# Prospect and Challenges of Glass Container Industry in Bangladesh:

## An empirical study on Selected Glass Container Industry of Bangladesh

**Dissertation submitted in partial fulfillment of the**

**Requirements for the Degree of**

**Masters in Procurement and Supply Management**


**Prepared by**

**Zakir Hossain**

**ID No. 13382010**

**MPSM Batch III**


**December 2014**


**BRAC Institute of Governance and Development (BIGD)**

**BRAC University, Dhaka**

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Supervised by

Dr. Md. Zohurul Islam

Academic Coordinator

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BRAC University

December 2014

***Dedicated to***

***My beloved parents and family members***

## Statement of the Author

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Zakir Hossain

**LETTER OF TRANSMITAL**

December 04, 2014

Dr. Md. Zohurul Islam
Dissertation Supervisor
&
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BRAC Institute of Governance and Development (BIGD)
BRAC University

Sub: Submission of Dissertation Report.

Dear Sir,

I am grateful to submit herewith my dissertation report on "Prospect and Challenges of Glass Container Industry in Bangladesh: An empirical study on the selected glass container industry" as a partial requirement for achieving the degree of Masters in Procurement and Supply Management. It is a great opportunity for me to work under your active supervision, care and guidance.

To complete this dissertation report, I have collected data from both primary and secondary sources. I had concentrated my efforts to prepare this report in most realistic and proficient way. I have tried to make the report with best uses of my knowledge and learning and tried to put the best output in the report. However, if there is any mistakes kindly look into the matter with forgiveness. I will be available enthusiastically at any time for any clarification or modification is required. I believe and hope that you would be kind enough to accept my report for assessment and oblige thereby.

Sincerely yours.

Zakir Hossain
ID No. 13382010
MPSM Batch III
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## SUPERVISOR CERTIFICATION

This is to certify that Mr. Zakir Hossain, ID No. 13382010, Batch No. 3, Masters in Procurement and Supply Management, BRAC Institute of Governance and Development (BIGD), BRAC University has prepared this dissertation report on "Prospect and Challenges of Glass Container Industry in Bangladesh: An empirical study on selected glass container industry of Bangladesh". He was under my supervision to prepare this dissertation report. His seriousness is very praiseworthy.

I wish him every success in life.

Dr. Md. Zohurul Islam
Dissertation Supervisor
&
Academic Coordinator
BRAC Institute of Governance and Development (BIGD)
BRAC University

## Acknowledgement

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I also pay my gratitude to Mr. Amyn Saleh, Director, The Bengal Glass Works Ltd. for his valuable suggestion at different stages of my study.

I would also like to acknowledge the cooperation of officers and staffs of BRAC University; the respondents of questionnaire survey in various organizations, my colleagues and friends who helped me at various stages of my assignment.

**Zakir Hossain**

## Abstract

Glass is a hard, brittle substance, typically transparent or translucent, made by fusing sand with soda and lime and cooling rapidly. It is used to make windows, drinking containers, and other articles. Container glass is a type of glass used for storing various liquid and solid materials such as bottles, jars, drinkware, and bowls. Container glass has a lower magnesium oxide and sodium oxide content than flat glass, and higher silica, calcium oxide, and aluminium oxide content. Its higher content of water insoluble oxides imparts slightly higher chemical durability against water, which is required for storage of beverages and food. Most container glass is soda-lime glass, produced by blowing and pressing techniques, while some laboratory glassware is made from borosilicate glass. Glass Container is a very widely used component, its applications ranging from small vial to large Jar. In spite of its versatility in application, Glass is a significantly underused in the Bangladesh market. There are so many different types of glass containers and jars, and their properties differ with the type of processing it undergoes. Glass is also an eco- friendly product and clocks a signification contribution towards the protection of the environment.

Using glass container has so many advantages, but glass has been continuously overlooked for cheaper alternatives non-renewable products like PET or Plastic products. My study aims to explore the reasons for this situation and determine how and to what extent the Bangladeshi market would be benefitted by a more visible glass industry. It seeks to inform the reader about the advantages of glass containers (stressfully, environmental) in comparison to other packaging materials like plastic, PET etc., so as to aid in future decision making processes.

This survey reveals that Glass Container has significant positive impact on quality of the product and sustainability of the environment. For the quality of the products, survey observes that ‘to maintain the quality of the product inside the packaging, glass container has contributed the highest assurance compare to any other kind of packaging’. Glass container is 100% recyclable and thus environment friendly and it is sustainable. The survey also revealed that about 60-65% people do not have proper knowledge on the impact of product quality due to the packaging of the foods and beverage.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction of the Study

Glass has been in society in its most basic form since circa 4000BC and was used mainly to produce weapons and jewellery, and by 1500BC glass vessels were used in cooking and drinking. Glass has been developed for thousands of years and production methods have evolved considerably since its induction.

A key factor that sparked a large increase in the mass production of glass was the development of the Solvay process in the 1860s, which significantly reduced the cost of sodium oxide, a major input into the glass production process. Two important developments in the 20th century were automation, with the introduction of full mechanization of Bottle Manufacture around 1920, and the introduction of the Float Glass Process in 1952 for Flat Glass.

Other major advancements in glass production have resulted from:

- Continuous large-scale production;
- Longer furnace lifetimes (typically 12-15 years, but in some cases even longer);
- Improved thermal efficiency;
- New production techniques (such as 'Just-In Time');
- Significant product innovation.

Improvements in the production process have led to a typical furnace output of 300 tonnes per day of molten glass but in some sub-sectors, such as flat glass, this figure is even higher: 500 tonnes per day is typical but some recent projects have hit 1000 tonnes per day.

Whilst production levels have increased, manufacturers have also strived to further improve efficiency in what is an energy-intensive process, fuelled by the need to operate furnaces at over 1600$^{o}$C.

Improvements in furnace efficiency have had a significant impact on the amount of energy required to melt a tonne of glass. The recycling of glass has been a major factor since it uses 25% less energy than making glass from virgin raw material. Whilst this performance may sound impressive, glass producers have been put under further pressure from Governments to improve their efficiency due to increased environmental concerns by society.

A feature of glass is its versatility and that its specification such as its strength, weight, colour and appearance can be changed to suit demand.

## 1.2 Statement of problem

Glass Container is a very widely used component, its applications ranging from small vial to large Jar. In spite of its versatility in application, Glass is a significantly underused in the Bangladesh market. There are so many different types of glass containers and jars, and their properties differ with the type of processing it undergoes. Glass is also an eco- friendly product and clocks a signification contribution towards the protection of the environment.

Made from nontoxic raw materials - sand, soda ash, limestone, and up to 70 percent recycled glass or "cullet" - glass is the only packaging material accepted worldwide as "generally recognized as safe". Glass has no chemical interaction, ensuring that the products inside a glass bottle keep their strength, aroma, and flavor. Glass does not deteriorate, corrode, stain or fade, so products inside a glass container remain as fresh as when they were bottled. Glass packaging gives people confidence that the product is pure.

So many advantages, but glass has been continuously overlooked for cheaper alternatives non-renewable products like PET or Plastic products. My study aims to explore the reasons for this situation and determine how and to what extent the Bangladeshi market would be benefitted by a more visible glass industry.

It seeks to inform the reader about the advantages of glass containers (stressfully, environmental) in comparison to other packaging materials like plastic, PET etc., so as to aid in future decision making processes.

## 1.3 Research Question

The main research question of this study is whether glass bottles are necessary for the packaging of liquid medicine, food and beverage packaging? In this pursuit of the answer of the above stated question, key performance indicators of quality, sustainability and environment will be studied. So, in other words, the main research question of this study is whether the quality of glass packaging is better than the other packaging, the prospect of glass container industry in the perspective of Bangladesh and the challenges of this industry in Bangladesh.

## 1.4 Objectives of the Study

The main objectives of the study are as follows:

1. To present an overview of the glass container industry In Bangladesh.
2. To create a SWOT analysis for the glass container industry in Bangladesh.
3. To identify the consumer perception of glass container and their awareness level regarding benefit of glass containers.
4. To report on the potential prospect and challenges of the glass container industry in Bangladesh.

## 1.5 Limitations

The extent and limit of the report were constricted due to some of the following considerations:

- The time allocated for the report was limited which constricted the extent of this report.
- The glass container industry of Bangladesh is not well documented except some exception, so no strict facts and figures were found from the enterprise respondents or any other secondary sources. There are only two glass container manufacturing industry in Bangladesh. Considering the data source availability, this report concentrated on The Bengal Glass Works Ltd.
- The study was limited to a small sample size of 30 people due to time constraints.
- The respondents were chosen by convenience sampling available related to the user of glass containers, which has its own disadvantages that apply in this study.

# CHAPTER 2

# ORGANIZATINAL ORIENTATION

## 2.1 Overview of the Bengal Glass Works Ltd.

The Bengal Glass Works Limited (BGW) is a Public Limited Company incorporated in Dhaka, Bangladesh, in 1967 under the Companies Act. It is the country's only fully automatic glass plant producing Amber Glass Bottles for the packaging of liquid pharmaceutical products as well as producing Glass Lamp Shells which are used for manufacturing incandescent light bulbs.

From its inception, Bengal Glass has been committed to providing the highest quality of products to its customers. As a result, it has won the trust of the major local and multinational pharmaceutical companies operating in Bangladesh. Today, its bottles are used to package pharmaceutical, homeopathic, personal care, agricultural and veterinarian products. Simultaneously, Bengal Glass is also meeting the country's entire demand for glass lamp shells and giving light to the entire country. Its unique location also offers easy access for customers in the North East Indian states of Sikkim and the "Seven Sisters" which are difficult to reach from the rest of India.


Fig 2.1.1: Factory Building, located east of Dhaka city, along the Shitalakya River

**Products:**

Bengal Glass has observed a steady growth in demand for its products and has periodically expanded its production capacity. In 1975, the commercial production of Amber Glass Bottles began with Furnace 1 with a capacity of 40 Tons Per Day (TPD) of glass and it has been expanded over time to 65 TPD with three production lines. In 1995, Furnace 2 went into production with an initial capacity of 10 TPD to produce Glass Lamp Shells and today it has a capacity of 25 TPD with three production lines. Lastly, in 2011, Furnace 3 went into production to support the growing demand for Amber Glass Bottles with capacity of an additional 65 TPD with two production lines, bringing the total Amber Bottle production capacity to 155 TPD.


Fig 2.1.2 : Products of BGW -1

With the two amber glass furnaces, the company has the capacity to produce 400 million USP Type III Amber Glass Bottles per year of various sizes (15 ml to 900 ml) with very fine specifications. The third furnace produces 133 million Glass Lamp Shells per year of various designs (45 mm to 75 mm diameter) for the incandescent lighting industry.

The company has also started producing Flint (clear) Glass Containers to use in various food processing companies and beverage industries.

Fig 2.1.3: Products of BGW - 2

**Facilities:**

All the furnaces are equipped with state of the art control rooms, which control the manufacturing of bottles all around the year with 94% pack-to-melt efficiency. A captive power plant provides uninterrupted power supply to the facility. The plant has the latest machines and equipment sourced from reputed suppliers. For example, the Furnaces are designed by SORG, Batch House from Zippe, IS Machines from Emhart, Rotary blowing machines from Olivotto, and Lehrs from Pennekamp.


Fig 2.1.4 : Annealing Lehr & Furnace Control Room

**Quality:**

The company stresses on the importance of continuous efforts in product development and quality control. The ongoing development of the production process of glass bottles and glass lamp shells is one of the company's important aspects of its Quality Management System (QMS) to enhance customer satisfaction. The QMS at Bengal Glass enforces that each step of the manufacturing process is strictly controlled and monitored at international quality standards.

Fig 2.1.5: Quality checking both visual and chemically

To support the quality control, the plant has a well equipped chemical laboratory which is responsible for inspection of incoming raw material as well as constant improvement in the quality of the end product. The lab is equipped with a Flame Photometer for alkali and extract testing, Polariscope for checking glass annealing, Spectrophotometer for color and light transmission measurement, Densimeter, Ramp Pressure Tester, Impact Tester, Thermal Shock Tester and several other tools.

**Environment:**

It is important to realize that glass is a highly energy consuming industry. A glass furnace operates at temperatures of 1500℃ and as a result a significant amount of energy is required. These resources are costly as well as precious and therefore it has been vital for Bengal Glass to implement energy efficiency measures at all levels of the manufacturing process. Along with efficiency, Bengal Glass is committed to recycling glass as a raw material in addition to reusing water and heat, while limiting the release of harmful gases into the environment. Over the 12 month period ending October 31, 2011, BGW saved 10,300 tons of CO2 emissions through various energy efficiency measures applied to its manufacturing process. These efforts were also recognized by the prestigious HSBC-Daily Star Climate Awards and Bengal Glass was awarded the prize for “Climate Champion in Green Operations” in December 2011.

Fig 2.1.6 : BGW received the HSBC-Daily Star Climate

## 2.2 Production Process of Glass Container.

Glass Container can be produced in both Traditional methods (glass-blowing and blow-molding) and automated process. Although traditional methods are still used by some artists and for special custom applications and some small manufacturing process, most bottle manufacturing is an automated process. This is a very complex process. The development of glass bottle machining peaked with the advent of feed and flow machines, which enabled manufacturers to generate larger production runs than was previously possible. Bottle machining is part of glass container production.

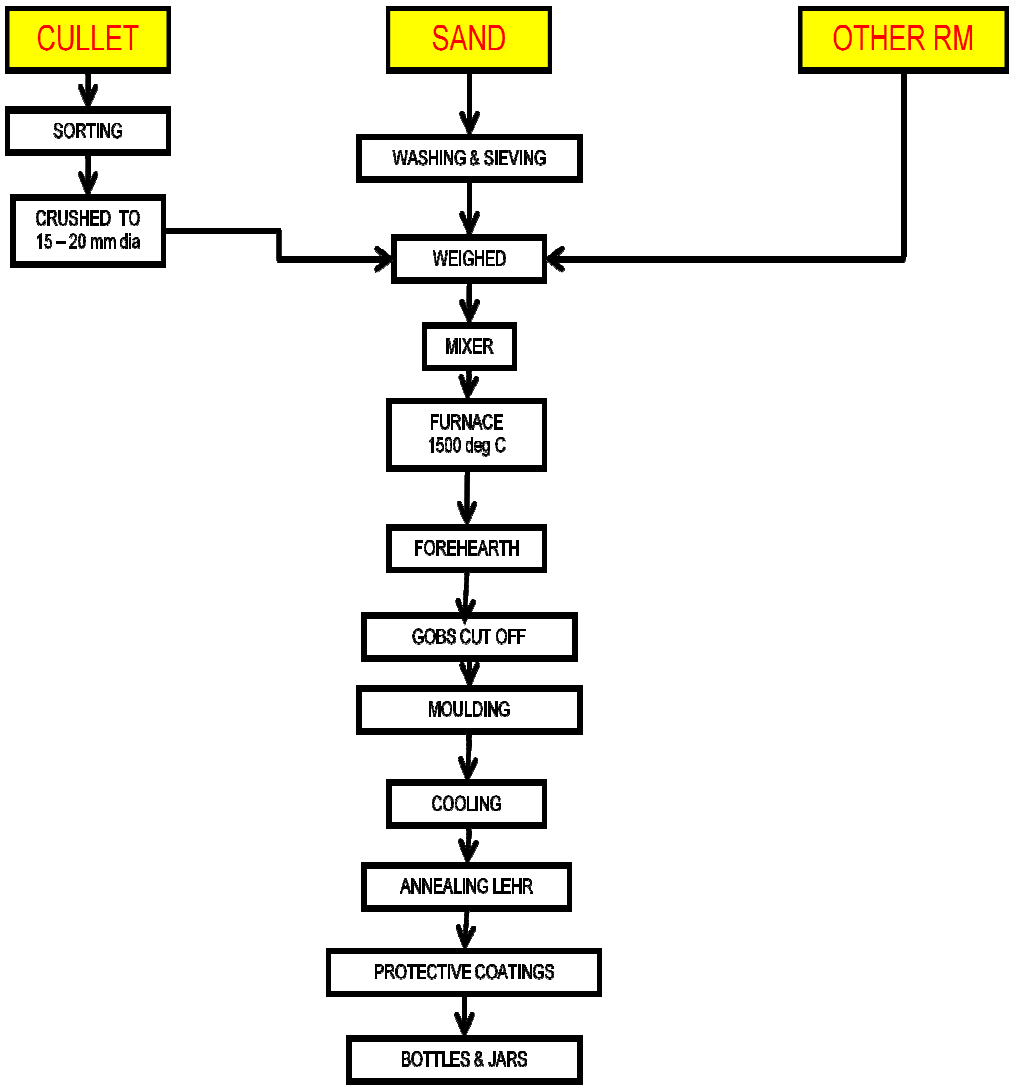



**FIG 2.2.1:** SCHEMATIC DIAGRAM OF GLASS MANUFACTURING

The main sub-sections of Glass Bottle manufacturing process are:

a) Batch Processing

b) Furnace or Hot End Process

c) Gob Formation

d) Glass Forming

e) Annealing

f) Hot End Treatment

g) Cold End Treatment

h) Checking and Packaging

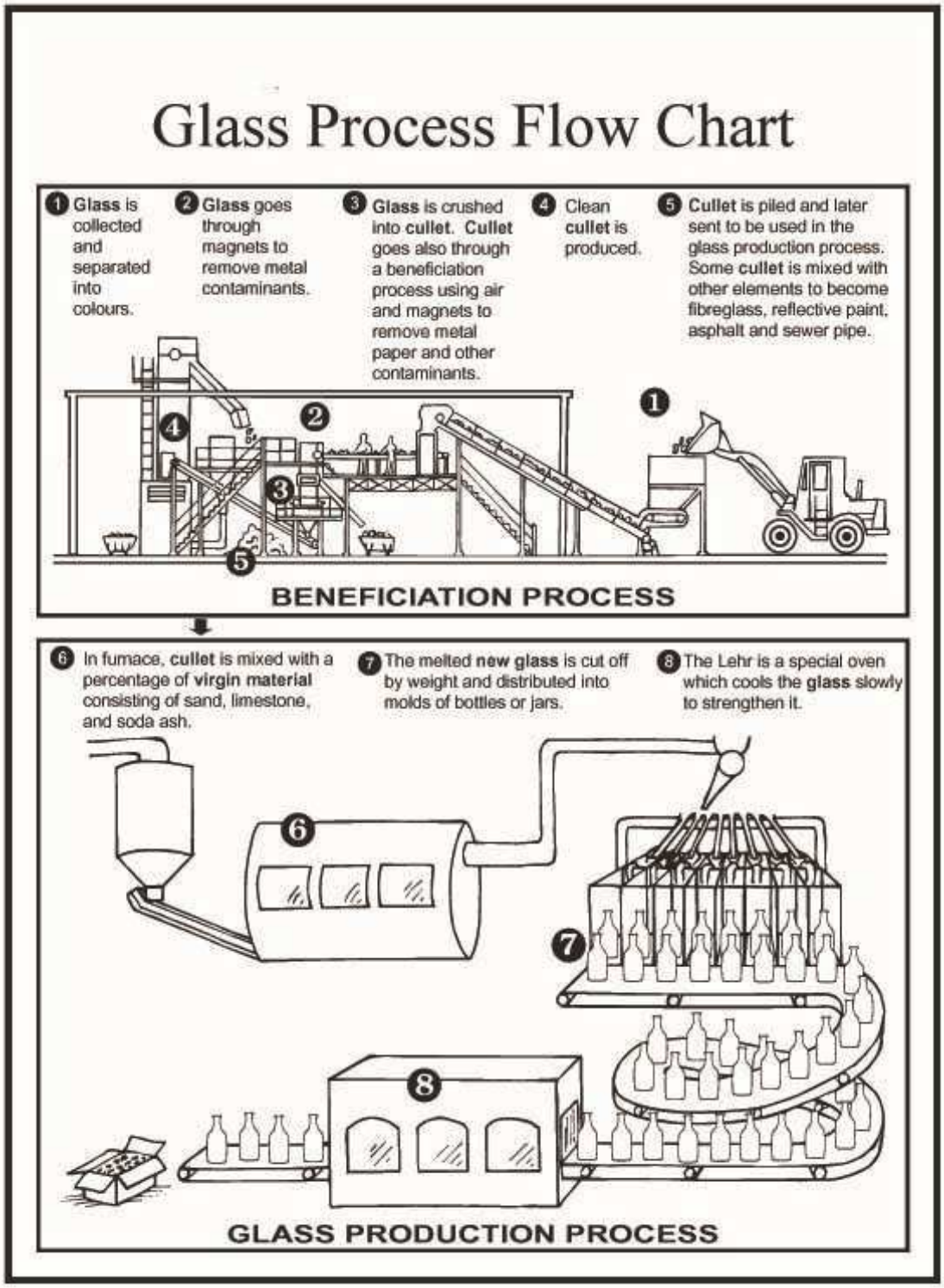



Fig 2.2.2 : Glass container Production Flow

## a) Batch Processing

Batch processing is the most important and critical part of manufacturing glass container. All the raw materials have to process individually as per their individual standard and make them clear and clear from all dust and foreign particles. The main raw materials required for glass containers are - silica sand, soda ash, limestone, feldspar, dolomite, cullet (crushed glass of the same composition), plus small quantities of other chemicals and decolorizers. This mixture is called the batch. Batch preparation at Bengal Glass is done by Automatic Batch House SCADA System based on preset batch formula for specific furnace. Auto batch container scales are used to mix the exact ratio of elements to the batch.

## b) Furnace or Hot End Processes

After the batch processing the materials goes to the furnace. All the materials are melted in the furnace with $1500^0$ C temperatures. Bottle manufacturing takes place at a glass container factory in multiple steps. The first stage of glass-container making begins with the hot end processes, which typically employ high amounts of heat to produce and shape a glass container. A furnace is first used to mold molten glass, which fed to the furnace as glass feed stock. Soda-lime glass stock accounts for the majority (around 90 percent) of glass products, and is typically largely comprised of silica, with about 10 percent each of calcium oxide and lime. Small amounts of aluminum oxide, ferric oxide, barium oxide, sulfur trioxide, and magnesia also account for about 5 percent of soda-lime glass. Before melting, cullet (recycled glass) is added to the stock, accounting for anywhere between 50 and 70 percent of the final glass composition. Once the stock has been fed into the furnace, temperatures inside can be as high as $1500^0$C. There are three furnaces at Bengal Glass of which two furnaces are used for making glass containers and one is used for making bulb shells. This report will discuss only two furnaces of making glass bottles. The next step is Forming Process, methods is applied: press-and-blow or blow-and-blow.

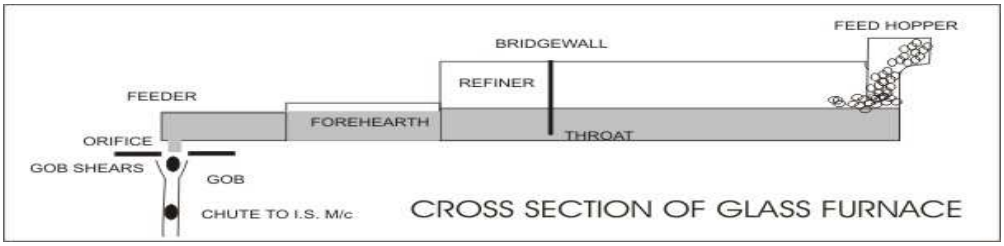



Fig 2.2.3 : Cross Section of Glass

## c) Gob Formation

Gob is one individual mass of molten glass which makes one container. Molten glass flows depending on the bottle size. Mechanical shears snip off "gobs" of molten glass. Each makes one container. Falling gob is caught by spout and directed to blank molds. Mass-production is made up of several individual sections; each is an independent unit holding a set of bottle-making Molds. Large bottles consists of a blank mold and a blow mold. Higher production using double or triple gobs on one machine. two or three blank molds and similar blow molds.

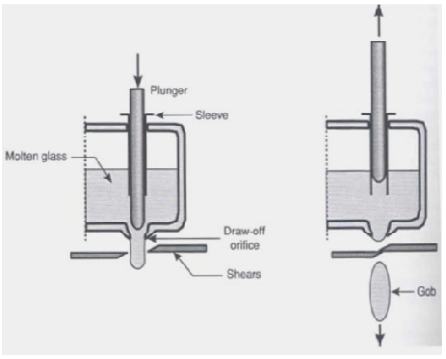


Fig: Gobs to form blank mold

## d) Glass Forming

Bottle forming is essentially a two stage process.

- Blank Mould and
- Blow Mould.

The blank side receives the ‘gob’ and makes the ‘blank’ or ‘parison’. This partly formed bottle is then transferred to the mould side and the parison is blow into the final shape.

**There are essentially three different processes:**

### I. Blow and Blow Process

Beverage bottles up till the late 1970s were all made by this process. The gob is dropped into the blank mould, and then two puffs of compressed air are successively applied to each end of the blank. The parison is then transferred

into the final mould and is blown to shape. It should be noted that while the parison is formed in the final stage, the air bubble may not form a perfect uniform internal shape, giving wall thickness variability.

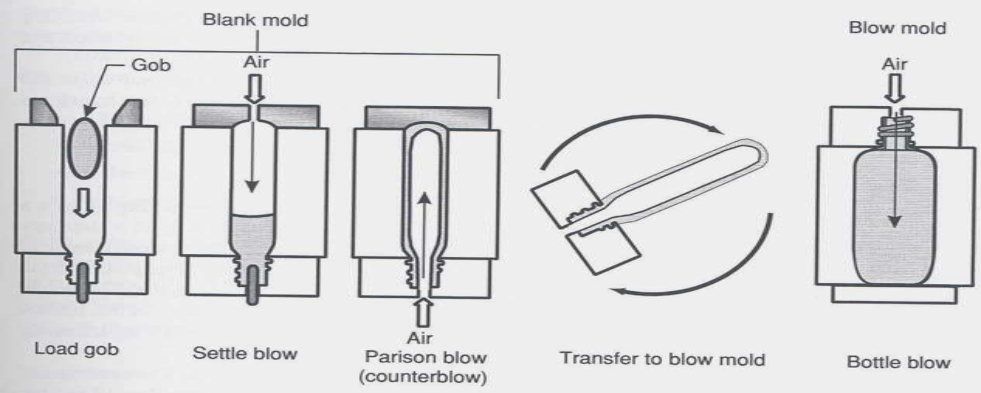



Fig 2.2.4 : Blow and blow

## II. Press and Blow Process

With this process the parison is not made by blowing but by being pressed into an exact shape by a plunger; this makes the process especially suitable for glass jars.

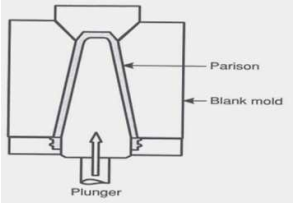



Fig 2.2.5: Press and blow

## III. Narrow Neck Press and Blow Process (NNPB)

This modern process allows bottles which would norm ally been made using the blow and blow method, to be light-weighted by 10 to 20%, due to a consistent wall thickness. This process is usually restricted to light weight NRB and is not usually available for Returnable bottles. A high degree of precision is required with this technology and it is normal for manufacturers only to be interested in using this process when there is a large volume to be produced. Also the tooling cost is higher. Surface treatment and annealing of bottles is necessary in order to give them inner and surface strength and sufficient ‘slip’ so that they run well down a packaging line.

## e) Annealing

When a bottle leaves the forming machine its outer surface is hard having cooled to $300^0$C; however, the inner part is still hot and soft. If cooling was to continue naturally, the inner parts would contract more than the outer cooler surface and dangerous stresses would develop. If a bottle is left to cool without annealing, it is so weak that if you give a tap with something metallic, it will implode! Annealing is therefore necessary and involves heating the bottle to $550^0$C and then slowly cooling it down in a tunnel called the Lehr.

## f) Hot End Treatment

This treatment is to protect the surface from abrasion. The layer consists of a metal oxide, usually tin. Titanium and zirconium can also be used. Tin is applied as a stannic chloride vapour and decomposes to the oxide during heating. If there is too much coating in the finish area of the bottle it can be blamed for promoting the rusting of crowns. This protective layer will gradually be dissolved over time making the bottle much more vulnerable to scuffing.

## g) Cold End Treatment

This is carried out as the bottles emerge from the annealing layer. Bottles are still at a temperature of approx. $100^0$C. Cold end treatments are soluble coatings (including polyethylene glycols and their esters) and are applied by spray heads that traverse backward and forward between the rows of bottles. These coatings allow the bottles to “slip” against each other and conveyors and act as lubricants.

### h) Checking and Packaging

At this stage in glass production, the bottles or glass containers are inspected and packaged. Inspection is often done by a combination of automated and mechanical inspection, to ensure the integrity of the final product. Common faults include checks (cracks in the glass) and stones (pieces of the furnace that melt off and are subsequently worked into the final container), which are important to catch because they can compromise the component. Packaging methods will vary from factory to factory depending on the specific type of bottle and the size of the production run.

## 2.3 Product Features and Classifications

Glass bottles tell stories about how they came into existence. As technology advances, the properties of glass bottles change. Professionals who seek to date old glass bottles inspect them to discover clues about how they were made. Glass is a traditional material which has long held a prominent place in the packaging of food, health and beauty products. "Dating back several millennia, glass, which attests to the creativity of our ancestors, has passed through the ages and civilizations while still remaining modern."

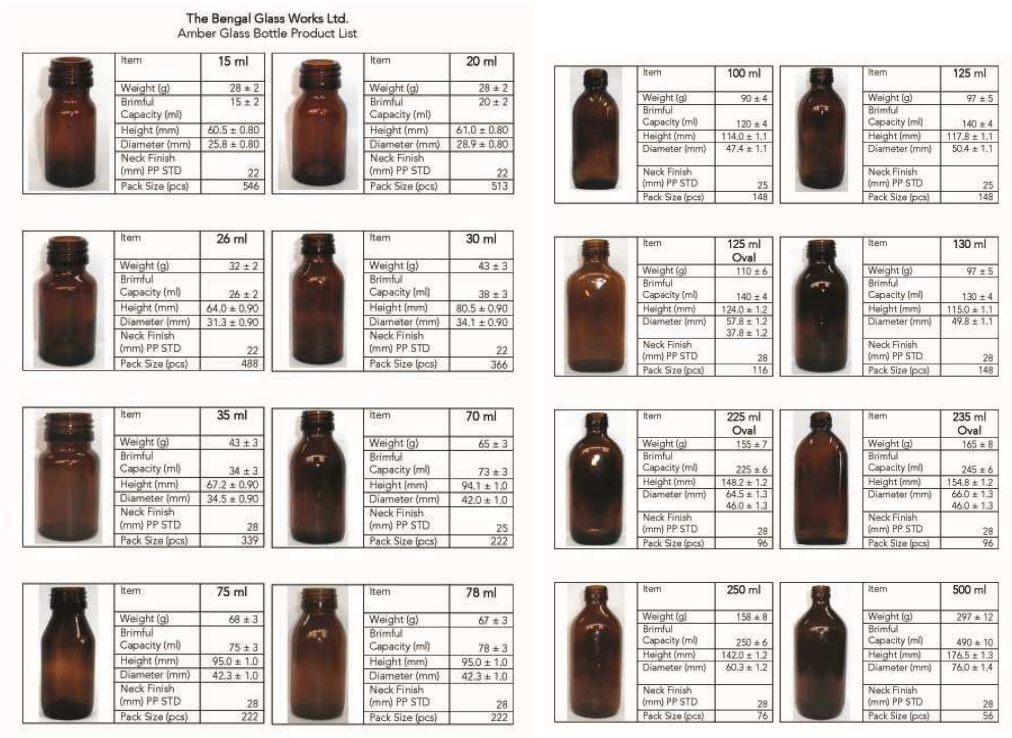
Glass is a very natural and therefore completely environmentally-friendly material which consists mainly of minerals such as sand, sodium and limestone. Today's baby bottles are not the same as those of our grandmothers; they are generally made of pharmaceutical glass, which is completely neutral and has excellent resistance to thermal shock. Used by hospitals, clinics and pharmaceutical laboratories and adopted by many day care facilities, what distinguish this glass are its innovative, high-tech properties. It contains no phthalates, BPA or any product capable of altering food. In short, it is a neutral material that poses no danger to baby food or the environment.

Glass is currently the only packaging that has been designated as GRAS (Generally Recognized As Safe) by the US Food and Drug Administration. Naturally transparent and 100% recyclable, glass is a trendy natural material.

**Classification of Glass Bottles Produced in Bangladesh**

Bangladeshi manufacturers are producing the glass bottles of USP Type III only. No manufacturer is producing USP Type I or Type II bottles. The Type III bottles those are produced in Bangladesh are classified into three groups:

1. **Pharmaceuticals Bottles:** Pharmaceutical companies include all the category of pharmaceuticals like Allopathic, Homeopathic, Ayurvedic etc. Both Flint and Amber glass bottles are used in those companies. The product range of the Bengal Glass Works are as follows:



The Bengal Glass Works Ltd.
Amber Glass Bottle Product List

| Item | 15 ml |
|---|---|
| Weight (g) | 28 ± 2 |
| Brimful Capacity (ml) | 15 ± 2 |
| Height (mm) | 60.5 ± 0.80 |
| Diameter (mm) | 25.8 ± 0.80 |
| Neck Finish (mm) PP STD | 22 |
| Pack Size (pcs) | 546 |

| Item | 20 ml |
|---|---|
| Weight (g) | 28 ± 2 |
| Brimful Capacity (ml) | 20 ± 2 |
| Height (mm) | 61.0 ± 0.80 |
| Diameter (mm) | 28.9 ± 0.80 |
| Neck Finish (mm) PP STD | 22 |
| Pack Size (pcs) | 513 |

| Item | 100 ml |
|---|---|
| Weight (g) | 90 ± 4 |
| Brimful Capacity (ml) | 120 ± 4 |
| Height (mm) | 114.0 ± 1.1 |
| Diameter (mm) | 47.4 ± 1.1 |
| Neck Finish (mm) PP STD | 25 |
| Pack Size (pcs) | 148 |

| Item | 125 ml |
|---|---|
| Weight (g) | 97 ± 5 |
| Brimful Capacity (ml) | 140 ± 4 |
| Height (mm) | 117.8 ± 1.1 |
| Diameter (mm) | 50.4 ± 1.1 |
| Neck Finish (mm) PP STD | 25 |
| Pack Size (pcs) | 148 |

| Item | 26 ml |
|---|---|
| Weight (g) | 32 ± 2 |
| Brimful Capacity (ml) | 26 ± 2 |
| Height (mm) | 64.0 ± 0.90 |
| Diameter (mm) | 31.3 ± 0.90 |
| Neck Finish (mm) PP STD | 22 |
| Pack Size (pcs) | 488 |

| Item | 30 ml |
|---|---|
| Weight (g) | 43 ± 3 |
| Brimful Capacity (ml) | 38 ± 3 |
| Height (mm) | 80.5 ± 0.90 |
| Diameter (mm) | 34.1 ± 0.90 |
| Neck Finish (mm) PP STD | 22 |
| Pack Size (pcs) | 366 |

| Item | 125 ml Oval |
|---|---|
| Weight (g) | 110 ± 6 |
| Brimful Capacity (ml) | 140 ± 4 |
| Height (mm) | 124.0 ± 1.2 |
| Diameter (mm) | 57.8 ± 1.2<br>37.8 ± 1.2 |
| Neck Finish (mm) PP STD | 28 |
| Pack Size (pcs) | 116 |

| Item | 130 ml |
|---|---|
| Weight (g) | 97 ± 5 |
| Brimful Capacity (ml) | 130 ± 4 |
| Height (mm) | 115.0 ± 1.1 |
| Diameter (mm) | 49.8 ± 1.1 |
| Neck Finish (mm) PP STD | 28 |
| Pack Size (pcs) | 148 |

| Item | 35 ml |
|---|---|
| Weight (g) | 43 ± 3 |
| Brimful Capacity (ml) | 34 ± 3 |
| Height (mm) | 67.2 ± 0.90 |
| Diameter (mm) | 34.5 ± 0.90 |
| Neck Finish (mm) PP STD | 28 |
| Pack Size (pcs) | 339 |

| Item | 70 ml |
|---|---|
| Weight (g) | 65 ± 3 |
| Brimful Capacity (ml) | 73 ± 3 |
| Height (mm) | 94.1 ± 1.0 |
| Diameter (mm) | 42.0 ± 1.0 |
| Neck Finish (mm) PP STD | 25 |
| Pack Size (pcs) | 222 |

| Item | 225 ml Oval |
|---|---|
| Weight (g) | 155 ± 7 |
| Brimful Capacity (ml) | 225 ± 6 |
| Height (mm) | 148.2 ± 1.2 |
| Diameter (mm) | 64.5 ± 1.3<br>46.0 ± 1.3 |
| Neck Finish (mm) PP STD | 28 |
| Pack Size (pcs) | 96 |

| Item | 235 ml Oval |
|---|---|
| Weight (g) | 165 ± 8 |
| Brimful Capacity (ml) | 245 ± 6 |
| Height (mm) | 154.8 ± 1.2 |
| Diameter (mm) | 66.0 ± 1.3<br>46.0 ± 1.3 |
| Neck Finish (mm) PP STD | 28 |
| Pack Size (pcs) | 96 |

| Item | 75 ml |
|---|---|
| Weight (g) | 68 ± 3 |
| Brimful Capacity (ml) | 75 ± 3 |
| Height (mm) | 95.0 ± 1.0 |
| Diameter (mm) | 42.3 ± 1.0 |
| Neck Finish (mm) PP STD | 28 |
| Pack Size (pcs) | 222 |

| Item | 78 ml |
|---|---|
| Weight (g) | 67 ± 3 |
| Brimful Capacity (ml) | 78 ± 3 |
| Height (mm) | 95.0 ± 1.0 |
| Diameter (mm) | 42.3 ± 1.0 |
| Neck Finish (mm) PP STD | 28 |
| Pack Size (pcs) | 222 |

| Item | 250 ml |
|---|---|
| Weight (g) | 158 ± 8 |
| Brimful Capacity (ml) | 250 ± 6 |
| Height (mm) | 142.0 ± 1.2 |
| Diameter (mm) | 60.3 ± 1.2 |
| Neck Finish (mm) PP STD | 28 |
| Pack Size (pcs) | 76 |

| Item | 500 ml |
|---|---|
| Weight (g) | 297 ± 12 |
| Brimful Capacity (ml) | 490 ± 10 |
| Height (mm) | 176.5 ± 1.3 |
| Diameter (mm) | 76.0 ± 1.4 |
| Neck Finish (mm) PP STD | 28 |
| Pack Size (pcs) | 56 |

Fig 2.3.1 : Pharma bottles

2. **Foods Jars and Bottles :** Food bottles are used mainly for packaging for pickles, jam, jelly etc. Bengal Glass is producing different category of food jars and bottles of capacity 200 ml to 900ml.

Fig 2.3.2 : Food Jars

3. **Beverage Bottles:** There are several types and categories of beverage bottles are used in Bangladesh but most of them are of imported. Only few types of glass bottles for beverage are manufactured in Bangladesh. The rest of them are of imported and/or of PET or other forms of bottles. The Bengal glass is producing five types of beverage bottles of capacity 200ml to 650ml.

**Product Specifications (Amber)**

| | Item | Weight (gms) | Brimful Capacity (ml) | Height (mm) | Diameter (mm) | Neck Finish |
|---|---|---|---|---|---|---|
| | 330 ml | 265 ± 8 | 350 ± 7 | 226 ± 1.5 | 62 ± 1.3 | 600 CC |
| | 650 ml | 405 ± 15 | 680 ± 15 | 281 ± 2 | 74.4 ± 1.5 | 600 CC |

**Product Specifications (Flint)**

| | Item | Weight (gms) | Brimful Capacity (ml) | Height (mm) | Diameter (mm) | Neck Finish |
|---|---|---|---|---|---|---|
| | 200 ml Juice | 165 ± 8 | 226 ± 8 | 144.0 ± 1.3 | 53.5 ± 1.3 | 38 Lug |
| | 200 ml | 240 ± 10 | 218 ± 6 | 180 ± 1.2 | 57.5 ± 1.3 | 655 CC |
| | 250 ml | 380 ± 10 | 256 ± 5 | 233 ± 1.6 | 56.5 ± 1.5 | 600 CC |

Fig 2.3.3 : Beverage Bottles

## 2.4 Glass Container Market in Bangladesh

Before going to the glass container market size in Bangladesh, we just have look of the overall global market of glass industry. Below pie chart shows the current market share of the globe. It shows that 50% of the total glass market is captured by the world's most populated by China and it followed by the Europe and then other part of the world. South East Asia is capturing only 7% of the total market share.

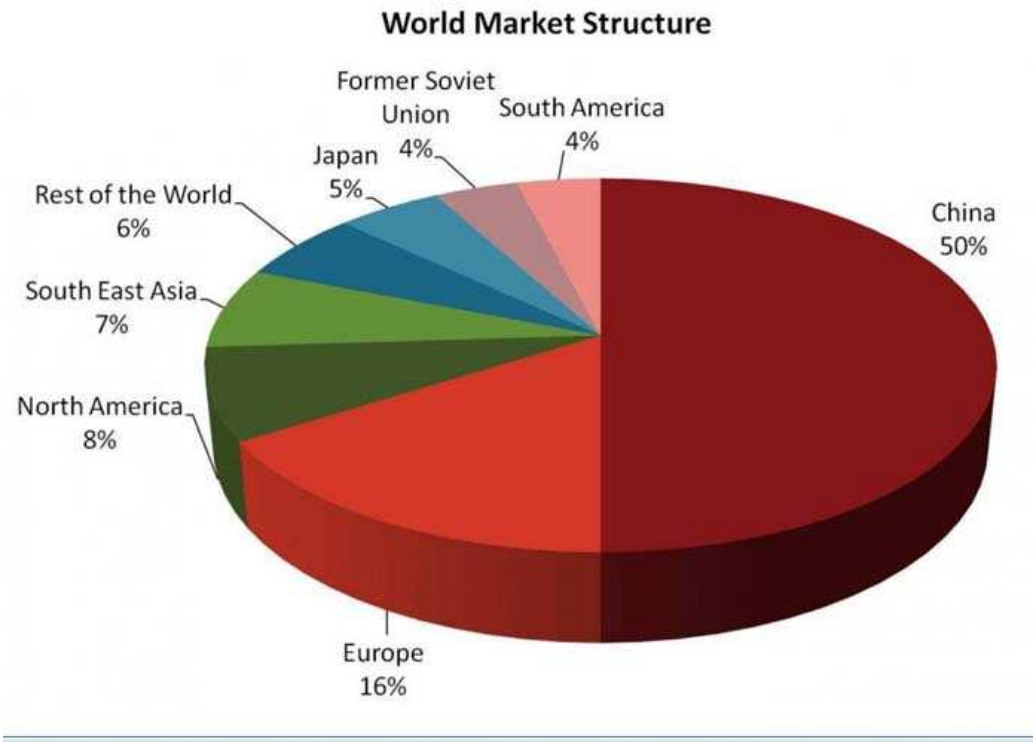



Chart 2.4.1 : World Glass Market Structure

Bangladesh is far behind in this industry. One of the reasons for this is the awareness of the people in regard to the benefit of using glass bottles compare to other form of packaging. Mass people still have very few knowledge about the glass container. The alarming point is that currently the low grade plastic/PET is capturing the existing form of glass packaging, which is completely unhealthy, un-hygienic and after all not usable for some of the products as per the standard. There is very few monitoring in this field.

As per current consumption in Bangladesh about 480 million of USP Type-III glass container of various types and sizes are required per year. The sources of these glass bottles are local manufacture, import, and re-use of old bottles. In Bangladesh only two manufacturing companies are manufacturing the required glass containers:

1. The Bengal Glass Works Ltd.
2. J.M.S Glass Industries Ltd.

The Bengal Glass Works Ltd. Is the oldest and largest glass bottle manufactures in Bangladesh. The industry is still in developing stage and mostly unstructured yet. Only little information is available. So far, the information available the market share of the total glass industry is as follows:

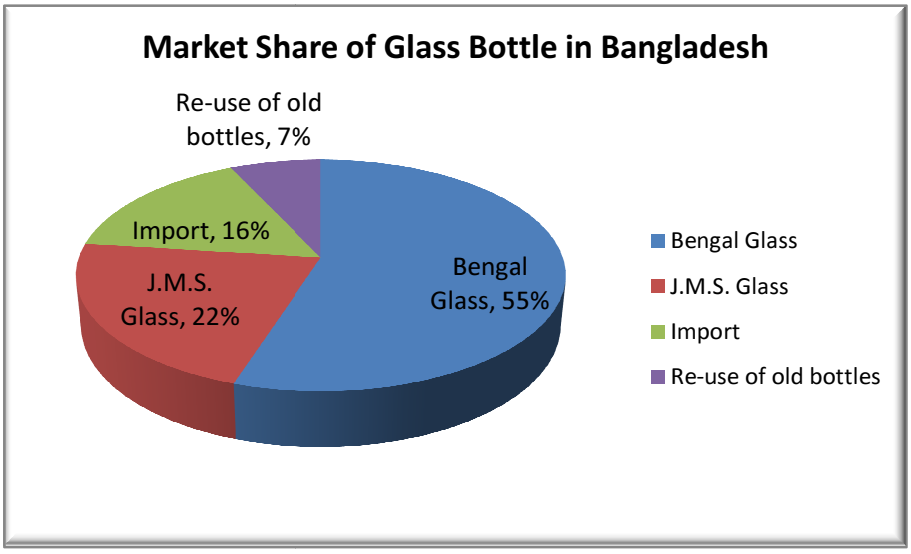



Chart 2.4.2 : Market share of Glass container in Bangladesh

## 2.5 Supply Chain Management of Glass Container

***Definition:*** *A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but also transporters warehouses, retailers, and customers themselves. A supply chain is dynamic and involves the constant flow of information, production and funds between different stages. Each stage of the supply chain performs different processes and interacts with other stages of the supply chain.*

Supply chain management of all glass industry is almost same. Some organization may vary due to the activity requirement of their specific requirement. However, the process flow activities of supply chain component of the Bengal Glass are as follows:

### Process Flow of the Supply Chain Activities of BGW

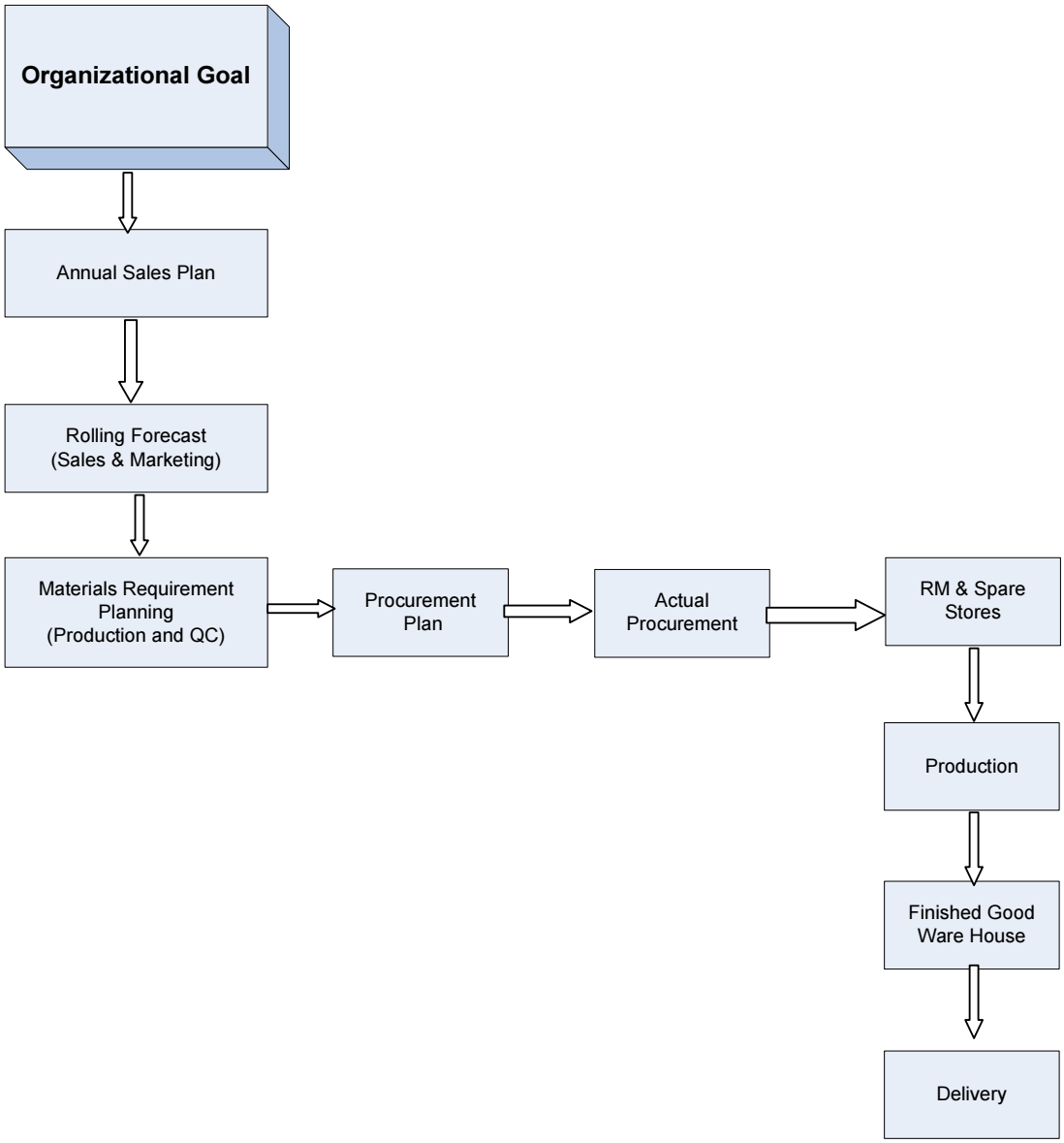



Fig 2.5: Process Flow of Supply Chain Activities of Bengal Glass

**Organizational Goal:** The supply chain process of BGW starts when the annual organizational goal is set by the management. The organizational goal is set by the management with discussing with the head of the functional department and approved by the monthly Executive Committee meeting. This is usually done during the November of every year for the next calendar year.

**Annual Sales Plan:** Based on the organizational goals of the company the Sales and Marketing department set their annual sales plan.

**Rolling Forecast:** Sales and Marketing department prepare rolling forecast every month based on market demand and sales trend. They update this rolling forecast and send the forecast to production and QC Department. The Production and QC jointly prepare the Material Requirement Planning and the production planning based on the revised rolling forecast.

**Material Requirement Planning:** The Material requirement planning is a report containing the requirement of major Raw Materials as per monthly consumption. Usually the minor Raw Materials are not mentioned in this report (copy enclosed in **Annex-3**).

**Procurement Plan:** Based on the Material Requirement Planning the Supply Chain department prepares the procurement plan. As per the company policy all imported materials are kept stock for 03 months and local raw materials are kept stock for 07-30 days based on the availability, lead time and nature of the goods. Usually the supply chain maintain this stock through a spread sheet called " Daily Stock Report with Re-order level"

**Actual Procurement:** Based on the re-order level the supply chain orders the materials and ensures the uninterrupted supply of all the materials. Throughout the procurement process the supply chain department follows the procurement policy, procedure and the ethical code of conduct of the organization.

**Storing:** The materials purchased by the supply chain directly receive by the Stores at factory office after ensuring the quality of the goods as per our requirement by the QC Department or the User department. There are separate stores for Raw Materials and Spare Parts. The BGW maintain the 8 different warehouses for RM, 4 for Spare Parts, 2 open yard for stocking Silica Sand, 2 open yards for stocking Cullet (broken glass), 1 ware house for storing processed cullet, 3 silos for stocking HSD, and 4 warehouses for storing Finished Goods.

**Production:** The manufacturing process of BGW is a 100% automated continuous process. It runs 24 hours all through the 365 days in a year, as the glass furnaces cannot be kept unused for a single minute. Therefore, the BGW has to maintain the efficient manufacturing process.

**Finished Good Warehouse:** The finished goods are kept in the finish goods warehouse and the distribution takes place from the warehouse based on the delivery order. The delivery order is produced at factory administration and stores jointly based on the sales order sent from the Sales and Marketing department at Head Office. The BGW maintain PUSH production process and the customer orders fulfill from the ready stock product.

**Delivery :** The BGW does not maintain the any delivery channel and does not maintain any delivery vehicle of its own. Customer themselves collect the goods from BGW's warehouse. Customers collect Sales Order from Head Office and the delivery schedule based on which they collect the goods from the factory. After delivery of the goods the risk goes to the customers. The natures of the BGW's finished product are 100% fragile goods and are very risky to handle. The BGW transfers risk to the customer at the delivery point after loading the goods to customers' vehicle or their nominated vehicle.

# CHAPTER 3

# LITERATURE REVIEW

## 3.1 Evolution and History of Glass

Since time immemorial, glass has been the preferred container material for pharmaceutics. Its current market share for primary packaging of injectables ranges at 98 %; every year more than 23 billion primary containers made from glass for parenterals like ampoules, vials or prefillable syringes are produced and used worldwide.

Glass is one of the oldest materials known to man. Stone-age civilizations already used shards of natural glass as cutting tools. Around 3500 BC, man began to produce glass himself by melting a mixture of sand, soda and lime. Later the blowing of glass was discovered and made glass vessels widely available. Glass owes its popularity as a material for pharmaceutical containers to a product of desirable characteristics. It is durable, inert, clean and transparent. Anyhow, even the best material is challenged from time to time – often just to prove that there is no superior alternative.

The shot glass, as we know it today, has gone through an interesting evolution influenced by many cultures. Glass has a long history of 5000 years.

- **3100 BC** Earliest glass artefacts found in Egypt
- **1500 BC** Small glass articles made from moulds have been found in Egypt and Syria. The first glass was produced probably in Egypt.
- **650 BC** First glass making manual was written, Assyrian Assurbanipal's Library
- **1 AD** Technique of blowing glass was invented in the Babylon area.
- **25-400 AD** Rapid development and growth of glass melting, working and forming technology in the Mediterranean region during the Roman Era

- **100 AD** Glass cost rapidly declines and for the first time becomes available to ordinary citizens
- **600-699** Strong Islamic influence
- **1000AD** Domination of Venice glass centre in glass production. Murano Island became a major glass centre.
- **1226** "Broad Sheet 'was first produced in Sussex
- **1330** French glassmakers produced "crown glass" in Rouen, France
- **1500** Angelo Barovier invented "cristallo", clear, colourless glass
- **1590** Development of glass telescope and microscope lenses in Netherlands
- **1600** Caspar Lehman, a Praque glassmaker, used the technique of cutting rock crystal to glass
- **1600** France became a major power in the glass industry
- **1608** The first American glass was made by settlers in Jamestone
- **1615** Introduction of coal furnaces in England
- **1620** Production of "Blown plate" was produced in London
- **1676** English glassmaker George Ravenscroft patented a formula for lead glass, heavy, clear glass, ideal for cutting.
- **1688** ``Polished plate`` was produced in France
- **1690** William of Orange passed a law that lifted taxes on distilled spirits and encouraged development and expansion of this industry
- **1745** Glass Excise Act passed in England
- **1765** "Crystal glass" production began a new era in glass industry
- **1773** Glassworks of polished plate glass were established at Ravenshead in England
- **1800** Industrial revolution dawned a new era in glass industry. Synthetic glasses with improved properties were available for the first time
- **1827** Glass pressing machine was invented in America
- **1834** Robert Lucas Chance introduced ``Improved Cylinder Sheet``
- **1843** Henry Bessemer introduced an early form of ``Float glass``
- **1847** James Hartley invented ``Rolled plate``

- **1867** First regenerative glass furnace was patented in German by Siemens brothers, Freiderich, Karl, Hans, Werner and Wilhelm
- **1875** Technical glasses were developed in Germany
- **1903** An automatic glass blowing machine was invented by Michael Owens
- **1913** Technique of ``Flat Drawn Sheet`` was introduced in Belgium
- **1950-1960** Glass science became a major research discipline. Major glass research centre was established by Ford Motor Co
- **1959** "Float glass" was invented in UK by Sir Akistair Pilkington
- **1984** First fluoride glass was discovered by Marcel and Michael Poulain and Jacques Lucas in Rennes, France.

## 3.2 What is 'Glass' and 'Glass Container' ?

### Definition of Glass

Glass is an amorphous solid (non-crystalline) material that exhibits a glass transition, which is the reversible transition in amorphous materials (or in amorphous regions within semicrystalline materials) from a hard and relatively brittle state into a molten or plastic state. Glasses are typically brittle and can be optically transparent. The most familiar type of glass is soda-lime glass, which is composed of about 75% silicon dioxide ($SiO_2$), sodium oxide ($Na_2O$) from sodium carbonate ($Na_2CO_3$), lime (CaO), and several minor additives. (Wikipedia)

**Definition of Glass Container**

**Container glass** is a type of glass for the production of **glass containers**, such as bottles, jars, drinkware, and bowls. Container glass has a lower magnesium oxide and sodium oxide content than flat glass, and higher silica, calcium oxide, and aluminium oxide content. From its higher content of water insoluble oxides follows

the slightly higher chemical durability of container glass against water, which is required especially for storage of beverages and food. Most container glass is soda-lime glass, produced by blowing and pressing techniques, while some laboratory glassware is made from borosilicate glass.

Glass Container is made from all-natural sustainable raw materials. It is the preferred packaging for consumers' concerned about their health and the environment. Consumers prefer glass packaging for preserving a product's taste or flavor and maintaining the integrity or healthiness of foods and beverages. Glass is the only widely-used packaging material considered ***"GRAS" or "generally recognized as safe" by the U.S. Food and Drug Administration (FDA)***. It's also 100% recyclable and can be reused endlessly with no loss in quality or purity.

## 3.3 Types of Glass Containers ?

Glass containers can be classified in various ways. Depending on the nature of the products the glass containers are of different kinds and types. This report limits the scope of glass containers in mostly used in pharmaceuticals packaging and the food and beverage packaging (non-alcoholic beverage). Bangladesh Glass container industry mostly follows the United State Pharmacopeia (USP) standard. As per the guideline of the USP the glass containers are of 3 (three) types according to their hydrolytic resistance:

### 3.3.1 USP Type I Glass Containers:

These are the ***neutral glass, with a high hydrolytic resistance*** due to the chemical composition of the glass itself. These are known as the **Borosilicate Glass.** Borosilicate Glass is a highly resistant glass. In this type of glass a substantial part of the alkali and earth cautions are replaced by boron and/or aluminum and zinc. It is more chemically inert than the soda-lime glass, which contains either none or an insignificant amount of these

cautions. Although glass is considered to be a virtually inert material and is used to contain strong acids and alkalis as well as all types of solvents, it has a definite and measurable chemical reaction with some substances, notably water. The sodium is loosely combined with the silicon and is leached from the surface of the glass by water. Distilled water stored for one year in flint type III glass (to be described) picks up 10 to 15 parts per million (ppm) of sodium hydroxide along with traces of other ingredients of the glass. The addition of approximately 6% boron to form type I borosilicate glass reduces the leaching action, so that only 0.5 ppm is dissolved in a year.

### 3.3.2 USP Type II Glass Containers:

These are the ***soda-lime-silica glass with a high hydrolytic resistance*** resulting from suitable treatment of the surface. Type II containers are made of commercial soda-lime glass that has been de-alkalized or treated to remove surface alkali. The de-alkalizing process is known as "sulfur treatment" and virtually prevents "weathering" of empty bottles. The treatment offered by several glass manufacturers exposes the glass to an atmosphere containing water vapor and acidic gases, particularly sulfur dioxide at an elevated temperature. This type of glass containers are suitable for most acidic and neutral, aqueous preparations whether or not for parenteral use.

### 3.3.3 USP Type III Glass Containers :

These are the ***soda-lime-silica glass with only moderate hydrolytic resistance***. This type of glass containers are in general suitable for non-aqueous preparations for parenteral use, for powders for parenteral use (except for freeze-dried preparations) and for preparations not for parenteral use.

Bangladeshi glass manufactures are only manufactured the USP Type III glass containers, because this is the common types of glass containers, which is used for all types of pharmaceuticals packaging for liquid product and for the suspensions. The foods and

beverage industries are also using the same type of glass bottles for the packaging. No Bangladeshi companies are producing the USP Type I and Type II bottles. The pharmaceutical companies those are using Type I and Type II bottles, are importing them from abroad.

### 3.4 Uses of Glass Container

Glass bottle packaging has been around for a long time. Yet switching from plastic containers to glass is becoming more popular in recent years, as consumers become more aware of environmentally-friendly packaging, and companies rediscover the benefits of glass. Here, we'll explore the growing popularity and benefits of glass bottle packaging, including safety, sustainability and image.

- **Safety.** Glass is made from all-natural raw materials. Other packaging materials, such as PVC, can have negative effects on the health of humans and the environment. Glass is the only packaging material that the U.S. Food and Drug Administration labels as GRAS: "Generally Recognized as Safe." Without the addition of chemicals during production, glass containers can effectively protect foods and beverages while preserving the products' taste and maintaining purity.

- **Sustainability.** Glass is a 100% recyclable, sustainable mono-material (meaning that is not composed of various materials) that can be recycled continuously without losing its purity or quality. Recycled glass containers can be made into new glass bottles, saving energy and raw materials. Other uses for recycled glass include landscaping, countertops, flooring, concrete pavement and tiles.

- **Image:** Glass has a shelf impact unlike any other packaging material, with clarity, shape and texture that cannot be matched by plastics or cardboard. The transparency of glass allows for a clear showcase of the product, while the material's strength contributes to its premium appearance.

## 3.5 Environmental & Other Benefit of Glass Container

### 3.5.1 Environmental Benefit

Glass is the trusted and proven packaging for health, taste and the environment. It is also the only widely-used food packaging granted the FDA status of “GRAS” or generally recognized as safe – the highest standard.

- Glass is 100% recyclable and can be recycled endlessly without loss in quality or purity.
- Legislation such as container deposit measures will further enhance the benefits associated with glass packaging.
- 80% of the glass that is recovered is made into new glass products.
- A glass container can go from a recycling bin to a store shelf in as little as 30 days. An estimated 80% of recovered glass containers are made into new glass bottles.
- Glass is nonporous and impermeable, so there are no interactions between glass packaging and products to affect the flavour of food and beverages. No nasty after taste - ever.
- Glass has an almost zero rate of chemical interactions, ensuring that the products inside a glass bottle keep their strength, aroma, and flavour.
- When consumers choose foods or beverages that are packaged in glass, they avoid potential risks while enjoying a number of benefits.

### 3.5.2 Other Benefit of Glass Packaging

Made from nontoxic raw materials - sand, soda ash, limestone, and up to 70 percent recycled glass or “cullet” - glass is the only packaging material accepted worldwide as “generally recognized as safe”. Glass has no chemical interaction, ensuring that the products inside a glass bottle keep their strength, aroma, and flavor. Glass does not deteriorate, corrode, stain or fade, so products inside a glass container remain as fresh as when they were bottled. Glass packaging gives people confidence that the product is pure.

| Key Features | Benefits |
|---|---|
| Inert and chemically inactive | - Does not undergo any transformation when subjected to chemical reactions |
| Pure and safe | - Does not contaminate content even if it is acidic<br>- Can be hermetically sealed<br>- Is nontoxic and impermeable |
| Odorless | - Does not emit any odor |
| Sterilizable | - Allows sterilization, as well as pasteurization |
| Longer shelf life | - Protects products against the effects of temperature and light |
| Nonpolluting | - Has least pollution impact compared to other packaging options (eg. PET) |

## 3.6 Overview of the Glass Container Industry

**Global Glass Packaging Market to 2019: Alcoholic & Non Alcoholic Beverage, Food, Pharmaceutical and Personal Care Packaging Analysis of the $59 Billion Industry.** ***The global glass packaging market is expected to grow at a CAGR of 3.9% from 2014 to 2019 to reach a value of $59,814.3 million by 2019.***

-Research and Markets, (http://www.researchandmarkets.com/research/lcqkbv/glass_packaging), 14/10/2014

Glass packaging used for alcoholic beverage segment is growing at a CAGR of 3.9% in terms of value and constitutes a significant part of the overall glass packaging market. The pharmaceutical segment, is the second largest application area for glass packaging, and is expected to grow at a CAGR of 4.2% by 2019.

Glass is made from all-natural sustainable raw materials. Owing to its greater resistance to abrasion, resistance to chemicals and its recyclable nature it is widely used for packaging food, alcoholic, and pharmaceutical products. The demand for glass packaging in pharmaceutical industry is attributed to its nature of being chemically inert, impermeable, strength and rigidity. Glass packaging is primarily utilized for alcoholic beverages all over the world but its demand is increasing in the pharmaceutical sector followed by personal care segment.

Alcoholic beverage packaging will continue to have the largest share of the world market for glass packaging and will drive glass packaging consumption on a global scale. The developing regions of Eastern Europe and Asia-Pacific will experience the largest growth in this application. Glass packaging consumption for pharmaceutical packaging will grow primarily in North America and Europe due to introduction of new therapies.

Partnerships and expansions for glass packaging in the recent past indicate that the industry is on its way to expand globally and leading glass packaging suppliers are strengthening their presence in emerging markets such as India and Eastern Europe. All these factors, along with the growing alcoholic beverage and pharmaceutical industry, will continue to drive the demand for glass packaging.

## Products Packaged in Glass Look Better, Taste Better and are the Purest They Possibly Can Be -*by Mike Lonsway*

- **Ref:** *Food Quality & Safety magazine,* December/January 2007

For generations, glass packaging has been trusted to store food, beverages and medicines. Glass has the staying power as a pure, sustainable package that's healthy for the consumer and the environment. Made from natural raw materials – sand, soda ash and limestone – glass is impermeable and nonporous, which protects its contents from degradation and tampering. In addition, glass is chemically inert, which guards contents from moisture and oxygen, and ensures that the freshness and flavor of its contents – along with the product's shelf life – are preserved.

Glass is the only packaging material generally recognized as safe (GRAS) by FDA. With the GRAS classification, glass containers require no leaching or extraction testing. The FDA requires all other packaging options to predict the amount of migrating foreign substances that will be consumed and sets limits on the amount consumed when products are packaged in anything other than glass.

**Consumer Preference**

A recent national consumer survey conducted by the Glass Packaging Institute shows that while consumers purchase products in a variety of packaging materials, they prefer glass for its quality, purity, taste, product protection and shelf life.

- 82 percent of respondents say glass keeps food in its healthiest form;
- 78 percent of respondents say glass preserves the purity of its contents;
- 75 percent of respondents say glass preserves the flavor of its contents;
- 73 percent of respondents say glass preserves the quality of the product;
- 62 percent of respondents say glass increases the shelf life of the product.

Consumers of organic products rate glass even higher—6 to 8 percent higher—in the areas of environmental safety, true flavor, best shelf life, healthiest form, best purity and best quality. Because glass is chemically inert, its contents have a long shelf life without the risk of cross-contamination, and it is free of the health concerns now prevalent with competing types of containers.

An added benefit of glass is its transparency. Consumers can see and trust the quality of the product being purchased. When purchasing a product packaged in glass, consumers place a higher value on products they can inspect.

## GLASS: A SMALL PART OF THE PROBLEM, A BIG PART OF THE SOLUTION- By J. Stockdale (Environmental manager of British glass).

The study examines the relationship between the emissions from relevant sectors of the glass industry and compares them with the carbon savings that can be achieved with the products the industry makes. It has been found that the carbon savings by the appropriate use of glass products far exceeds the carbon outlay incurred in making these glass products. It suggests the wider use of glass as an environmental friendly product and as an answer to the world's energy and carbon problems. The study explores ways in which glass can be used to reduce carbon emissions and increase energy savings. The main categories of sustainable glass uses are - Four main areas are discussed: glass fibre insulation, advanced glazing (low emissivity glass and advanced solar glass).

## UTILIZATION OF RECYCLED AND WASTE MATERIALS IN VARIOUS CONSTRUCTION APPLICATIONS-

- **Johnny Bolden, Taher Abu-Lebdeh and Ellie Fini**

The study suggests the use of recycled materials has a positive impact through different aspects. This include the benefits in enhancing sustainability of the construction industry while reducing cost, providing solutions to environmental pollution and reducing the need for natural resources. In this study, a questionnaire survey was conducted to find out the current practices in using waste and recycled materials in the construction industry. Results indicated that some companies were not aware of the availability, quality of the materials' performance, cost savings, or any other benefits including environmental benefits. It is, thus recommended to create better documentation for green infrastructure, connecting researches and industry with an overview of what recycled materials are available for different construction applications. Companies need to be innovative in their use of recycled materials and reduce their dependency on raw materials. Also, more data and better documentations are needed to encourage the use of waste and recycled materials in the construction industry.

# CHAPTER 4

# RESEARCH METHODOLOGY

## 4.1 Method of Collecting Data

Questionnaire survey was adopted for collecting primary data in this research work. Questionnaire survey was conducted on 30 different category of officers, executives, managers and suppleir and traders related to this industry. Since the users of this containers are mostly in pharmaceuticals, the respondents were selected mainly from differnet pharmaceuticals, ayurvedic and employees and businessmen, suppliers of this industry. Before asking for filling the questionnaire, the general idea of the research objectives were exchanged with them. After the exchange of general idea of the research objectives, the questionnaire was given to them. They were requested to fill the questionnaire based on the practical experience and their opinion regarding the glass container/bottles in overall. Both open end and close end questions were set in the questionnaire to reveal the real perception of the respondents.

## 4.2 Sample size, population size and sampling method of collecting data

The sample size for this study was determined to be 30 as the scope and time frame of the study was limited. The users and beneficieries of the effect of the glass container is the mass people but the people involved in this business and influencers are limited. The pahrmaceuticals companies, homeopath doctors and manufacturers, ayurvedic medicine manufatures, some few, food manufacturers, beverage manufacturers etc. There are approximately 600 such influencers who can take the decisions of packaging of glass containers or other packaging. Hence the population size of the organization is considered as 600 except the mass people. A sample of 30 out of 600 means arround 5% of the population, hence the sample may be considered statistically significant. However, non-probability convenient sampling method was used to collect data for the study.

## 4.3 Place of Study and Study Period

Survey was conducted from 20 November, 2014 to 30 November, 2014 at different offices of the related industry and business personnel. Only the offices situated in Dhaka were visited for this survey.

## 4.4 Analysis Tools Used

Different types of statistical analytical tools have been used to analyze and interpret the subject matter of the study like frequency distribution table. Frequency distribution table and the percentage of the respondent in individual questions have been done to analyze the findings of the sample. The graphical representations of the answers in the form of 'pie chart' have been demonstrated for easy understanding of the responses**.**

# CHAPTER 5

# RESULTS AND DISCUSSION

As mentioned earlier, although there are many advantages, but glass has been continuously overlooked for cheaper alternatives non-renewable products like PET or Plastic products. My study aims to explore the reasons for this situation and determine how and to what extent the Bangladeshi market would be benefitted by a more visible glass industry.

It seeks to inform the reader about the advantages of glass containers (stressfully, environmental) in comparison to other packaging materials like plastic, PET etc., so as to aid in future decision making processes.

A case study has been conducted to find out the actual scenario of the glass container industry, the prospect of glass container in Bangladesh and the challenges the glass container industries are facing currently and the future of glass container industry. For this purpose, questionnaire survey has been conducted to the related person who have provided their independent opinion based on their experience. The respondents include glass manufacture, service holders, business men, and other stakeholder of the glass industry. Sample questionnaire is presented in appendix-A.

## 5.1 General information about sample of the questionnaire survey

| | | |
|---|---|---|
| Sample size | : | 30 (Number of people surveyed) |
| Profession | : | 20 nos Service/Private Service<br>06 nos Pharmacist<br>02 nos Teacher<br>01 no Chartered Accountant<br>01 no Businessman |
| Gender | : | Female - 05 nos<br>Male - 25 nos |

## 5.2 Overview of the survey questions

In order to get the perception of the respondents regarding the **prospect and challenges of glass container industry in Bangladesh** on the project's key performance parameters, 15 questions have been set to find out the quality of glass, the prospect of glass industry and the challenges of glass industry. The respondents have been asked to give their perception on a scale of 1 to 5. The scale is set as- 5 for 'Strongly Agree', 4 for 'Agree', 3 for 'Neutral', 2 for 'Disagree' and 1 for 'Strongly Disagree'. Distribution of responses and percentage of responses for these questions are presented in table A1 and A2 of appendix-B. Frequency distributions of the responses are demonstrated in pie charts which are presented in appendix-C.

## 5.3 Findings of the questionnaire survey

### 5.3.1 Distribution of Responses:

Total 15 questions of different aspects of glass container and its effect on quality of food, environment and sustainability to the total number of people of the sample size i.e. 30. The respondent was asked to answer their opinion in 5 point scale (Storngly Agree: 5, Agree: 4, Neutral: 3, Disagree: 2, Strongly Disagree': 1).

The probability distribution of the questionnaire answer is given below:

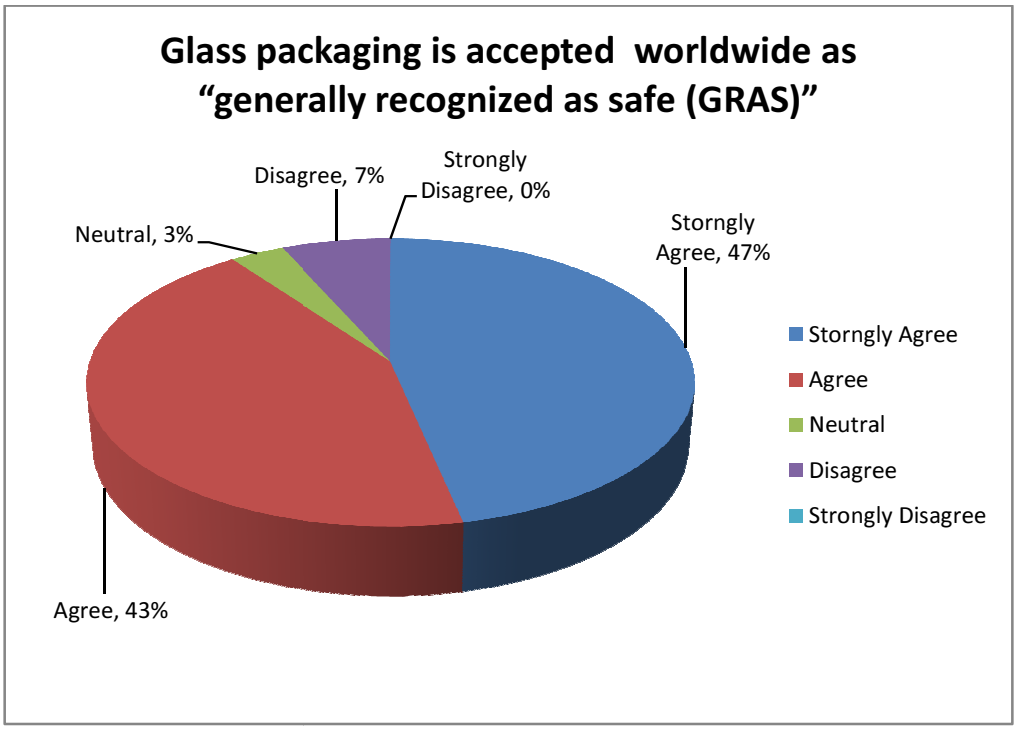
## Distribution of responses for question no7(i) to 7(xv) of questionnaire

| Q# | Question | Frequency Distribution (Number) | | | | | Total Frequency |
|---|---|---|---|---|---|---|---|
| | | Storngly Agree | Agree | Neutral | Disagree | Strongly Disagree | |
| 1 | Glass is the only packaging material accepted worldwide as "generally recognized as safe (GRAS) | 14 | 13 | 1 | 2 | 0 | **30** |
| 2 | Glass container protects the inner product from any effiect of Ultra Violet Ray | 12 | 14 | 1 | 3 | 0 | **30** |
| 3 | Glass bottle is inert and therefore has no potential to interact chemically with inside materials. | 12 | 14 | 0 | 4 | 0 | **30** |
| 4 | Glass has no chemical interaction, ensuring that the products inside a glass bottle keep their strength, aroma, and flavor. | 12 | 13 | 1 | 4 | 0 | **30** |
| 5 | Glass Container is environment friendly | 13 | 13 | 4 | 0 | 0 | **30** |
| 6 | Glass does not deteriorate, corrode, stain or fade, so products inside a glass container remain as fresh as when they were bottled. | 4 | 17 | 5 | 4 | 0 | **30** |
| 7 | Glass packaging gives people confidence that the product is pure | 5 | 10 | 10 | 5 | 0 | **30** |
| 8 | Glass container is 100% recyclable | 11 | 12 | 4 | 0 | 2 | **29** |
| 9 | Glass Container is the safest packaging materials | 12 | 12 | 0 | 6 | 0 | **30** |
| 10 | Glass does not emit odor, so keep the product fresh in the long run | 11 | 15 | 2 | 2 | 0 | **30** |
| 11 | The shelf life of product in glass container is higher than any other packaging. | 13 | 9 | 3 | 5 | 0 | **30** |
| 12 | Components of plastic material used in manufacturing process migrate contents into the product. | 6 | 15 | 4 | 3 | 2 | **30** |
| 13 | Glass bottles is 100% recyclable | 6 | 13 | 7 | 1 | 2 | **29** |
| 14 | Do you prefer glass bottle as a packaging when you buy any of your favorite food or beverage? | 10 | 7 | 8 | 5 | 0 | **30** |
| 15 | do you think that mass people of Bangladesh have proper knowledge on the quality of the packaging and their impact . | 1 | 4 | 6 | 12 | 7 | **30** |
| **Total** | | **142** | **181** | **56** | **56** | **13** | **448** |

### 5.3.2 Graphical Re-presentation of the questionnaire response :

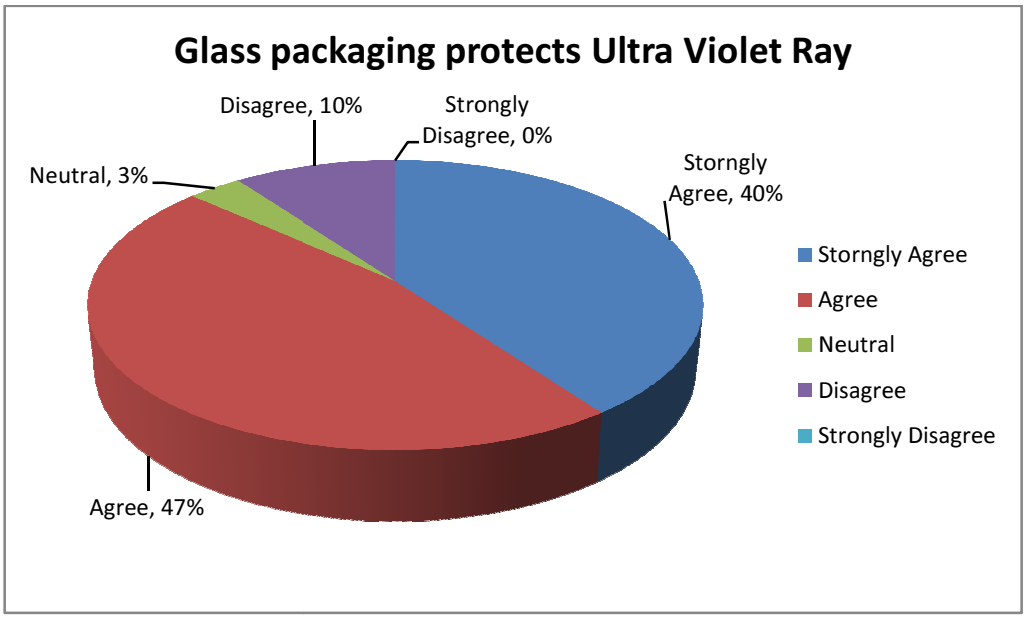
The graphical representation of each questionnaire answer is presented below in pie chart:

**Q# 7(i) : Glass packaging is accepted worldwide as GRAS**



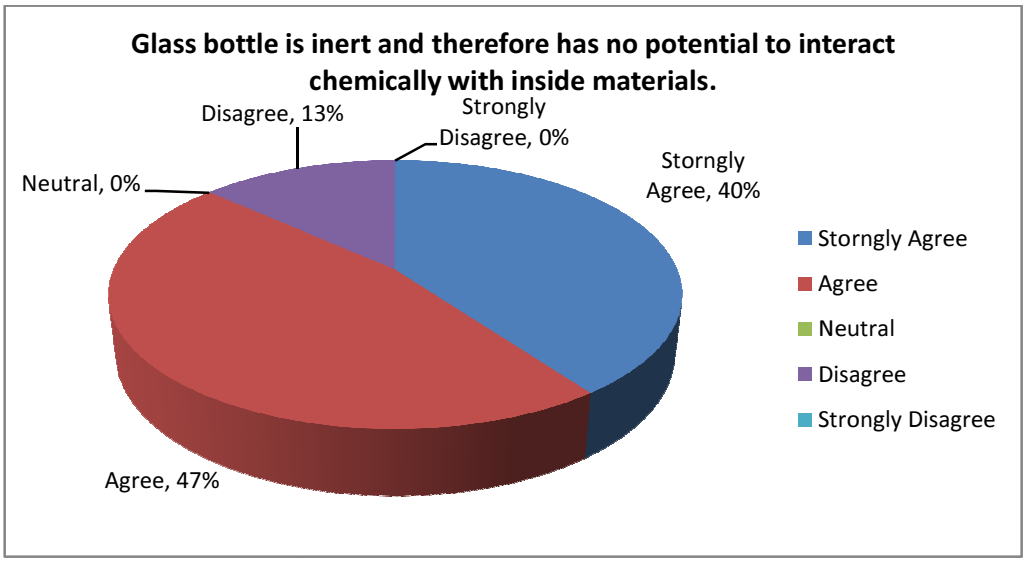

In response to this question, 47% respondents have given their opinion that glass packaging is accepted as 'generally recognized as safe' has 'strongly agree' with the FDI, 43% respondents perceive as 'Agree', 3% perceive as 'neutral' and 7% perceive as 'disagree'. No respondent perceives as 'strongly disagree'.

**Q# 7(ii) : Glass packaging Protects Ultra Violet Ray**



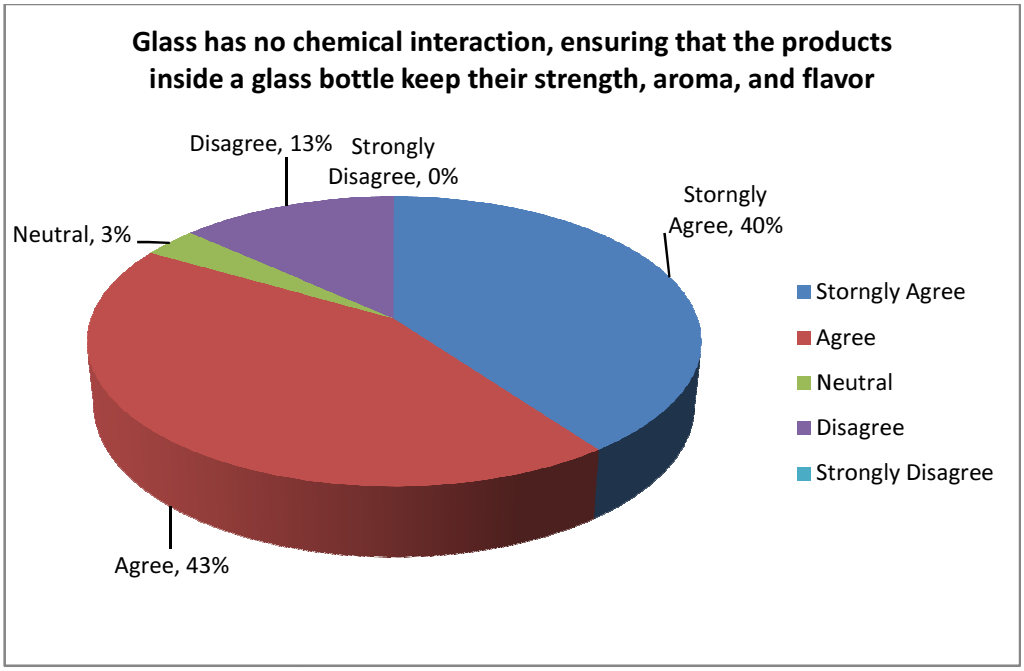

In response to this question, 40% respondents have given their opinion that 'glass packaging can protect ultra violet ray' has 'strongly agree' with the statement, 47% respondents perceive as 'Agree', 3% perceive as 'neutral' and 10% perceive as 'disagree'. No respondent perceives as 'strongly disagree'

**Q# 7(iii) : Glass bottle is inert and therefore has no potential to interact chemically with inside materials.**



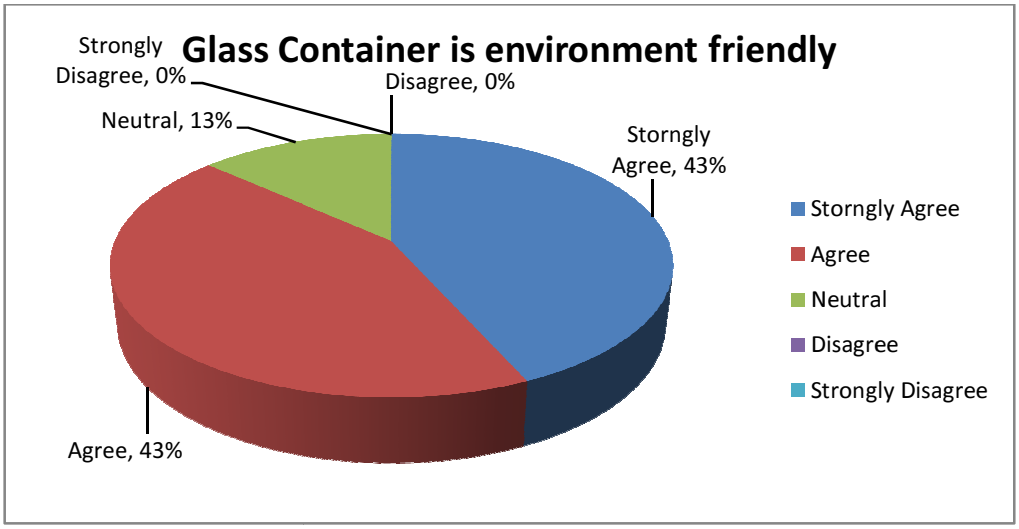
In response to this question, 40% respondents have given their opinion that 'glass bottle is inert and has no potential to interact chemically with food or beverage' has 'strongly agree' with the statement, 47% respondents perceive as 'Agree', 0% perceive as 'neutral' and 13% perceive as 'disagree'. No respondent perceives as 'strongly disagree'

**Q# 7(iv) : Glass has no chemical interaction, ensuring that the products inside a glass bottle keep their strength, aroma, and flavor.**



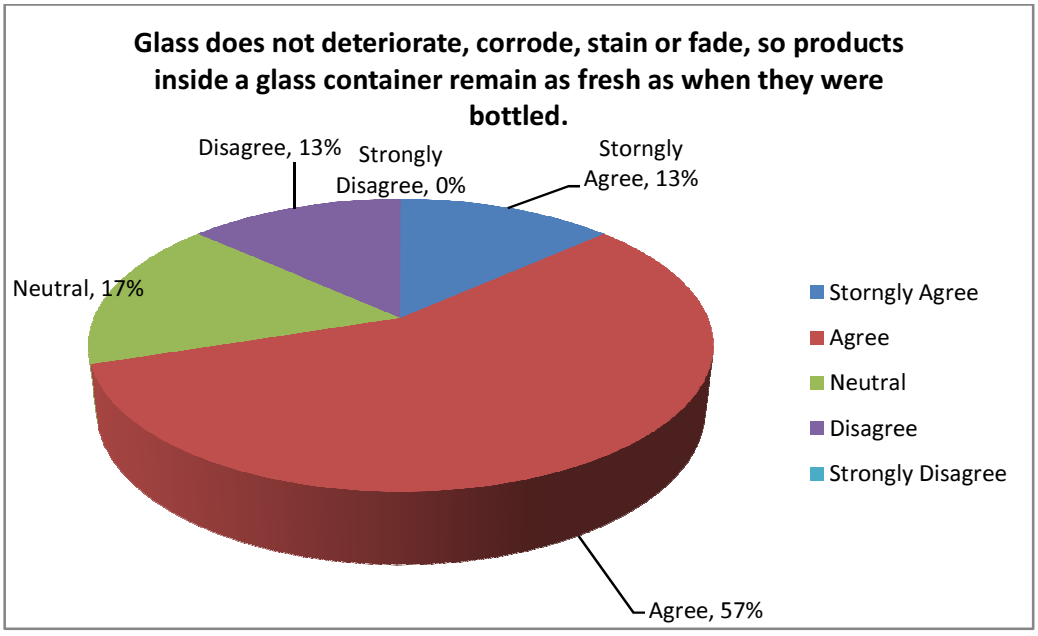

In response to this question, 40% respondents have given their opinion that 'products inside a glass bottle keep their strength, aroma and flavor' has 'strongly agree' with the statement, 43% respondents perceive as 'Agree', 3% perceive as 'neutral' and 13% perceive as 'disagree'. No respondent perceives as 'strongly disagree'

**Q# 7(v) : Glass Container is environment friendly.**



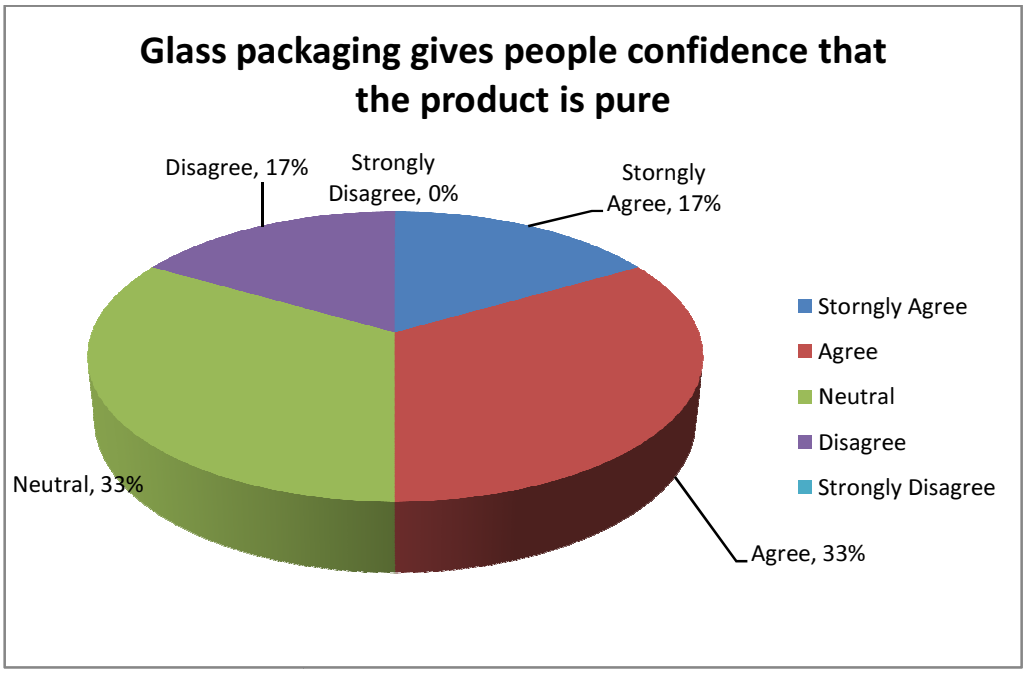

In response to this question, 43% respondents have given their opinion that 'glass packaging is environment friendly' has 'strongly agree' with the statement, 43% respondents perceive as 'Agree', 13% perceive as 'neutral'. No respondent perceives as ' disagree' and 'strongly disagree'.

**Q# 7(vi) : Glass does not deteriorate, corrode, stain or fade, so products inside a glass container remain as fresh as when they were bottled.**



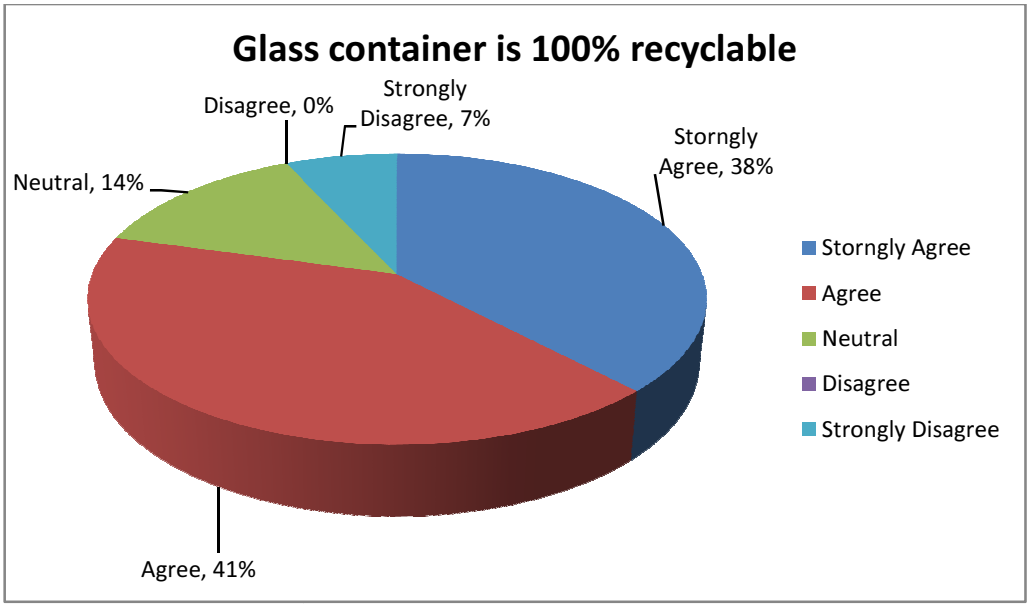
In response to this question, 13% respondents have given their opinion that 'glass does not deteriote, corrode, stain or fade, so keep fresh' has 'strongly agree' with the statement, 57% respondents perceive as 'Agree', 17% perceive as 'neutral' and 13% perceive as 'disagree'. No respondent perceives as 'strongly disagree'.

**Q# 7(vii) : Glass packaging gives people confidence that the product is pure.**



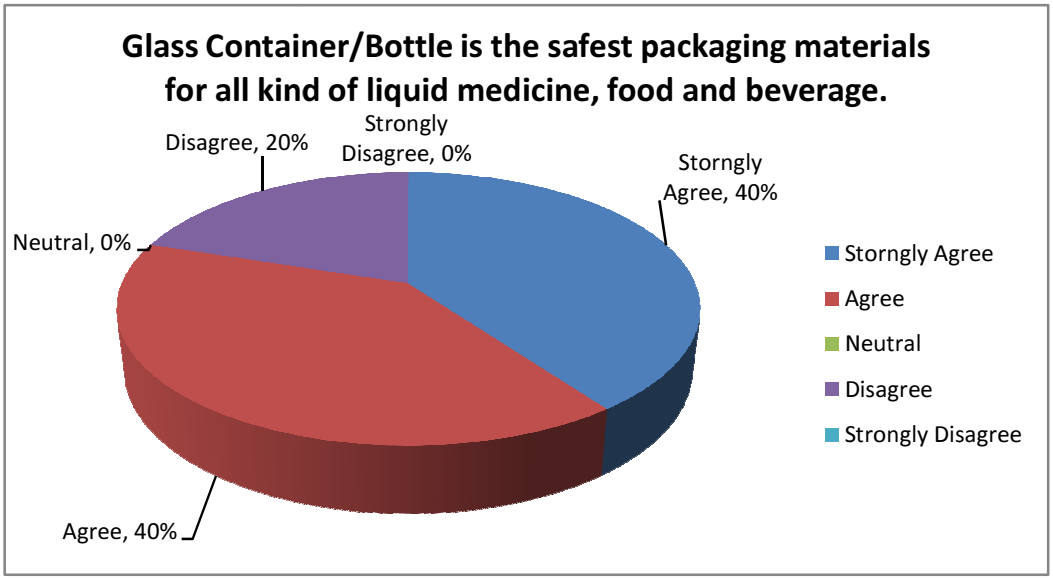

In response to this question, 17% respondents have given their opinion that 'glass packaging gives people confidence that product is pure' has 'strongly agree' with the statement, 33% respondents perceive as 'Agree', 33% perceive as 'neutral' and 17% perceive as 'disagree'. No respondent perceives as 'strongly disagree'.

**Q# 7(viii) : Glass container is 100% recyclable.**



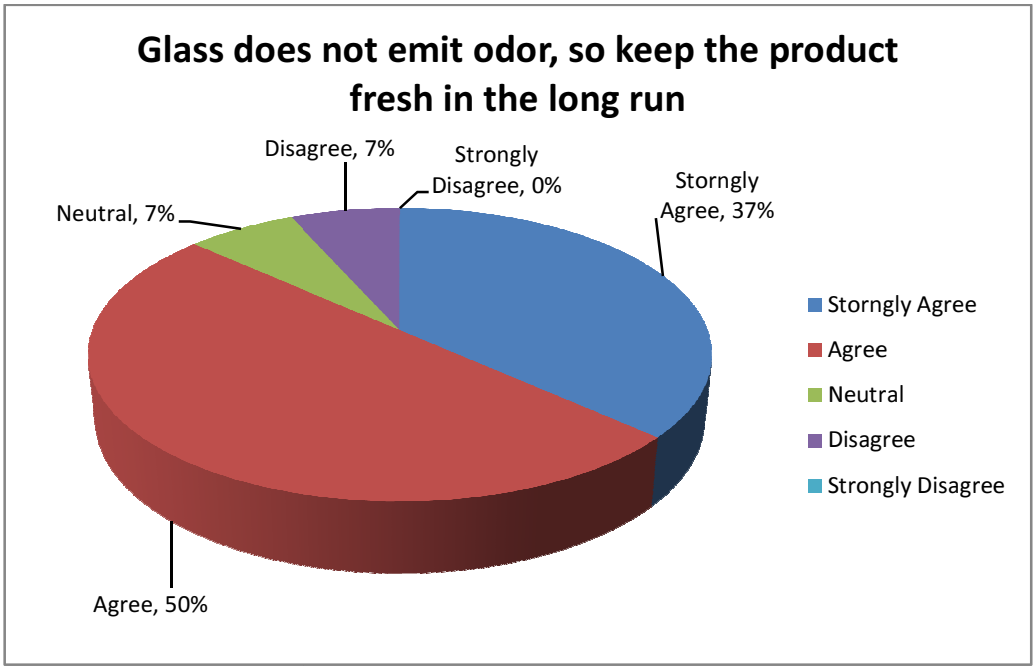

In response to this question, 38% respondents have given their opinion that 'glass container is recycleable' has 'strongly agree' with the statement, 41% respondents perceive as 'Agree', 14% perceive as 'neutral' and 0% perceive as 'disagree' and 7% percieve as ' strongly disagree'.

**Q# 7(ix) : Glass Container/Bottle is the safest packaging materials for all kind of liquid medicine, food and beverage.**



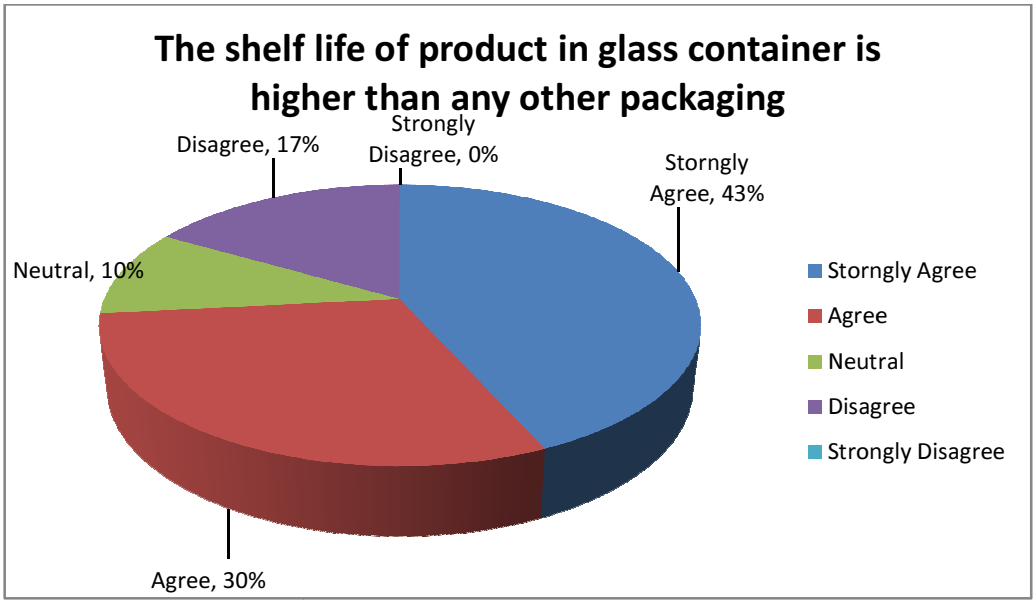
In response to this question, 40% respondents have given their opinion that 'glass container is the safest packaging material' has 'strongly agree' with the statement, 40% respondents perceive as 'Agree', and 20% perceive as 'disagree'. No responent percieve as 'neutral' and ' strongly disagree'.

**Q# 7(x) : Glass does not emit odor, so keep the product fresh in the long run.**



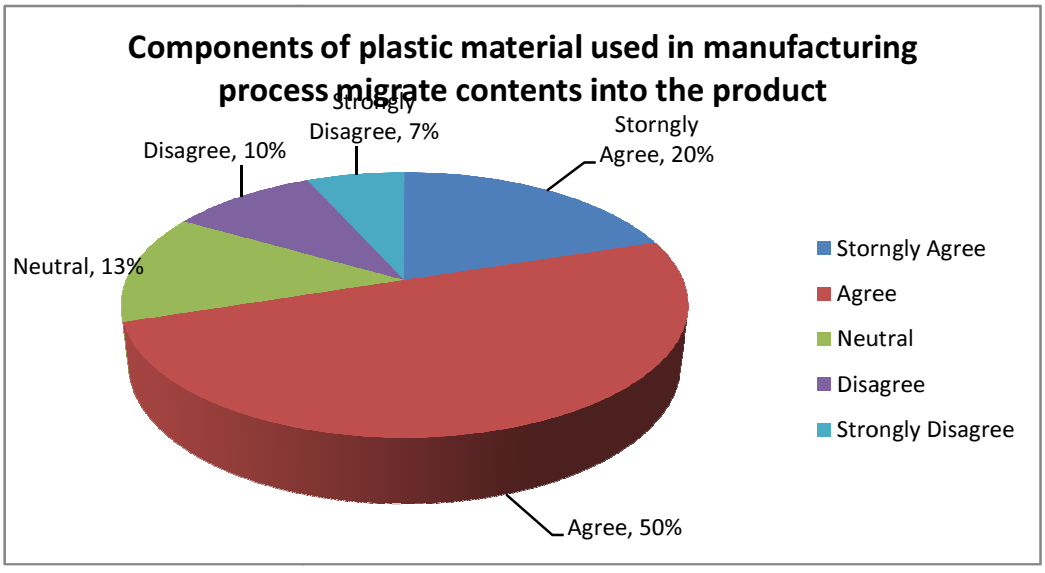

In response to this question, 37% respondents have given their opinion that 'glass container does not emit odor, so keep product fresh for long time' has 'strongly agree' with the statement, 50% respondents perceive as 'Agree', 7% perceive as' neutral' and 7% perceive as 'disagree'. No responent percieve as ' strongly disagree'.

**Q# 7(xi) : The shelf life of product in glass container is higher than any other packaging.**



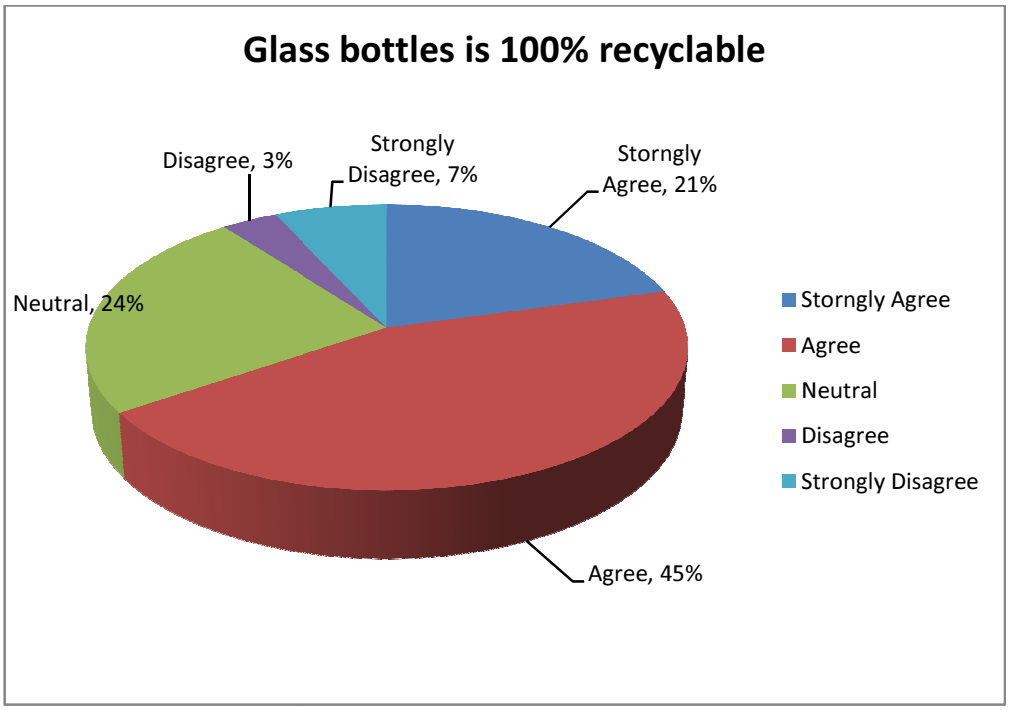

In response to this question, 43% respondents have given their opinion that 'the shelf life of product in glass container is higher than any other packaging' has 'strongly agree' with the statement, 30% respondents perceive as 'Agree', 10% perceive as ' neutral' and 17% perceive as 'disagree'. No responent percieve as ' strongly disagree'.

**Q# 7(xii) : Components of plastic material used in manufacturing process migrate contents into the product.**



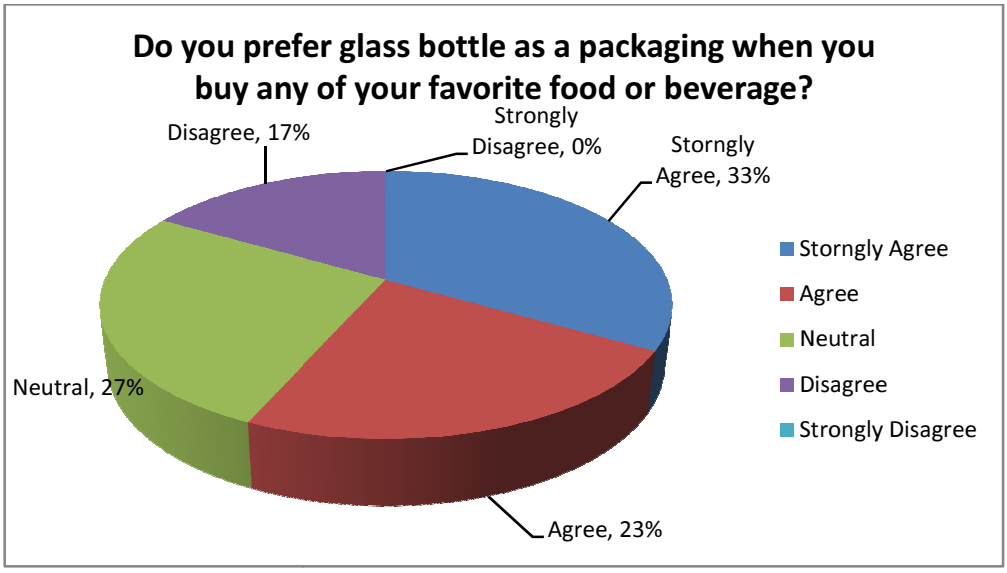
In response to this question, 20% respondents have given their opinion that 'components of plastic material migrate contents into products' has 'strongly agree' with the statement, 50% respondents perceive as 'Agree', 13% perceive as ' neutral' and 10% perceive as 'disagree' and 7% percieve as ' strongly disagree'.

**Q# 7(xiii) : Glass bottles is 100% recyclable.**



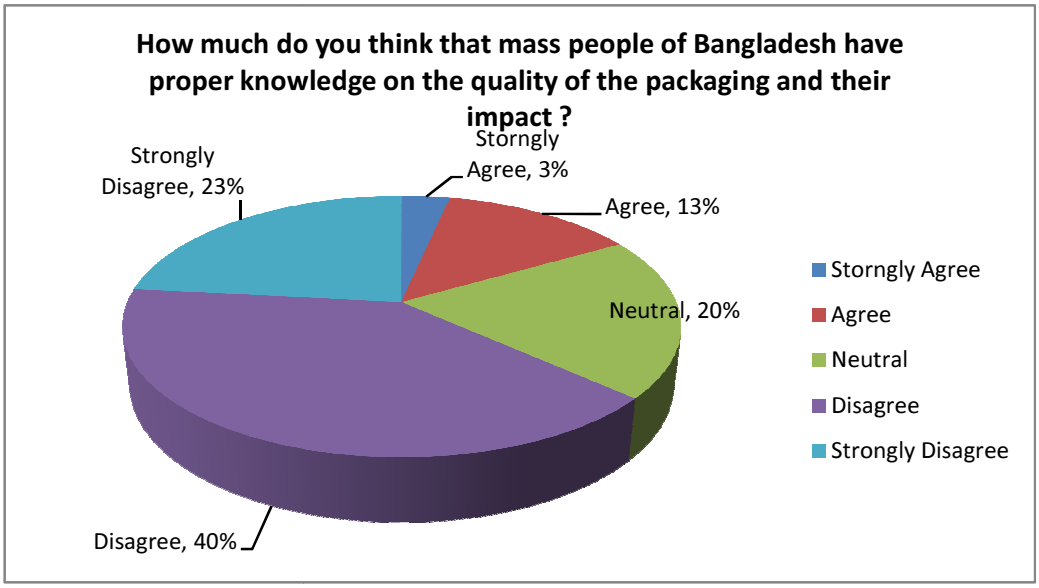

In response to this question, 21% respondents have given their opinion that 'glass bottle is 100% recyclable' has 'strongly agree' with the statement, 45% respondents perceive as 'Agree', 24% perceive as ' neutral' and 3% perceive as 'disagree' and 7% percieve as ' strongly disagree'.

**Q# 7(xiv) : Do you prefer glass bottle as a packaging when you buy any of your favorite food or beverage?**




In response to this question, 33% respondents have given their opinion that 'they perfer glass packaging when they buy their favourite food or drinks' has 'strongly agree' with the statement, 23% respondents perceive as 'Agree', 27% perceive as ' neutral' and 17% perceive as 'disagree'. No respondent percieve as ' strongly disagree'.

**Q# 7(xv) : How much do you think that mass people of Bangladesh have proper knowledge on the quality of the packaging and their impact**



In response to this question, 3% respondents have given their opinion that ‘mass people of bangladesh do not have proper knowledge on the quality of the packaging and their impact’ has ‘strongly agree’ with the statement, 13% respondents perceive as ‘Agree’, 20% perceive as ‘ neutral’ and 40% perceive as ‘disagree’. 23% perceive as ‘ strongly disagree’.

## 5.4 Summary of the key findings

Above questionnaire survey reveal that Glass Container has significant positive impact on quality of the product and sustainability of the environment. For the quality of the products, survey observes that ‘to maintain the quality of the product inside the packaging, glass container has contribute the highest assurance compare to any other kind of packaging’. Glass container is 100% recyclable and thus environment friendly and it is sustainable. About 60-75% respondent have given their opinion as ‘agree’ and ‘ strongly agree’ on this issue. Only a few 5-10% respondent opinion as ‘disagree’ and ‘ strongly disagree’ and about 10-15% respondent gave ‘neutral’ means they neither agree nor disagree with the statement. The survey also revealed that most of the people about 60-65% do not have proper knowledge on the impact of product quality due to the packaging of the foods and beverage.

## 5.5 Findings from other study

A survey of consumers in the US has found that 59% of consumers believe glass is the most environmentally friendly packaging material. Almost the same number, 60%, said glass was the material least likely to change the taste of food and drink. The survey was conducted as part of the Glass is Life campaign.


When asked which type of packaging they would choose for their favourite food or beverage, 69% chose glass – the highest of any material. This is despite glass only accounting for 10% of packaging across the world.

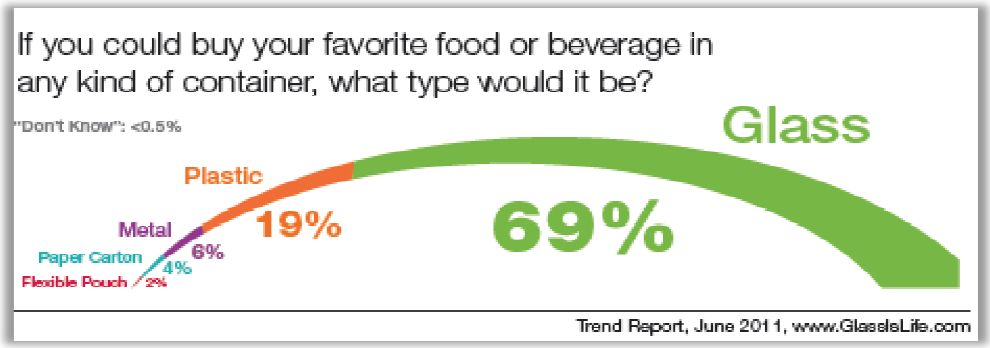



Chart: Glass Bottle Preference

The US survey reflects the findings of our European survey released in May which found that 75% of consumers prefer their food and drink to come in glass packaging.

Three quarters of all European consumers prefer glass as the packaging material for their food and drinks, according to a recent survey by the independent research consultancy InSites. And for good reasons, too, consumers believe that packaging preserves the taste of its contents; it is considered healthy and safe; and is environmentally friendly. The survey's findings are consistent with the current expanding consumer trend of wanting to live a healthy and sustainable lifestyle.

Recent developments, such as an increase in glass recycling and a recommendation from the European Commission for parents to use glass baby bottles as one of the healthiest options on the market, strengthen today's trends of living a healthy and sustainable lifestyle, responsible consumption and a resource efficient Europe. The study polled around 9,000 consumers in 17 countries across Europe about their perception of packaging materials.

A survey carried out by InSites and published in May 2011 found that glass remains the consumers' preference for food and drinks. In the UK alone, the survey found that 64% of respondents choose glass packaging for a special occasion beverage. When asked why they prefer glass, 38% of UK consumers mentioned that glass preserves the taste of the food or drink better than other materials. Longevity of the packaged product was cited as a reason for choosing glass by 30% of UK consumers, while 29% mentioned that their favourite brands were in glass packaging.

## 5.6 Prospect of glass container industry in Bangladesh

**1.** Glass is commonly used in pharmaceutical packaging because it possesses superior protective qualities. In Bangladesh, the pharmaceutical industries are currently playing a vital role in contributing to the GDP. Medicine export is increasing day by day. The market is expanding now in Europe and in North American countries, where quality of the medicine and the environmental sustainability is the main issue and they are already accepted the glass container is the main and safest packaging material for the liquid medicine, food and beverage. To comply with the standard of those countries, the local pharmaceuticals will need to maintain the quality of the packaging and this will increase the use of glass containers in near future. Moreover, in Bangladesh the Ayurvedic and Homeo medicine is used in large volume and the use of Harbal medicine is increasing as people are being more health conscious than earlier. Both these sectors are using their packaging mostly in glass container and hence the use of glass container will increase in future.

**2.** The packaging in glass container is economical compare to other form of packaging like PET. Despite many other disadvantages in PET, it is also more costly than the glass container.

3. As per the FDA, glass is nonporous and impermeable, so there are no interactions between glass packaging and products to affect the flavor of food and beverages. No nasty after taste—ever.

a. Glass has an almost zero rate of chemical interaction, ensuring that the products inside a glass bottle keep their strength, aroma, and flavor.

b. Glass can be specified to absorb damaging ultraviolet light, ensuring product purity and taste. In fact, glass has an inherently longer shelf life than any packaging material.

c. Glass does not deteriorate, corrode, stain or fade, so products inside a glass container remain as fresh as when they were bottled.

4. Safe and Light-Weight : Today's glass containers are more than 40% lighter than they were 20 years ago. And light weighting efforts continue throughout the industry. Glass packaging can handle vacuum or high-pressure sealing, safeguarding against moisture and oxygen invasions. This protects food and beverages from spoilage and bacteria. Glass containers are impermeable, air-tight, and transparent. You can see the freshness of food and beverages.

5. Unmatched Environmental Benefits **:** Recycling glass containers provides for unmatched production efficiencies and significant environmental benefits:

   a. Saves raw materials — Over a ton of natural resources are conserved for every ton of glass recycled, including 1,300 pounds of sand, 410 pounds of soda ash, 380 pounds of limestone, and 160 pounds of feldspar.

   b. Lessens the demand for energy — Energy costs drop about 2-3% for every 10% cullet used in the manufacturing process.

   c. Cuts CO2 emissions — For every six tons of recycled container glass used, a ton of carbon dioxide, a greenhouse gas, is reduced. A relative 10% increase in cullet reduces particulates by 8%, nitrogen oxide by 4%, and sulfur oxides by 10%.

   d. Extends furnace life — Including cullet in the manufacturing mix makes it less corrosive and lowers the melting temperature (from 2800 degrees F. to 2600 degrees F.), prolonging furnace life.

   e. No processing by-products — Glass recycling is a closed-loop system, creating no additional waste or by-products.

Considering above benefits and the primary survey responses it can be said that the prospect of glass container is still in very good. Though currently there are

some alternative packaging is used by some pharmaceuticals and food processing companies, they have to get back to the glass packaging in near future due to the necessity of the maintain quality of the food, sustainable environment and overall the requirement of the exporting country.

## 5.7 Challenges of glass container industry in Bangladesh

The main challenge so the glass container industry in Bangladesh is the alternative uses of packaging material. It is found that the some pharmaceutical companies and food processing companies are using the alternative packages like PET and other form of plastic packages for the processing of liquid food and beverages, which is completely healthy and unhygienic. Few examples are given below:

1. Hot filling: Recent reports suggest that endocrine disruptors leach into the contents of bottles made from polyethylene terephthalate (PET), which is the main ingredient in most clear plastic containers used for beverages and condiments worldwide. According to Leonard Sax, MD, PhD, temperature appears to influence the leaching both of phthalates and of antimony from PET, with greater leaching at higher temperatures. PET is a semi-crystalline thermoplastic, which softens at approx. 76℃ (what is called “Glass Transition”). Thus, one must address how products may interact with PET packaging material during the hot-filling process. Since some products are packed in a plastic container before high-pressure, heat processing - which can reach boiling hot temperatures of 100 degrees Celsius - certain products have already reached elevated temperatures in contact with the container in the filling process that far exceed temperatures found when microwaving foods. The plastic and the product contained within may also remain at elevated temperatures for some time after filling. This may alter the packaging structure and consequently its mechanical and mass transfer (barrier and migration) properties as well as posing a potential health concern.

2. **Safety:** PET is **not inert** like glass and therefore has potential to interact chemically with the product and make it unsafe for the consumer. Components of plastic or material used in manufacturing process migrate into contents like traces of acetaldehyde or PET oligomer. The main chemical found in polycarbonate plastic, called **bisphenol A (BPA)**, causes neural and

behavioral effects in fetuses, infants, and children. BPA works as an **endocrine disruptor** and interferes with natural hormone balance and can cause:

a. Early puberty in both male and female
b. Altered prostrate and urinary development in infant males
c. Variety of cancers
d. PET bottles also contain additives such as **phthalates** (DMP, DEHP, etc) which are a group of chemicals used to make toys, detergents, lubrication oils, etc. and also act as endocrine disruptors and cause abdominal obesity and insulin resistance which leads to Type 2 diabetes and cardiovascular disease.

3. Lack of Awareness of the mass people: Lack of awareness is another most important challenge of the glass container industry. People still do not have proper knowledge of the benefit of glass bottles and the harmfulness of PET or other packaging materials.

4. Increasing socio-economic development coupled with rapid urbanization has resulted in significant growth in the manufacture and importation of packaged products. This has led to a massive increase in the generation of post consumer waste and environmental pollution. For instance, there has been an increasing use of plastic packaging for consumer goods over the last two decades in Bangladesh and this waste is creating considerable environmental challenge. As per estimates household packaging waste generated in Bangladesh consists of 5% paper, 2.6% metals, 2% glass and 4% plastic. The bulk of this is disposed of at refuse dumps where they are burnt, left to degrade or deposited in landfills. Unfortunately poor management of plastic waste has resulted in a lot of litter resulting in a bad image for plastics as packaging material. Uncontrolled littering has drawn attention of government to introduce legislation to control the impact of waste on the environment.

# CHAPTER 6

# CONCLUSIONS AND RECOMMENDATIONS

## 6.1 Conclusion

In conclusion, it can be said that glass container has not received its fair share in the Bangladesh market and in the minds of its consumers. Glass container has so many advantages over its competitors but it seems that the consumers are not aware of them. This is one of the major reasons for the lower consumption of glass containers in Bangladesh as compared to its competitors. Glass has a huge potential for growth in Bangladesh. The growth will far surpass the production capacity. But the potential has to be tapped by informing the consumers about why glass container is good for them and for the Earth. A huge potential exists in the area of solar application.

## 6.1 Recommendations

1. The use of glass container can be increased (and needs to be increased in light of its environmental sustainability) by imparting relevant information to the consumers.
2. The different types of glass container available, theirs individual characteristics and benefits provided have to be made known.
3. Applications of glass container in the pharmaceutical sector, for energy saving, etc, have to be widely incorporated in their marketing plan. The industry has to move on from personal selling to advertising to consumers of its products.
4. The policies and rules may have to be amended to compel the companies to use the glass container for the safeguard of the mankind as well as for the sustainable world.

# *Appendix-A: Survey Questionnaire*

**Title of Dissertation: Prospect and Challenges of Glass Container Industry in Bangladesh: An Empirical Study on The Bengal Glass Works Ltd**

Name: Zakir Hossain, Supply Chain Manager | The Bengal Glass Works Ltd. | Novo Tower (10th Floor), 270 Tejgaon I/A, Dhaka-1208, Bangladesh

[This survey questionnaire prepared to perform an academic research. It is a partial requirement for the fulfillment of the Degree of "Masters in Procurement and Supply Management" at the Bangladesh Institute of Governance and Development, BRAC University. Your honest response is valuable for the research work. I do assure that the information given by you will be kept confidential and will be used only for the academic purpose.]

**Please fill the questionnaire:**

## Section A: General Information

1. Name : _____ 2. Age: _____

3. Profession : _____ 4. Gender: ☐ Male ☐ Female

5. Education : ☐ Basic / ☐ Last Degree : _____

6. Please mention your responsibility in relation to the glass container industry (please identify right that mostly match with you).

   a. You are the direct user of the glass container. ☐

   b. You know the benefit of using glass container. ☐

   c. You are directly involve with the business of glass container industry ☐

   d. You are the trader/manufacturer of substitute products of glass container ☐

   e. You are the glass container manufacturer ☐

   f. Others (please specify)……

**7.** Please tick (√) mark to the most appropriate option for the following judgmental questions regarding impact of Glass Container/Bottle in the packaging of Liquid Medicine, Food and Beverage.

(Scale: Storngly Agree: 5, Agree: 4, Neutral: 3, Disagree: 2, Strongly Disagree': 1)

| Sl no | Questions | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|---|
| **Impact on Quality** | | | | | | |
| i) | Glass is the only packaging material accepted worldwide as "generally recognized as safe (GRAS)". How much do you agree with this statement ? | ☐ | ☐ | ☐ | ☐ | ☐ |
| ii) | Glass container protects the inner product from any effiect of Ultra Violet Ray. How much do you agree on the this ? | ☐ | ☐ | ☐ | ☐ | ☐ |
| iii) | Glass bottle is inert and therefore has no potential to interact chemically with the medicine or other liquid food or beverage. How much do you believe this ? | ☐ | ☐ | ☐ | ☐ | ☐ |
| iv) | Glass has no chemical interaction, ensuring that the products inside a glass bottle keep their strength, aroma, and flavor. How much do you agree with this statement ? | ☐ | ☐ | ☐ | ☐ | ☐ |
| v). | Glass Container is environment friendly. How much does this impact on green environment? | ☐ | ☐ | ☐ | ☐ | ☐ |
| vi) | Glass does not deteriorate, corrode, stain or fade, so products inside a glass container remain as fresh as when they were bottled. What is | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | |
|---|---|---|---|---|---|---|
| | your opinion ? | | | | | |
| vii) | Glass packaging gives people confidence that the product is pure . | ☐ | ☐ | ☐ | ☐ | ☐ |
| viii) | Glass container is 100% recyclable. What is your opinion on above statement ? | ☐ | ☐ | ☐ | ☐ | ☐ |
| ix) | Glass Container/Bottle is the safest packaging materials for all kind of liquid medicine, food and beverage. How much do you agree with this statement ? | ☐ | ☐ | ☐ | ☐ | ☐ |
| x) | Glass does not emit odor, so keep the product fresh in the long run. What do you think? | ☐ | ☐ | ☐ | ☐ | ☐ |
| xi) | The shelf life of product in glass container is higher than any other packaging. How much do you agree ? | ☐ | ☐ | ☐ | ☐ | ☐ |
| xii) | Components of plastic material used in manufacturing process migrate contents into the product. Do you agree ? | ☐ | ☐ | ☐ | ☐ | ☐ |
| xiii) | Glass bottles is 100% recyclable, so there is no effect on environment pollution. Do you agree ? | ☐ | ☐ | ☐ | ☐ | ☐ |
| xiv) | Do you prefer glass bottle as a packaging when you buy any of your favorite food or beverage?? | ☐ | ☐ | ☐ | ☐ | ☐ |
| xv) | How much do you think that mass people of Bangladesh have proper knowledge on the quality of the packaging and their impact ? | ☐ | ☐ | ☐ | ☐ | ☐ |

Thanks for your cooperation

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- *US Food and Drug Administration Web Site (www.fda.gov/Safety/Recalls)*