* Glass bead making moulds are filled with powdery glass as it is done in all fused glass bead making process. The only difference is that after filling the moulds with a coloured glass powder, a tool known as the *Woeɛ* is used to drill holes of varying depths into the powdery glass and another tool known as *nwohon* is filled with another coloured powdery glass and poured into the drilled hole and fired. The resultant beads have spotted designs or vertical lines in them. Examples are ad*ɛ, ɛsa ani, ebuburo nkosua, asadwira*, etc.

The fused painted bead method is usually done by the Krobo bead makers of Ghana. In this process moulds are filled with powdery glass and fired for the first time. Colouring oxides are then mixed with water and used to design the beads for a second firing. The design appears embossed on the bead and looks solid.

Firing of glass beads

The firing of the glass beads in a kiln is the next stage after filling the moulds. Two main types of kilns are used here. These include the updraft fire wood kiln and the downdraft gas kilns. Updraft fire wood kiln is the widely used kiln in the selected catchment area. Therefore firewood is the most prevalent source of fuel used; since it is abundant and relatively cheaper than the other sources of fuel such as gas and electricity. Firewood is obtained locally and the cost of a bunch of firewood ranges between two Ghana cedis and three Ghana cedis (GH¢ 2-GH¢3). Bamboo and orange trees are usually the preferred type of firewood. The setting up of the fire in the kiln is the first stage.

The filled moulds are arranged on top of the kiln for pre heating of the mould to take place. This could take about an hour to two. The pre-heated moulds are then removed from the top of the kiln and placed inside the kiln for complete drying to take place. Here the fire is kept low until the drying process is thoroughly complete. The number of moulds to be fired in a kiln is dependent on the size of the kiln, size of the moulds, the type of beads and the size of the beads to be fired.

Usually, their kilns take 5-9 moulds in one firing. The kiln can fire between five to seven times in a day. Averagely, about hundred moulds could be fired in a day. Full blast firing which is done after complete preheating is achieved by stalking the fire box with a lot of firewood for a specific time. This increases the temperature in the kiln thereby causing the glass powder to fuse together in the mould. The whole firing process can last for an hour or two depending on the size of the bead being produced and the intensity of the heat. After firing each mould is brought out and a tool called **ɛ***nkekay***ɛ** is used to test the beads to see whether it is well fired.

Unlike ceramic firing where cooling is done by turning off the kiln and allowing the wares to cool gradually to room temperature before the wares are off loaded from the kiln, in the case of glass beads, they are removed directly from the kiln and packed outside the kiln on the bare floor after firing. The hot moulds are stacked on top of each other. This manner of packing the moulds ensures that the moulds retain some heat and the cooling process delayed. Additionally, the delayed cooling prevents the glass beads from shattering as a result of the rapid change in temperature.

When the moulds are placed independently of each other, there is a sudden drop in temperature which has the tendency of cracking both the moulds as well as the glass beads. After cooling, the beads are removed from the moulds by turning the moulds upside down for the beads to fall in a bowl or a big basin. Beads that have difficulties in coming out of the moulds are removed by hitting the mould against another mould to cause the glass beads to fall from their sockets into a receptacle. The **ɛ**nkekay**ɛ** could also be used in removing stucked beads from moulds.

Finishing

Most beads after firing have rough edges which have to be smoothened. The beads are made smooth by stringing it on a copper wire and rubbing the sides on top of a grinding stone. Beads of the same sizes are strung together so that a good effect is obtained. The edges could also be smoothened on the grinding stone or with an electric grinding machine. Sand of varying grain sizes could be placed on the grinding stone to aid in the polishing process. Coarse sand is applied initially before much finer sand is thereafter applied. This polishing process increases the

smoothness of the glass. After polishing the beads are washed in clean water and oiled with ordinary cooking oil to make them lustrous and aesthetically attractive.

Packaging

Beads made in these towns are packaged by threading them depending on their sizes and the type of beads produced before they are threaded into strands of about hundred beads. A tool called **ɛ***doa* in the local dialect is used to thread the beads. A long thread of about two and half feet (2½ feet) is cut and used as a tape measure in checking the measurement of the threaded beads in order to get even strands. A number of strands are then put together to form a bunch which are then sold. No special package such as wrappers, hampers etc are used by the bead producers in Ashanti. However retailers of the beads use special wrappers, paper and rubber to package beads that are to be exported or sold to foreigners (refer to Plate 4. 34).

Plate4.34 A collection of recycled glass bead products

4.2.5 Pricing

A lot of factors influences the prices of beads produced in Asante. These include the quality of the bead, the colouring oxides used, the person buying it, where it is being sold as well as the status of the person buying it. Also, antique beads or beads which have historic significance are more expensive than modern day beads. Foreigners and

patrons of glass beads have a preference for antique glass beads, for they regard such beads as being of a superior quality. Hence, beads such as *Bodom* which is among the oldest beads are sold at a very expensive price if compared to beads like *gyae kora tween* which is relatively new. More recently the pricing of glass beads produced in Ashanti is significantly influenced by the colouring oxides used in the production of the beads.

Beads made of bright colours are more expensive than those made of dark colours since bright colouring oxides are rare and more often than not imported. The price of a bead is also largely dependant on the person buying whether he or she is a wholesaler, a retailer or an individual. Beads sold to wholesalers are relatively cheaper than the ones sold to retailers and individuals. In addition, beads sold at fairs, exhibitions, durbars and other important ceremonies are more expensive than the ones sold at the place of manufacture and in the open market. Beads exhibited at fairs and other important durbars could sell as high as twice the price in an open market.

The status of the person buying the beads could also lead to it attracting a much higher price than usual. For instance beads sold to Caucasians, foreigners, traditional rulers, statesmen, or perceived wealthy individuals may be priced relatively higher; since they are perceived to have a higher purchasing power and in the position to pay any price demanded by the sellers.

4.2.6 Marketing

The selling of beads directly to customer, retailers and wholesalers are ways in which Bead producers in Ashanti market their beads. Most of the bead producers after production sell their beads directly on Mondays' at the bead market (*B ככlaho)* at the

Kumasi Central market. At such markets, the selling price is the same for all categories of buyers whether they are wholesalers, retailers or private individuals. However, if wholesalers and retailers purchase the beads directly from the producers at the production sites in bulk, their unit price is comparatively lower than on the markets. Some more additional beads are even added to the quantity purchased as bonus.

These price differences might probably be due to the transportation cost incurred by the producers in sending the beads to the market. Wholesaler after purchasing the bead further sells them to retailers who in turn sell them directly to customers. Some of the producers also export the beads directly to people, institutions and groups outside the country. A typical example is Mr. Asumadu who is a bead producer at Darbaa.

4.2.7 Challenges

Health hazards

One of the greatest challenges of Ashanti bead workers is the health hazards associated with recycled glass bead production. The heat generated by their kiln is about 700°C-800 °C. This heat emanating from the kiln is so strong that it sometimes causes sickness such as headaches, eye problems, burning of hairs and general burns to the producers who hardly wear any protective clothing. In addition to that, back-aches, waist pains and general bodily pains are commonly experienced among recycled glass bead producers due to the long hours of sitting and standing during the production period.

It was observed that there were no nose masks used at most of the work places visited. This implies that most of the workers were being exposed to some poisonous chemicals in the batch which could lead to lung related illnesses. Fumes and other gaseous substances released into the atmosphere as a result of the fusing of the glass and the decomposition of the clay used for the moulds are dispersed into the atmosphere which is readily inhaled by producers. The silica in the recycled glass would not cause silicoses since the carbonaceous substances and other free radicals that are likely to be release into the atmosphere to cause these illnesses are more likely to be emitted during the first firing of the glass. However the first firing of bead moulds can cause silicoses since the clay contains some considerable amount of free silica and other radicals as part of its constituents which if released into the atmosphere has serious health consequences. The colouring oxides also have appreciable levels of toxicity, which are also of serious health concern.

High cost of colouring oxides

The colouring oxides used are also very expensive since they are imported into the country. The high cost of importation, coupled with the cumbersome distribution channels contributes to the high cost of colouring oxides. The collapse of most of the hitherto vibrant ceramic industry has made colouring oxide very scarce and hence expensive. Colouring oxides are not readily available locally. The only exception is iron oxide and manganese which produces brown and black or dark hues.

Mr. Gyamfi, a respondent, (house No AK 14 Akropong) who is also a glass bead producer at Akropong attested to the high cost of colouring oxides, he also attributed this to additional cost passed on by middle men who break the bonds of colouring

oxides and sell in smaller quantities to glass bead producers. Another respondent (Madam Theresa Akosei), the head of the Asamang Co-operative Beads and Marketing Society also explained that they used to get their colouring oxides from K.N.U.S.T (the Ceramics section) at a relatively cheaper price but their stocks gradually run-out leaving glass bead producers stranded. Later when the glass bead factory was established at Asamang, the establishers who were foreigners brought some colouring oxides for them to use and that has been used till the collapse of the factory. Mr. Asumadu of Darbaa another respondent also believes that the dyes are now very expensive and that account for the high cost of production.

Low patronage of recycled glass beads

Another important challenge facing the bead producers is the low patronage of beads in recent times. This they attributed to the abolition of some cultural practices and beliefs which hitherto promoted bead production and usage. The abolition of some cultural practises like *bragor*כ, widowhood rites etc which necessitated the wearing of beads have negatively impacted the patronage of recycled glass beads.

The doctrines of some religious faiths that forbid the wearing of adornment have also negatively affected the glass bead market. Churches like Deeper Life, Bible Believers Church, Seventh-Day Adventist Church, etc, forbid the wearing of ear ring, necklaces, etc. Additionally, the current profession of some category of workers like doctors, nurses, police and military personnel, etc have prescribed uniform that are worn to work that does not give room for the wearing of beads or adornments in the broader context.

4.2.8 Institutions that offer assistance to glass bead producers

A lot of statutory and non governmental organisations have as their mandate to provide assistance to small scale industries in order to help them grow their industries through advocacy, technical training, financial assistance, networking, and creation of potential markets. These agencies include, Ghana Regional Appropriate Technology and Industrial Services (GRATIS), Ghana Export Trade (GETRADE), National Board for Small Scale Industry (NBSSI), District Assemblies, EMPRETEC, Aid to Artisan Ghana, 31st December Women's Movement, Ghana Export Promotion Agency etc.

Although these agencies have committed themselves to assisting small scale industries there seems to be a disconnection between these agencies and the small scale industries. Most bead producers visited were unaware of the modalities for seeking assistance from these agencies. Even some glass bead producers were totally ignorant about the existence of such bodies except their own cooperative union that meet periodically at Kumasi Centre for National Culture.

It was realized that Aid to Artisan Ghana, 31st December Women's Movement and Ghana Export Promotion Agency were the only agencies fairly known by a section of the bead producers in Ashanti. 31st December Women's Movement was instrumental in the setting-up of a glass bead factory at Asuofia Asamang for glass bead producers' cooperative union in the catchment area. This factory is fast being turned into a hostel facility for newly posted teachers into the catchment area. A situation brought about as a result of the low patronage of glass beads and hence the

factory operating far below its maximum capacity levels, making production unprofitable.

However, the hostel business is fast becoming very lucrative and a much reliable source of income for the operators of the factory. The hitherto formidable co-operative union which could boast of a membership of about seventy plus, is now a shadow of its formal self. The membership has dwindled over the years leaving only one recognisable person in the person of Madam Theresa Akosei, the head of the Asamang Co-operative Beads and Marketing Society and her household.

Darbaa, another glass bead producing centre has also benefited from some assistance by the Ghana Export Promotion Agency. They facilitated in the securing of funds for the building of the glass bead factory currently at Darbaa, managed by Mr Asumadu. The agency also arranged for further training in Italy for Mr. Asumadu and other associates. Beside these afore mentioned interventions by these two named agencies, the wider glass bead producers are yet to benefit from any of such facilities.

From the perspective of the researcher the glass bead producers would be better positioned to benefit from such interventions by the above mentioned institutions if they register their small scale businesses with the Register Generals Department. This would qualify them to benefit from government periodic assistance disbursed through the common fund via the district assembly structure.

This should also be complimented with proper record keeping and prudent financial management. The glass bead producers should identify with the co-operative of

artiste and artisans at the Centre for National culture and invite agencies like the banks and other financial institutions, Ghana Regional Appropriate Technology and Industrial Services (GRATIS), Ghana Export Trade (GETRADE), National Board for Small Scale Industry (NBSSI), District Assemblies, EMPRETEC, Aid to Artisan Ghana, etc. to educate them on the operations and modalities for seeking assistance from their outfit. These seemly little but pragmatic measures could help in the advancement of the glass bead industry in Ashanti.

4.3.0 Analysis and Interpretation of Data

4.3.1 *Tools and equipment*

The various tools used by the bead producers at Akropong, Asuofia Asamang and Darbaa are very efficient and help the bead producers to produce high quality products. The producers have in-depth knowledge about their tools and use them quite appropriately. However, one respondent at Asuofia Asamang hinted that they discontinued the use of a disc grinder because it created dark spots in their finished glass beads. This problem could most likely be attributed to the metal used in fabricating the blade of the disc grinder. The disc which is mainly made of silicon carbide may contain some amount of iron which wears off as a result of abrasion, into the powdery glass which would result in the dark spots they complained about.

To resolve such challenges stainless steel or diamond blades are the most commendable blade for such purposes. Given the situation as it was, the operators could also have attached a magnetic steel plate at the outlet of the disc grinder that could attract the irons' in the glass and minimise iron contamination of the glass batch.

Still on the tools, another tool that could do with some modification is the *Foa* (similar to the springing tool) which is a locally made wooden stamp used in designing moulds. The nature of the tool limits the shapes that the tool could be put to use. Very intricate designs and decorative designs could however be made on paper and transferred onto Plaster of Paris (P. O. P) cut out and used for the same purpose. Such designs could be easily stamped into clay bat and used as a mould for producing pendants and other recycled glass souvenirs. P.O.P is easy to curve and even hasten the drying process of the glass bead moulds.

The Plaster of Paris which is also known technically as Calcium Sulphate Demihydrate ($CaSO_4 2H_2O$) is obtainable in a powder state and mixed with water in the ratio 3:2, that is three parts of Plaster to two parts of water. Prior the mixing of the Plaster, a hollow wooden box or cylinder is made with its edges and seams sealed with clay to prevent any leakage. Three part of plaster is carefully sifted into a bowl filled with two parts of water. The Plaster-water combination is allowed to sit undisturbed for about three minutes after which it is mixed homogenously with the hand and poured into the wooden box for it to set up into a large solid.

The solid plaster is released from the mould with the excess and rough edges scrubbed off with a hacksaw. The plaster is then cut into smaller units with the hacksaw for the design to be drawn on it. Various relief designs are made on the plaster by drawing and tracing designs from paper unto the plaster moulds. Locally made tools such as knife, *Woe***ɛ** and **ɛ***nkekay***ɛ** could be used in curving the relief design out of the plaster mould and are then dried in the sun. It is subsequently

pressed in a prepared clay as it is done with the *foa*. The same technique for the bead production is followed and used to get various sovenirs and decorative pieces formed. The process of making the plaster springing tools is demonstrated in plates 4.35- 4.38).

Plate 4.35 Plaster of Paris block .

Plate 4.36 Tracing of design onto plaster

Plate 4.37 a and b Curving out traced design

Plate 4. 38 Plaster springing blocks

The locally improvised firewood kiln is quite conducive for recycle glass bead production. Nevertheless, the amount of heat loss is unacceptable. The mode of operation should be given a second look. After the initial preheating of the kiln and during the latter stages of the full blast stage, the entrance of the kiln should be blocked to increase energy efficiency and minimize heat loss.

Respondents expressed the fear that, the covering of the entrance of the kiln during firing may result in decolouring of the finished beads. This fear is true so far as the preheating stage and the early stages of full blast firing is concerned. The intensity of the smoke generated by the firewood, coupled with the burning of carbonaceous materials from the clay moulds at these mentioned stages of firing would change the colour and lustre of finished glass beads. However, during the latter stages of the full blast firing process and particularly during the soaking period, the smoke would have subsided and the closing of the entrance and damper at the top of the kiln would not cause any damage.

4.3.2 *Materials*

The materials used are exceptionally good and very efficient. The glass bead producers have fair knowledge of the particle size distribution of the glass to use, the colouring oxides, the required proportions to add to a glass batch to attain certain desired colours and other desired characteristics etc. An apparent porosity test was conducted on Darbaa clay as well as Mfensi and Trabuom clays. The results of clay from Darbaa compared to that of the other clays showed that the Darbaa clay is relatively porous with minimum shrinkage less than 8.2%.

4.3.3 *Test on clay samples: Mfensi, Darbaa and Trabuom.*

When the clay was fired at 800^{o}C the porosity was found to be high (25.19%) with a low ringing sound when struck. When the firing temperature was increased to 1160^{o}C, the researcher observed an increase in density and mechanical strength of the clay. Its porosity and firing shrinkage did not change much and its ringing sound increased. These properties imply that Darbaa clay used for making glass bead mould is the most appropriate clay. The co-efficiency of expansion of the fired clay is relatively low which explains why the fired clay mould could be taken straight from the kiln and exposed to room temperature without cracking or exploding.

The minimum shrinkage characteristic of Darbaa clay facilitates the easy removal of glass beads from the mould without much difficulty. Mfensi clay and Trabuom clay on the other hand, shrink in excess of ten percent (10%). This high shrinkage prevents the easy removal of glass beads from their sockets in the clay moulds. Below is the finding of the laboratory experiment conducted on Darbaa clay, Mfensi clay and Trabuom clay to test for apparent porosity and shrinkage levels. Thirteen test pieces were made with the following dimensions: length, eight centimetres (8cm), breadth, three centimetres (3cm) and height, two centimetres (2cm). A line of five centimetres (5cm) was drawn on each test piece to test for lineal shrinkage. The results have been tabulated in a table 4.2.

Table: 4.2 laboratory tests on Darbaa, Mfensi and Trabuom clays

Clays	Dried weight	Fired weight	Shrinkage	Volume shrinkage	Soaked weight	Water of absorption	Apparent porosity
Darbaa	95.3g	87.49g	8.19%	7.81g	108.77g	21.28g	25.19%
Mfensi	73.42g	66.28g	10.05%	7.14g	75.48g	9.2g	13.88%
Trabuom	71.21g	63.62g	12.06%	8.13g	68.06g	5.62g	6.98%

4.3.4 *Production techniques*

Comparing the production techniques outlined by Wilson (2003), Ashanti glass bead producers specialises in fused glass bead production. Where powdered recycled glass is poured into moulds and fused at elevated temperatures to produce glass beads. This technique has over the years been over exploited without any variation in it. Production techniques like drawn beads, wound beads, mould- pressed beads, fussed canes or Mosaic beads, recycle bottle beads, etc have simply not been explored.

It was also observed by the researcher that most of the patrons of recycled glass beads particularly tourists have a preference for old beads; a preference probably, fuelled by the perception that they are authentic and more durable than recent versions of glass beads. This is a contributing factor to the repetition of old designs without exploring new techniques or designs. The lack of variety in the production technique is also a contributing factor to the steady decline of the glass bead industry. Patrons have seen similar glass beads produced repeatedly that they have become bored with the industry.

The glass bead market is also seasonal with sales going up around August to January. In between these seasons the producers have to rely on other alternatives sources of livelihood like farming or petty trading to make ends meet. So if there is a decline in sales during the major seasons, it really makes producers vulnerable to low prices. This makes the quest for alternative products inevitable. On the whole, glass bead producers expressed the desire to inject fresh impetus into the glass bead market using the same materials and possibly the same production techniques to introduce new products into the market to at least sustain the current market.

4.35 *Innovative products using the plaster solid moulds technique*

Armed with this information the researcher set-out to experiment to design and create innovative products like souvenirs and other allied products which would serve as an avenue for creating new market for the bead producers in order to diversify the recycled glass bead market in Ashanti. The same tools, equipment, raw materials, like recycled glass bottles, clay and colouring oxides were utilised by the researcher. The only replacement was the *Foa* a wooden stick fashioned in the likeness of a sprigging tool used to create openings in the mould where the powdered recycled glass would be poured into, prior to firing. This tool was replaced with plaster blocks embossed with *adinkra* symbols. *Adinkra* symbols were selected because it's indigenous nature and its familiarity to the producers. The exercise was only experimental.

Describing the process of production, a mixture of plaster or P.O.P and water was poured into a wooden frame and allowed to set. The harden plaster was cut into workable pieces, (refer to plate 4.35). Traditional *adinkra* symbols were drawn on a

piece of tracing paper and transferred onto the plaster, (refer to plate 4.36). The outline design was carefully curved with a pen knife, (refer to plate 4. 37). Particles of plaster trapped in between the design were bushed away with a painting brush. The finished designs were embossed *adinkra* designs on plaster blocks, (refer to plate 4.37).

Plastic clay was soaked overnight, wedged, kneaded and formed into a spherical shape, (refer to plate 4.31). The clay was beaten down to a flat clay bat with a circumference of about twenty centimetres (20 cm). The edges were trimmed with a spatula and smoothened with a damp sponge (refer to plate 4. 32). The embossed plaster was stamped into the clay to create a print of the design to create a mould. This was repeated on other moulds. These moulds were allowed to sit undisturbed and dried for about a week. When the moulds reached the bone dry state they were fired in the kiln. After firing the moulds were allowed to cool at room temperature. Fanta glass bottles were ground to powder and sieved through an 80 mesh sieve and later a 120 mesh sieve. A ratio of 1:7 was used to dry mix the Colouring oxides with the powdery glass in a bowl. This confirms the ratios quoted by Stokes (1999) (refer to plates 4. 39 and 4.40).

Plate 4. 39 Dry mixing of colouring oxides and powdered glass

Plate 4.40Filling of the moulds with a mixture of colouring oxides and glass

After filling the mould with the recycled glass, the moulds were packed in the kiln and fired for thirty to an hour (refer to plate 4.41). The moulds are brought out of the kiln and a tool known in the local parlance as **ɛ***nkekay***ɛ** was used to check whether the products are well fired. If found to be well fired the moulds are stacked one on top of the other to slow the process of cooling and to prevent cracking. When the moulds have cooled to room temperature the same tool was used to release the products from the moulds into a bowl. The *adinkra* designs were placed in a bowl containing water and polished on a grinding stone (refer to plate 4.42).

Plate 4. 41 Firing of products

Plate 4. 42 Polishing of fired pieces

After polishing on the grinding stone the products were placed in a mixture of water and oil to enhance its lustre and subsequently dried in the sun. The products were assembled using epoxy with a brand name Araldite to adhere the pieces together to make very aesthetically attractive souvenirs. The same procedure was used to produce buttons and a chandelier. (Refer to plates 4.43- 4.63)

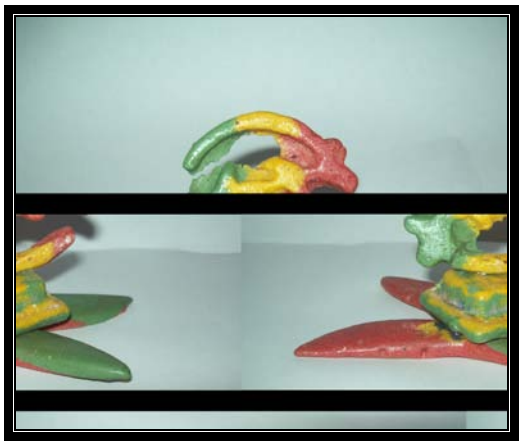

Plate 4. 43 *Gye Nyame*

Plate 4.44 Africa

Plate 4.45 a and b Another versions of *Gye Nyame*

Plate 4. 46 Africa

Plate 4. 47 *ɛtuo mu yɛ sum*

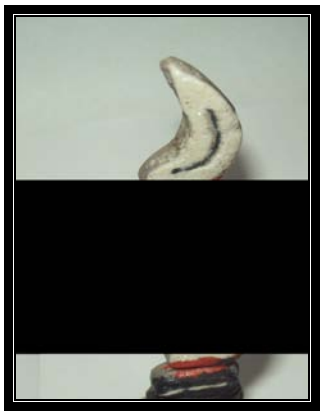

Plate 4. 48 ***Akobɛn***

Plate 4.49 ***Ese ne tɛkyerɛma***

Plate 4. 50 ***Owuo Atwdeɛ baako mforo***

Plate 4. 51 ɛmire (Mushroom)

Plate 4.52 ***Nyame Biribi wɔ soro ma me nsa nka***

Plate 4. 53 ***Owuo Atwedeɛ baako mforo***

Plate 4. 54 *Ɛtuo mu yɛ sum*

Plate 4. 55 ***Akofena***

Plate 4. 56 Pencil holder

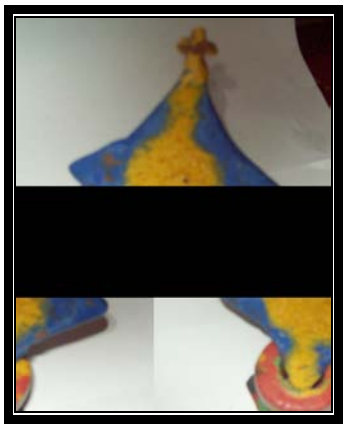

Plate 4. 57 Church bells

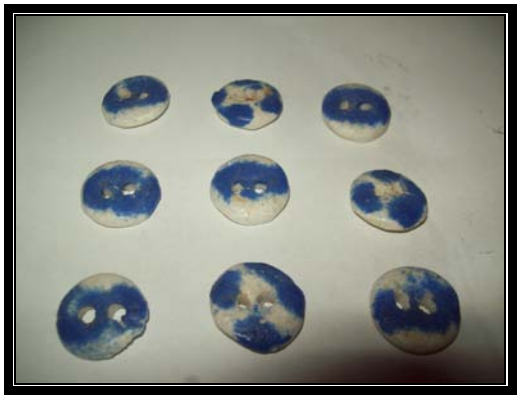

Plate 4. 58 Buttons

Plate 4. 59 chandelier

Plate 4.60 Beads for belt making

Plate 4.61 Ghana map

Plate 4. 62 Ear rings

Plate 4.63 Collection of *adinkra* symbols

4.3 Validity of Research Questions

This research was necessitated by the quest to answer two pertinent questions that is one, how many well known glass beads producing towns are still active in Ashanti? Two, what raw materials, tools, equipment and techniques are used for recycling glass beads in Ashanti? Three, what are the major strengths and weaknesses associated with the glass beads industry? And four, what innovative techniques could be injected into the recycled glass beads producing industry to rejuvenate the industry?

The entire research work confidently answers the questions posed by the research questions. To further test the contribution of the research to recycled glass bead industry in Ashanti, the researcher exhibited a collection of souvenirs, buttons and

other decorative pieces together with some stringed recycled glass beads at the glass bead showroom at Darbaa. After a week of display all the recycled buttons and souvenirs were completely sold out with order for new consignment. The producers in the catchment area were enthused about the success of the project and have taken up the challenge to diversify the existing glass bead market.

Fifteen patrons were contacted to say what inspired them to purchase the souvenirs, and they responded that the products were well finished, very handy and unique. The bead producers also commented that they could earn more for selling the recycled glass souvenirs. Additionally, it saved their raw materials and the profit margin was comparatively satisfactory.

4.5 Summary

This chapter enumerated the tools, materials, equipment and production techniques employed by recycled glass bead producers in producing their wares. Attempts were made to highlight some of the challenges confronting the industry and the possible agencies that they could fall on for assistance. The researcher then narrowed down to the possible way of rejuvenating the declining recycled glass bead market by pragmatically demonstrating potential products they could introduce to revamp the exiting industry.

In this regard, specially crafted souvenirs, buttons, decorative pieces and chandelier were produced using the same resources available to the producers and exhibited at a showroom at Darbaa the high patronage of which validated the contribution made by this research work. The research demonstrates that, if measures are put in place to

enhance the available known technology (tools, materials, equipment and techniques), it could contribute to the rejuvenation and the subsequent expansion of existing market of the recycled glass bead industry in Ashanti. These squarely fulfilled all set objectives of this research.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

This research which is focused on recycled glass for bead production in three selected towns in Ashanti could not have come at a more opportune time. The objectives of the research are, one to Identify the well known glass beads producing towns in Ashanti; two, to study and examine the raw materials, tools and equipment as well as the production techniques used for the recycled glass bead industry in Ashanti; three, to assess the major strengths and weaknesses in the development of the industry; four, to carry out experimentations to innovate and design products using recycled glass beads production techniques, proved to be very cogent and relevant to current developments in the recycle glass bead industry in Ashanti.

Guided by these objectives, whiles still focusing on the research questions which are; One, how many well known glass beads producing towns are still active in Ashanti? Two, what raw materials, tools, equipment and techniques are used for recycling glass beads in Ashanti? Three, what are the major strengths and weaknesses associated with the glass beads industry? And four, what innovative techniques could be injected into the recycled glass beads producing industry to rejuvenate the industry? The researcher embarked on a number of activities that are outlined below:

The researcher employed qualitative research method using the descriptive approach to carry out this study. The research instruments were interviews and observation. The researcher studied and examined some of the cardinal tools, materials,

equipment and techniques which are considered pivotal to the recycle glass bead industry. The research findings proved that the practitioners have a high sense of craftsmanship and exhibited profound knowledge on the tools and materials used. They were true to their materials and the resulting products were visible testimony of this high level of craftsmanship. However, the industry is threatened with extinction, in communities where previously the industry was considered a communal activity in recent years only pockets of recycled glass bead producers could be sighted. Even these producers, alternate glass bead production with other alternative sources of livelihood like farming and petty trading. The economic benefits derived from the recycled glass bead industry have gone down significantly.

The production techniques employed have been over exploited without much innovation in the production techniques much to the disadvantage of the local producers, whose products are directly or indirectly competing with imported recycled glass beads on the same market. These developments challenged the researcher to experiment by designing and creating innovative products like souvenirs, buttons, waist belts, chandelier and macramé using the same resources and similar techniques known to the recycle glass bead producers. A sample survey proved that, the experimented products were more aesthetically attractive, the hue registered more prominently, the colour harmony of the oxides were very good, the products were very handy and portable, attention was paid to detailing resulting in a wonderful finishing. The products caught on well with the market and have been a great source of inspiration for these practitioners who have resolved to inject fresh impetus to the industry.

5.2 *Conclusions*

The recycled glass bead industry in Ashanti is a cottage industry that has stood the test of time. It has provided and still serves as a source of livelihood to many families and in times past the entire communities. The three selected centres for the study on the production of recycled glass beads were, Darbaa, Asuofia Asamang and Akropong. These centres have seen many successes in the past and received many tourists from the world over. The recycled glass bead industry is still, regardless of its many challenges, a promising tourism potential that could be explored and exploited to create employment and contribute significantly to the gross domestic products of Ghana. Even in the developed countries such as Great Britain, the United States of America, Netherland, etc .which are far advanced in technology, have bead markets and museums that visitors visit to learn the history and culture of the indigenes. An underdeveloped country such as Ghana cannot sit unconcerned for the recycled glass bead market to deteriorate into total extinction. This concern forms the cardinal focus of this research work to try and conceive innovative ways of rejuvenating the current declining market for recycle glass bead production by improving existing technology and producing expanded range of products to widen the existing market. Such a measure also has the potential to cushion the producers' against the unstable sales and the seemingly unpredictable recycled glass bead market. To demonstrate that these ideas are implementable, the researcher introduced the fragmented fused beads production technique, souvenirs', buttons, chandelier among other products using similar resources available to these practitioners. The result was a success with the producers resolved to be more experimental in their profession to discover unique and innovative products.

5.1. ***Recommendations***

After a very intense but fruitful holistic study and examination of the activities of recycled glass bead production in selected towns in Ashanti, the following recommendations are worth considering:

1. In order to benefit from any assistance from central government or other cooperate entities like the banks and other financial institutions who prefers to deal with associations rather than individuals due to the challenges of the country's poor address systems and difficulties in loans recovery, the (remnants of) recycled glass bead producers in the three centres should identify with the Association of Craftsmen and Artisans at the Kumasi Centre for National culture.

2. The ceramic department KNUST or the Building and Road Research Institute (B.RR.I) should be challenged to take up the mantel of producing locally made colouring oxides that could be offered for sale to recycled glass bead producers and other interested individuals or bodies.

3. The recycled glass bead producers ought to diversify their products to widen the narrowing market to attract prospective clients.

4. Non Governmental Organisations (NGOs) and other government establishment set out to offer assistance to small and medium scale industries should strategise to make their services accessible to recycled glass bead producers and engage them in consultative building.

5. Further research work should be conducted into the properties of clays used by recycled glass bead producers in Ashanti to verify its usefulness in other

productive ventures. For example, kiln construction, kiln furniture, cement production, etc.

6. Government and other non- governmental organisations should seriously consider the creation of a bead market or museum in the country to serve as a tourist attraction and a major sales point for recycled glass bead producers.

7. Students particularly from the Ceramics Department and Department of Integrated Rural Art and Industry should be encouraged to go for industrial attachments at recycled glass bead centres in the country to learn the profession to save it from being extinct and also come out with innovative ways of improving the industry.

8. The college of Art and Social Sciences should have collaboration between indigenous craftsmen such as recycled glass bead producers and the college to develop modern technology rooted in indigenous technology. Such technologies would be easily transferable to the large Ghanaian community to enhance the development of Ghana.

9. More research should be done in the area of safety and health hazards associated with recycled glass bead production.

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