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GENERAL REVIEW

OF THE

GLASS INDUSTRY

PAKISTAN

SANDERSON & PORTER, INC.

GENERAL REVIEW OF THE GLASS INDUSTRY

PAKISTAN

Submitted to the
FEDERAL CHEMICAL & CERAMICS CORPORATION, LTD.
Karachi, Pakistan

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

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CONTENTS

	Page
INTRODUCTION	1
EXECUTIVE SUMMARY	5
Markets	5
Raw Materials	5
Production Capacity and Demand	6
Increases in Production Capacities	6
STUDY OVERVIEW / RECOMMENDATIONS	8
Raw Materials	8
Glass Imports/Manufacturing	8
Production Statistics	9
Quality	10
Coordination of Resources and Technical Know-how	10
GLASS PRODUCTS AND THEIR IMPORTANCE	12
RAW MATERIALS	15
Raw Material Resources in Pakistan	18
Raw Material Resources: Discussion	19
Raw Material Cost	20
PRODUCTION CAPACITIES	22
Containers	23
Sheet Glass	23
Bulbs and Tubes for Lamps	25
Ampoules and Vials	25

CONTENTS (continued)

	Page
GLASS IMPORTS	27
General Net Glass Import Comparison	28
Net Import Data for Glass	30
Net Import Data: Other Articles and Materials	36

EXHIBITS

A -	Literature References	41

LIST OF TABLES

No.	Title	Page
1	Summary of Estimated Glass Production Capacities	26
2	General Net Glass Import Comparison	29
3	Net Import Data for Glass	31
4	Classified Net Glass Import Data	34
5	Commodity Grouping into Categories	35
6	Net Import Data: Other Articles and Materials	37
7	Explanatory Notes	40

INTRODUCTION

Since 1960-61, the glass industry in Pakistan has been struggling with problems attendant to reorganization, growth and modernization of its processes and equipment. Evidence of this is available from the work done by the Pakistan Council of Scientific and Industrial Research Laboratories (PCSIR) especially from its involvement towards establishing a National Institute of Glass and Ceramics Technology (NIGACT).

In an effort to further the work of the industry in general, the Federal Chemical & Ceramics Corporation Ltd. (FCCCL) in January, 1975 entered into an agreement with Sanderson & Porter, Inc., of New York to undertake a "feasibility study for a sheet glass manufacturing facility" so as to determine the technical and economic viability of such a venture.

Actual field work commenced in June, 1975 and early investigations by FCCCL's Glass & Ceramics Division and the Sanderson and Porter project team uncovered developments which forcibly modified the essence of the project. First, new information became available from the Research Department of the Pakistan Industrial Credit and Investment Corporation Limited (PICIC) through its "A Report on the Glass Industry in Pakistan," issued during February, 1975. Second, updated glass imports data from the Pakistan Central Statistics Office (CSO) showed significant decreases in Sheet Glass imports through 1973-1974. Third, the two existing sheet glass manufacturers were undergoing a modernization program which would increase their combined capacity by twenty-five percent. Thus, it was apparent--almost immediately and beyond <u>any question of doubt</u>--that an economic justification for a new flat glass plant was not possible. This was promptly reported to the executives of Federal Chemical & Ceramics Corp. Ltd. at a meeting held on June 14, 1975 and attended by Messrs. Mushtaq Ahmad and Ashraf Hassan at the FCCCL offices in the NSC building. At that time, it was decided that the scope of the project would be amended and that Sanderson & Porter, Inc., instead was to undertake a general status review of the glass industry.

The revision was intended to provide FCCCL with an independent assessment of the industry and point out: (a) opportunities for expansion and (b) procedures to streamline information and activities in the industry so as to provide the tools to improve the technology and contribute to the economic benefit of Pakistan in this area.

Verbal approval was granted to initiate the work on this basis on June 21, 1975 by Messrs. Ahmad and Hassan. The agreement to the verbal revisions to the contract by Mr. Mahmoud Ahmad were conveyed through Mushtaq Ahmad. Therefore this report must be considered in the framework of the revised format and not in the terms of the original contract specifications.

To initiate the new work program, visits were scheduled--and were made--to the following manufacturing plants.

Corning Glass Pakistan Ltd.
Korangi Industrial Area
Karachi

Manufacturers of glass tubing by Danner process. One furnace and one production line. Produces soda-lime and neutral glasses. Also, reprocesses tubing into ampoules and vials.

Industrial Glass, Hyderabad

One of the pioneer glass manufacturers in Pakistan. It manufactures containers, tableware and miscellaneous functional and decorative glassware in soda-lime glass. Operates three furnaces with multiple shops utilizing hand-blown, and semi-automatic pressing and blowing operations. It has a glass decorating department.

Glass Bangles Manufacturer, Hyderabad

Manufacturer of glass bangles in a modified soda-lime glass of low melting temperature and slow setting properties. Uses semi-automatic and automatic forming processes. Melts in several small day-tanks and one continuous furnace.

Manzoor Glass & Ceramics Ltd.

Manufacturer of glass containers in flint, green and amber soda-lime glasses. Full line from one ounce to one gallon capacity. Has three furnaces feeding automatic machines and hand shops. It is the second largest plant in Pakistan.

Murree Glass, Rawalpindi
Subsidiary of Brewers & Juice Bottlers

Manufacturer of glass containers in modern new plant. Uses a unit melter with an automatic machine and capacity for another in the future. First improved, semi-automatic, batch plant seen in Pakistan; almost ready to start operations.

Kawahja Sheet Glass, Hasanabdal

Manufacturer of sheet glass. Has two modern furnaces each feeding an automatic Fourcault machine. Recent additions have duplicated capacity, and should be able to make glass of better quality and sheet thickness. Excellent old batch plant operations. Has small hand shop available for specialties.

Pakglass Limited
(owners of Rashana Glass, Lahore)
Karachi

Manufacturer of glass containers. Has small unit melter feeding a small automatic machine. Recent change in ownership and management attempting to improve operations. The other plant at Lahore has hand and semi-automatic processes.

Philips Electric Industries of Pakistan Ltd.
Karachi

Manufacturer of glass tubing by Danner process and of bulbs for electric lamps in soda-lime and modified glasses. Has one unit melter feeding automatic machinery. Reprocessing is done to make electric bulbs and fluorescent tubes. Modern operations with good technical controls.

Elmpak Glass & Hyeson Bulb Factory
Karachi

Manufacturer of bulbs for electric lamps and glass containers in modified soda lime and soda-lime glass respectively. Has two small furnaces feeding an automatic bulb machine and semi-automatic container processes. Tableware is also made.

Contiguous to the glass manufacturing is the Hyeson bulb operation where a complete electric lamp is manufactured from component parts.

The Prince Glass Works Ltd.
Karachi

Manufacturer of sheet and rolled glass, glass containers, and general pressed glassware. Has five furnaces feeding eight automatic forming machines in addition to hand shops. Extensive modernization program is underway to improve operations from the automization of the batch plant to furnace design changes and forming machinery installations.

It should be noted that the reception and hospitality that was extended to our team during their visits was most cordial and gracious. Not once was an objection raised to our visual inspection. For this we are most appreciative and would like to extend our thanks to all the individuals at each plant who made this possible.

As is apparent, these factory inspections and interviews were an integral part of our data collection program. In addition, a concerted effort was made in all possible quarters to gather all pertinent data in order to enable us to establish a meaningful data base upon which we could conduct our analyses and structure our conclusions. However, basic and factual glass industry data such as production figures, product shipments, value of shipments, etc. simply was not made available in Pakistan. The manufacturers, the government corporations and the other statistical sources we repeatedly contacted were not able to produce the information we requested. As a result, the effectiveness and ultimate assistance this study and report was hoped to generate is hindered. Future demand projections and analysis and all forecasting is sorely affected by lack of such historic data. Nevertheless, it is felt that because of the experience and capabilities of the project team, the evaluations and observations contained in this report will provide an adequate guide upon which at least some initial decisions regarding the future role of the glass industry can be made.

Finally, a definite attempt has been made to reduce technical shop jargon, when possible; to circumvent the information which is considered unreliable; to dispel some erroneous beliefs which may affect decision-making processes; and to stress the enormous efforts which are necessary to channel the available human and material resources for successful and lasting achievements in the glass industry of Pakistan.

EXECUTIVE SUMMARY

A study to review the glass industry in Pakistan was conducted by Sanderson & Porter, Inc. of New York for the Federal Chemical & Ceramics Corporation, Ltd. (FCCCL) of Karachi, Pakistan under the auspices of a United States Agency for International Development loan.

This report is the result of that study and this summary capsulates the study team's findings as follows.

Markets

Currently, glass-related imports for the five major classifications cited in this report (i. e. Lighting Bulbs, Decorative and Household, Custom Jewelry, Laboratory and Scientific, and Optical Glass) are valued at about 30 million rupees per year. Of this total, we estimate between 15 and 20 million rupees are comprised of glass products with the remainder being appurtenances thereto essentially falling into the specialty product category.

These specialty items, on the surface at least, appear to possibly comprise sufficient volume to justify the construction of a new plant to produce specialty products. However, more exact import statistics to accurately classify the products are required prior to any decision in this regard.

As for the other general classifications of glass imports, excluding glass fibres, we can see absolutely no justification for new and separate manufacturing facilities. Also, imports of fibreglass do not indicate a sufficient volume to support even a minimum-sized plant of one ton/hour either at present or in the foreseeable future.

Imports of ampoules and vials have increased in value to over 7.2 million rupees in 1973-74. We estimate present values of such imports may be in the range of 9-10 million rupees. This volume, conceivably, could support a new facility provided these imports are verified to be the absolute value of the products reported in the import statistics.

Regardless of the domestic productive capability and governmental policy some amounts of glass imports, however small, will continue. Future import statistics for the specialty glasses therefore must be carefully correlated since they will reveal areas of potential possibilities for manufacture.

Raw Materials

One of the most important prerequisites which the glass industry must meet is that of establishing centrally located indigenous raw materials processing operations. There is an urgent need for such facilities that would guarantee a reasonably large stockpile of uniform composition and particle size.

The analysis of limestones, sand and feldspars as reported in the open files of the Pakistan Geologic Survey appear satisfactory. However, sufficient processed reserves must be available and modern equipment for crushing, screening and washing installed. This equipment is available locally. Also technical assistance to advise such an operation is available from the Pakistan Industrial Development Corporation (PIDC) and the PCSIR laboratories.

Production Capacity and Demand

Pakistan's production capacity for glass containers is estimated to be 120,000 tons/year. This is sufficient to satisfy present and near future demand.

Production capacity for sheet and rolled glass presently is evaluated to be about 36,000 tons/year for sheet and 9,000 tons/year for rolled glass. Imports have decreased from 1970-4 from 1278 tons to 349 tons/year, an insignificant amount. Sufficient capacity exists at present to supply the demand for flat glass products at least through 1980 and perhaps beyond, depending on the rate of increase in demand.

Production capacity at present can turn out 75 to 85 million pieces, bulbs and tubes for lamps per year. The manufacturing capacity exceeds the demand for these products and is expected to do so for many years.

The total capacity for production of ampoules and vials cannot be estimated at this time, since present machinery is used for the production of a multitude of products interchangeably.

Increases in Production Capacities

There are various methods that should be considered to increase the production capacities of the existing plants. This, in lieu of a new plant construction and its capital intensive requirements, would result in an overall increase of glass production capacity for Pakistan and allow the industry to keep in step with anticipated future demands.

1. Increasing operating efficiencies throughout the plants. This would include improving melting techniques to produce larger tonnages of better quality, increasing forming machine speeds, and reducing glass defects.

2. Enlarging the depth of the melting chamber by six to twelve inches increases a furnace's melting capacity by 20-25%, depending on individual circumstances. Depths of melting chambers in modern industry range from 24" to 60".

3. Enlarging the size of a melting furnace, at its present site, will increase its production capacity accordingly. In this manner one-machine furnaces can sometimes be converted into a two-machine unit, doubling its capabilities.

4. A combination of enlarging the size and depth of a furnace can in many cases convert the operation from one to three machines with corresponding forming and tonnage capabilities.

5. Finally, additional melting units can be added to existing plants to increase their tonnage output capacities. Also, the increased tonnages can be of different glass colors or types of glass and glassware.

All the plants we visited had ample land and facilities to take advantage of any or all of the above methods.

STUDY OVERVIEW /RECOMMENDATIONS

Raw Materials

As indicated earlier, the development of raw material processing operation is the primary area on which the industry must concentrate. Detailed investigations should be commissioned in this regard and could be accomplished with technical aid from PIDC and PCSIR. To initiate this study, present suppliers of indigenous raw materials should be contacted to determine the volumes of processing, material stockpiling, and shipping traffic which are occurring. Coordination with the requirements of the glass industry will determine the extent and sequence of final action to be taken in this basic supply task.

There is an urgent need to establish such processing facilities. Once such an operation goes "on stream" it would be the responsibility of the processor to maintain an adequate stockpile of materials of the required particle size for eventual distribution to the industry. This would thus provide both central raw material resources as well as base upon which the industry can grow.

Glass Imports/Manufacturing

More than half the import value of glass and glass-related articles falls within five classifications cited in this report. The combined import values in 1,000 rupees and its percentages of total imports are:

	70-71	71-72	72-73	73-74
Value:	26024	19454	20225	29650
Percentage:	47	59	72	67

Further examination of the groups included in each classification revealed that some articles were not purely glass but were included in total value as finished products. However, we estimate glass values alone would still remain within 15 to 20 million rupees per year. Also, although these classifications have to be considered as being part of the glass industry, in reality they comprise the specialty product grouping.

From the above import data, we feel an investment to undertake a comprehensive investigation to study the possibility of constructing a specialty product facility in Pakistan is justified. However, to accomplish this, complete and accurate data must be compiled--an effort that will take time.

Nevertheless, the effect such a new plant would have on foreign exchange and Pakistan's balance of payments could have a positive economic impact.

For the remaining classifications studied (excluding glass fibres) import data, existing facility locations and estimated production capacities indicate that at present there is no justification to recommend new manufacturing facilities. This also applies to Fiberglass which, although not manufactured in Pakistan, does not show a consumption volume to justify even a minimum economic production unit of approximately one ton per hour, i.e., 2,000 Cu. Ft. per hour.

A possible exception exists in the manufacturing of neutral glass tubing used largely in the local production of ampoules and vials. Imports for both have increased during two consecutive periods, totalling a value of 7.2 million rupees for 1973-1974. We feel, therefore, that a study should be made to determine the nature of imports for ampoules and vials and what quantities, if any, were packaged medical products. Also, imports of neutral glass tubing for local reworking should be ascertained. In this vein discussions should be held with Corning Glass of Pakistan Limited to establish actual production capacities as well as the Company's plans for present and future demands of neutral glass tubing. It must be taken into account though that soda-lime glass tubing is also manufactured and used in Pakistan. Therefore, the figures for both types of glasses must be considered. Action to be taken will depend on the investigation results.

Production Statistics

Still another area on which the FCCCL should concentrate is that of developing a coordinated plan to obtain essential quantitative manufacturing and market demand figures. This effort must be of a continuous nature and accomplished in cooperation with the Glass Manufacturers Association, individual manufacturers, commercial product users, and the proper governmental authorities such as the CSO.

Plant production capacities, glass product shipments, productive versus equipment idle time, equipment repairs, new construction changes, unfilled order schedules, market demand forecasts, imports of glass and production equipment, etc. must be compiled. This is data which can be cross-referenced for checking purposes and which can be analyzed for directing decision-making on behalf of the industry. Such factual data is the resource for investment justification and is needed by both private and government sectors. The availability of such accurate data is critical not only to the glass industry but to all industry in Pakistan. The cooperation of everyone is mandatory.

Quality

In matters pertaining to glass quality, there is a need to coordinate the enforcement of existing glass product standards issued by the Pakistan Standards Institute. Therefore, a review and updataing of existing glass quality standards must be effected before any positive steps can be taken in this area. It should be accomplished in coordination with the Pakistan Standards Institute and the PCSIR Laboratories so that the product specifications, the sampling requirements, and the enforcement procedures evolve into a master plan with all parts in agreement to facilitate regulatory purposes. The Glass Manufacturers Association and consumer representatives should be invited to participate and contribute towards final standard specifications. They should present their views for the plan and the enforcement procedures which will later require their cooperation. Enforcement of such quality standards will provide the necessary impetus for the glass houses to effect sound quality control practice.

Coordination of Resources and Technical Know-how

The implementation of all the foregoing would yield positive results towards the creation of an environment where participation, cooperation, and coordination would exist between the government sector and the glass manufacturing industry. In addition, and to strengthen its role, the FCCCL's Glass and Ceramics Division should revise its structure and create a separate--and permanent--position responsible only to the glass industry. The individual selected for this position should preferably be from the industry and have practical operating experience. His duties would include coordination within his own sphere of influence and with the various governmental corporations. Furthermore the related purchasing function should be under the control of this individual. Purchases for the glass industry--namely raw materials, refractories, instrumentation, and special machinery--are directly concerned with foreign exchange and are under imported materials procurement controls. As the largest glass plant in the country is comparatively small by international industry standards and all factories and shops are considered to be too small to receive individual attention from outside suppliers, something as simple as receiving informative literature about new materials and new industrial developments is difficult to obtain.

Such a service could be provided if these import purchase procedures were centralized and coordinated for the industry as a whole. Thus the benefits of economies of scale and uniformity of quality, as well as, negotiating strength for prices and delivery could be realized. At the same time, the purchasing data inputs would be established in such a way as to simplify future yearly forecasts, and to assure accuracy and conformity of such data.

Finally, technical know-how, as a primary ingredient, is necessary t bring the glass industry up-to-date on all its operations, equipment, and processes. This updating is basic to achieve the results expected in quality and productivity with the attendant improved economic return.

An approach in this regard would be for the FCCCL to once again take the initiative and provide the technical know-how to facilitate the cooperation and interest of the industry. Such action would:

a. set the stage to compile accurate production and economic data.

b. aid the FCCCL in the investigations and coordination of the recommendations given in this report.

c. determine the specific needs of each manufacturer and the investment required, if any, to improve his individual operations.

GLASS PRODUCTS AND THEIR IMPORTANCE

Glass is a very inert, stable, and inorganic material. That is why it is commonly said that glass does not react chemically with other materials, does not burn, nor can it be destroyed by time. The product is made by melting a number of compounds at high temperatures to obtain a final product which has the required properties at reasonable commercial costs.

Glass is a low-cost, highly processed product having very unique properties. Its raw material resource requirements are virtually limitless. Because of these properties, complex machinery and equipment requiring a large capital investment, is required for its processing.

As just stated, glass is a low-cost material. Its raw material processing to hot glass ready for the forming operation costs about $35 per ton for soda-lime glass which, incidentally, constitutes some 90 percent of all glass tonnage manufactured. This includes the container and sheet glass commercial markets. Here forming operations are an intricate process demanding fully automatic machinery for only through automatic operations can efficiency and productivity be achieved.

The importance of glass products may be considered from various aspects. However the two factors which are generally used are quantity produced and relative cost per unit weight for most volume products. In this regard, total world glass production is estimated at between 30 and 35 million metric tons per year. The dollar value per ton ranges from less than $200 to over $2,000 essentially as follows:

Sheet and container glass	less than $200/ton
Polished plate glass	$350-400/ton
Tumblers and tableware	$450-500/ton
Vacuum television tubes	$550/ton
Tubing, rod or continuous filament yarn	$750-1,500/ton
Specialty optical, hospital or scientific calibrated products	up to $2,500/ton

This wide range in costs is due generally to three factors: (1) cost is determined by its chemical composition which determines the amount and quality of raw materials; (2) by the complexity of the processing operations; and (3) by volume or rate of production.

Since containers and sheet glass constitute 90 percent of all glass manufactures, it has been a general practice for twenty-five years to simplify global nomenclature into three major categories: holloware, flatware, and specialty glasses.

World-wide, hollow glass predominates in tonnage. In the developed countries, its manufacture varies between 60 and 80 percent of total production, and its growth as an industry has been at a pace 3 to 5 times faster than population growth. Thus even the highly industrialized countries must look to greater applications for this glass category. Since holloware, indirectly is a consumer product, and as a result of the technological advances being made in the packaging and food processing industries, it is anticipated that a real growth potential will exist in this particular market area.

Flatware places a strong second, its segment of the total market varying between 10 and 40 percent of overall tonnages. Flatware production, in all probability will not overtake that of holloware because of the nature of its usage and replacement requirements. Flatware demand is based on new construction and new installations where the product may last a lifetime. Thus flatwares' industrial growth will continue its upward trend due to basic demand of housing for individuals, businesses and governments. Also, new technology and developments in architectural designs, in manufacturing processes, and in product applications are currently increasing demand beyond normal expectations. A recent example is the emergence of glass-ceramics in the form of flatware kitchen appliance top surfaces by Corning Glassworks. The development of this new application was realized in the last five years and has tremendous growth potential in future years.

The specialty glass category has changed radically in the last twenty-five years. It probably will continue in a state of flux for many more decades due to new technical innovations, mechanization, and general industrial growth throughout the world. Many specialty glass products, because of increased demands, have been segregated into their own industrial classifications while hundreds of new products and composite materials continuously are being added to the category. A number of such new classifications are cited in this report as their products are imported or manufactured in Pakistan. These include: Fiberglass; Tableware; Laboratory & Scientific; Optical; and Tubing & Pipe.

The pharmaceutical industry recognizes ampoules and vials as a separate entity although they can be regarded as being derivatives of Tubing & Pipe.

In fact, they can also be classified as containers. For example, ampoules and vials are containers and in some instances are still manufactured by automatic machinery. However the introduction of new technology has resulted in the emergence of neutral glass which, today, is used extensively by the pharmaceutical industry for its ampoules and vials. Thus, it is a matter of individual interpretation to decide into what classification ampoules and vials may fall.

Essentially there is not a universal definition for the specialty glass category. New technology has enlarged the specialty field to a point beyond reasonable enumeration of products or product applications. As each new advance and/or product is made it must become a subject of individual discussion, interpretation, application and classification.

RAW MATERIALS

The compounds which have the ability to form glasses and which constitute a large percentage of the final product are the oxides of silica, boron, germanium, and phosphorus. These cover a predominant bulk of the compositions and give the characteristics of the vitreous state. In this report we are concerned with only the one that is common, the one which probably accounts for over 95 percent of all commercial volume glasses. This is silicon dioxide, or silica sand.

Sand is in plentiful abundance--almost limitless--everywhere in the globe. Sand constitutes 70 to 75 percent of the weight of glass. The remainder stems from combinations of other inputted materials which are necessary to manufacture a product which is more flexible and acceptable for our uses and to our needs.

Sand by itself melts into a product known as fused-silica at temperatures over 3,100°F (1,700°C). However, it is economically not feasible to produce glass from sand alone for commercial operations. To make sand into a commercially acceptable glass for tableware, bottles, windows and other commonly known articles, other materials must be also introduced into the process. For example, in order to lower sand-dissolving temperatures (and thereby lower costs) the addition of very corrosive compounds known as alkali oxides is required. These oxides of sodium and potassium are not a natural raw material resource but must be manufactured by the chemical industry as carbonates. The largest volume product thus produced is sodium carbonate, commonly known as soda ash. Soda ash reacts with sand to form sodium silicate, an extensive industrial commodity which is an adhesive and an important chemical intermediary for other manufacturing processes.

A true stable glass is formed through the addition of alkaline earths such as calcium and magnesium oxides. These compounds are insoluble materials and are natural resources found in the form of carbonates of calcium and magnesium. They are commonly referred to as calcite and dolomite limestones, with the latter being a mixture of calcium and magnesium carbonates.

Sand, soda ash, and limestones are the basic materials that will produce a basic resistant soda-lime-silica glass which can be commercially melted. The proportions in current use are approximately 72-74% sand, 14-16% soda ash, and 10-12% limestones. However, with the emergence of industrial mechanization and automation, the typical basic glass did not possess enough flexibility for the forming processes nor enough sophistication for the consumer market. Other special materials had to be added to the glass compositon and became basic for acceptable glass.

Alumina or aluminum oxide was added to increase glass resistance to attack from water in the atmosphere. This is called weathering chemical durability. The natural material most commonly used to provide this alumina is feldspar which contains approximately 18% alumina, 14% sodium oxide with the remainder being sand. Feldspar is compatible with the basic materials and is in natural abundance.

Other minerals and chemical compounds are used in small quantities to incorporate cetain desirable qualities. These will vary according to the glass product or the manufacturing process. Some of these include barytes and other sulphates, borax, lead compounds, fluorspars, antimony compounds, etc., to name a few used in the common glasses of high volume and general commercial applications.

The materials used in minute quantities in almost all glasses are colorants and decolorizers. The colorant group includes those elements which generally have highly colored chemical compounds and stem from colored mineral sources. They include the oxides of iron, nickel, cobalt, manganese, chromium, copper, and almost all other materials containing transition elements. Most of these colorant elements have two or more states of oxidation with the color produced being highly dependent on the oxidation-reduction conditions of the glass.

Colorants in glass normally exist in a solution state but materials such as gold and silver can exist as metals in colloidal particles. The most common colloidal color is the gold ruby; the most common oxide color is the green iron. This is due to the mixture of the blue from the lower oxide and the yellow from its higher oxide. Thus, a single composition of glass colored by iron may vary from a distinct clear blue, through a green, to a distinct topaz yellow; the difference stemming from the state of oxidation.

Decolorizers are ingredients used to hide faint tints of color imparted to the glass through impurities in the raw materials, mainly iron, as well as other contaminations, and which habitually enter operations through the melting cycle. The main agents used for this purpose are selenium and cobalt oxides. As a result of the pink color introduced by selenium and the blue of cobalt it is usually possible to blend a final neutral gray color that is considered colorless for most practical purposes.

The state of oxidation-reduction of the glass which affects color must be maintained in proper balance. This is a tedious and delicate operation. To aid in maintaining this balance, therefore, a number of elements and compounds used along with other batch materials must also be interjected.

To oxidize glass, the common materials utilized are sodium nitrate and arsenic. To reduce the glass, carbon or charcoal, sulphur, and silicon are ordinarily used. Another modifier of the oxidation balance is the type of fires used in the furnace. Fire conditions have been known to change the color of the glass by disturbing the oxidation-reduction balance of the batch and offsetting the chemical elements used for that purpose.

Although large numbers of elements or compounds are used as (1) special materials for desired glass properties, (2) for colorants and decolorizers, (3) and as aids to maintain required oxidation-reduction balances, the total weight of all these materials usually does not comprise more than one percent of the glass composition.

Finally, our attention is drawn to cullet. This is the broken glass which is either returned from factory operations or purchased from outside suppliers. It is not considered a raw material. However, it is an essential part of batch formulations with definite and consequential effects on glass melting operations. Cullet, of the proper size, will aid the batch melting rate as it liquifies faster than the surrounding batch components. Certain quantities of cullet then can be essential for rapid melting, particularly under heavy furnace loads.

The great bulk of commercial glasses are manufactured within comparatively close chemical compositions categorized as soda-lime-silica glass. As has been stated, this is a low-cost product with abundant raw materials available throughout the world. When reasonable consumer prices are in effect, production of this product is a commercially attractive operation. However, easy access to raw material resources is a prime consideration when contemplating establishment of manufacturing operation.

Glass melting, being a high temperature continuous chemical reaction, also requires that the raw material particles be of a good mixture and of approximately the same size. The mixture and size of particles is especially critical for rapid and efficient automatic processing operations. Both naturally available and manufactured materials must be processed to a reasonable and controlled range of particle size.

Crushing the natural rock inevitably produces dust and leaves particles which are too large for proper melting and product homogeneity. Both are detrimental and must be removed by screening before the raw material is acceptable for the glass industry. Proper particle size is critical but variations are tolerable within predetermined acceptable ranges.

Another important factor is uniformity in raw material chemical composition. Natural material deposits on the earth's crust are not homogeneous but contain layers, pockets, and lumps of various chemical concentrations and contaminations. The only known economical manner to overcome these variations is to mix large quantities of the mined material in order to approach, by law of averages, a uniformly distributed chemical composition.

In summary, then, the availability of minerals or chemicals with the necessary elements are not enough by themselves, to satisfy product requirements. Most materials found naturally contain impurities which may be detrimental to product quality or may affect manufacturing operations. These generally, though, can be removed by one or various operations to achieve a tolerable level.

Raw Material Resources in Pakistan

Good, indigenous basic raw materials are available in Pakistan. Sand, limestones, and feldspar which comprise 99% of the soda-lime-silica glasses are in abundant supply over most of the territory in all provinces and districts. Soda ash is presently being manufactured by Sind Alkalies Limited at Landhi, Karachi and Imperial Chemical Industries at Khewra, in the Salt Range. In addition, there are also abundant supplies of other minerals which may be made usable as minor glass ingredients in the future. These include barytes, chromite, fluorspar, and gypsum.

Prior to our study there had been a vast amount of work involving sampling, mineral deposit evaluation, chemical analyzing, and sample processing by the PIDC, GSP, and PCSIR. Therefore it will serve no purpose to repeat that which is already well documented to prove, once more, that the materials are abundant and of good chemical composition. However, we feel some comments are necessary to differentiate scientific evaluation from practical glassmaking and bulk material processing for the industry.

Following is a listing of areas where each of the raw materials are found.

Sand: Daud Khel and Musa Khel in Mianwali, Dara Pezu in D.I. Khan, Jhungshahi and Thana Bulla Khan in Sind, Paniala in Salt Range, Munda Kucha in Hazara, and Lamakata-Bhangar Ghat in Sylhet District. There are other less promising or unevaluated areas.

Calcite limestone: Chidru, Marmandi, Skesar, Nammal, Daud Khel in the Salt Range; Surghund Hills near Hindubagh; Kotri, Thana Bulla Khan in the Punjab.

Dolomite limestone: is available in considerable quantities in the districts of Hazara, Jhelum, Mianwali, Haripur, Mardan, and Thatta.

Feldspar: both potash and soda spars in Raidawari, Dadar, along Khairabad road, all areas in the Hazara district.

Raw Material Resources: Discussion

Our investigation uncovered a widespread--and we would add erroneous--belief that poor or mediocre glass is being manufactured in Pakistan because of contaminants in the raw materials, mainly that of iron in the sand. First, even if there was too much iron in all sands, the resulting glass would appear to be either bluish, green or yellowish but in no way would its quality or other processing operation be affected. Second, good quality colorless flint glass has been observed in Pakistan, reportedly made with Daud Khel sand, proving it can be made with local sand.

It is true, however, that the raw material situation is in a grossly inadequate position to serve even the most primitive glass industry. Glassmakers should not be in the business of having to prepare their own raw materials. The industry requires ample supplies of dependable quality materials which must be reasonably uniform in chemical composition and grain particle size as explained before.

To illustrate the inadequacy of the raw material sector serving the needs of the glass industry we think it would be of value to recite the results of our visits to the various deposits areas. These trips were made to obtain composite samples for chemical analysis. We atarted by driving to Thana Bulla Khan and after arrival found that the sand deposits were situated some twenty-three miles into the mountains without available transportation to reach them.

The group in charge of the business office, which was also the truck tally checkpoint, gave us a portion of the only sample they had together with a copy of its chemical analysis made by the PCSIR in 1971.

Further attempts were made while visiting Lahore, Rawalpindi, and Peshawar with similar results. The fact became obvious that even after arrival at any site, we would not be able to obtain any composite samples. Piles of processed or semi-processed materials were not available as trucks were loaded as soon as material was removed from the ground. This was confirmed later while reviewing an extensive private report titled, "Investigation on Local Raw Materials for a Glass Factory, Internal Private Report, Karachi; Philips Electric Industries of Pakistan Limited, June 1971." This report was the result of some 3,000 miles of land travel throughout Pakistan.

The practical problems with raw materials can be summarized into three areas. First, when deposits are found and evaluated by scientific and technological procedures there is an approximate knowledge of the quantity and quality of material available. Regardless of how thorough the investigation or accuracy of the chemical analyses, they can only provide a guideline of average composition values for the deposits. They cannot certify each shipment or lot unless the analyses are repeated with fresh and adequate composite samples.

Second, it appears that mining is not being done in large enough quantities to accumulate reasonably uniform stocks of materials of similar chemical composition where one chemical analysis of a composite sample can certify the lot. Small lots, especially if delivered uncrushed or unscreened to the plant site (which is the general practice today) will naturally show composition variations which are most difficult to estimate and result in incorrect material weighing when preparing the batch formulas at each plant.

Third, material beneficiation frequently is required to remove detrimental impurities such as iron and clay in most sands. Also screening is necessary on all materials to secure an acceptable particle size distribution for continuous melting operations.

These problems could be solved by processing the raw materials at the mine site or another specific location for that particular purpose.

The glass plants, each in their own manner, are presently washing, crushing and partially screening with a variety of equipment which more or less suits their individual needs. They have no choice and no doubt it is causing them quality control and production problems.

In the past, this local and individual plant processing may have been economically viable due to the small amount of raw materials needed coupled with hand blowing and slow semi-automatic glass processing. Today the consumption of these same materials has increased sufficiently and the market quality demands changed to warrant an improvement. This is not a luxury but a requirement for any type of processing and a necessity for continuous melting and automatic glass manufacturing.

Raw Material Cost

The cost for materials varies because of the number of small suppliers and the small tonnage trucks used in transportation. Nevertheless, the latest quotation obtained by the FCCCL's Glass & Ceramics Division is as follows:

Washed Silica Sand	Rs. 225.00/ton
Soda Ash	1,800.00/ton
Dolomite (ground)	300.00/ton
Feldspar (ground)	600.00/ton

There could be up to 10% variation for delivery to plant site.

PRODUCTION CAPACITIES

Actual output of plants, however accurate, cannot be equated with capacity for production. Output usually includes the glassware packed and shipped without consideration of production time, operational efficiencies, and/or equipment not being properly utilized for production. Capacity defines the plant's maximum potential within a reasonable operating period per year, obtainable with efficient operation and product scheduling. Production capacity is only limited by equipment outputs.

An unavoidable discrepancy in units of measurements for glass production figures will always be evident. This is because raw material handling and glass melting use a weight measure such as tons, while glass forming operations and the rest of the glasshouse are more inclined to use marketing figures such as gross, square feet, number of pieces, as they are more meaningful for sales and consumer product usage. However it is not wise to express capacities in those marketing terms. Glass forming speeds and tonnage capacities change drastically if "gross" means twelve dozen bottles of one ounce capacity or an equal amount of one gallon capacity containers; if "square feet" means sheet glass of 2 mm. or 6 mm. thickness; if "pieces" mean just the number of items irrespective of their individual glass weight.

Glass plant production capacities are usually limited by the maximum furnace melting capabilities expressed in tons per day. Units in tons per year are also frequently used but they must be qualified either by a historical or by calculated operating days effective period. This period varies but is somewhere in the vicinity of 300 days out of the 365 days available in the year. The remaining days are an allowance for accumulated down-time, out of production or lost days which occur periodically because of holy-days, breakdowns of equipment, and various other reasons.

An important consideration in developing the "operating days effective period" factor is the different tonnage outputs explained above which result from the different sizes, speeds, and weights of the products manufactured. Another point to be considered would involve the yearly calculations of capacity. However this can usually be discounted by indicating glass tonnage losses as less operating days.

The basis used in the following calculations and comparative figures is 300 operating days per year. This is considered conservative for this type of industry. The daily melting capacity of the individual furnaces that is indicated was given by the manufacturers.

Containers

The production capacity for Pakistan is given in the PICIC report mentioned earlier as 80,000 tons/year. Of that total amount 35,500 tons per year are attributable to automatic machine production.

Using the basis of 300 operating days per year, and allowing for automatic machine production, the container producing plants visited, have the following calculated capacities (potential tons per year of available glass).

Pakglass:	20 tons/day Unit Melter	6,000
Murre Glass:	40 tons/day Unit Melter	12,000
Manzoor Glass:	3 25 tons/day Furnaces	22,500
Prince Glass:	35 & 55 tons/day Furnaces	27,000
		67,500
Less given PICIC auto.-machine production		35,500
Total excess over 80,000 tons/year		32,000
Total capacity (Preliminary calculation)		112,000

The above calculations do not include Prime Glass automatic container production which was reported (in 1965) to have a capacity of 15 tons/day in one of two furnaces for a Lynch bottle machine.

Also, the above calculation does not include any improvements or contemplated expansion by the manufacturers. For example, Indus Glass at Hyderabad was rebuilding an additional third furnace.

It is believed that a conservative estimate of Pakistan's glass container production capacity should not be less than 120,000 tons/year.

Sheet Glass

Figures for sheet glass as given in the PICIC report are: 24,000 tons/year. Prince Glass and Kawahja Glass together have a total of four sheet-glass, Fourcault design machines, and one rolled glass machine.

These machines are designed to pull 30 tons of glass per day at varying speeds according to sheet thickness. It should be remembered that

sheet glass furnaces are not likely to be built under-capacity. This was corroborated by observation of those running and those being rebuilt at increased capacity and with improved design.

Using the same basis of calculation, namely 300 operating days per year, the calculated capacities are as follows (tons per year):

Sheet Glass:	4 x 30 x 300	36,000
Rolled Glass:	1 x 30 x 300	9,000

In our effort to determine whether or not an additional sheet glass facility was needed in Pakistan we studied import data and made some demand projections through 1980. As indicated below, imports and local production averaged a 5.1% annual increase from 1970 through 1974. If we assume that the annual demand rate will double, even triple (a very liberal assumption, we might add) this annual increase, we show that even a 15% increase in demand through 1980 would not reach current production capacity (capacity of 36,000 tons vs. demand of 32,714). On this projection we could not see how an additional facility could be economically justifiable.

YEAR	PRODUCTION[a]	IMPORTS[b]	CONSUMPTION
'70-'71	9,963	1,278	11,241
'71-'72	9,410	493	9,903
'72-'73	12,022	404	12,426
'73-'74	13,794	349	14,143
CALCULATED ANNUAL DEMAND		10%	15%
	'74-'75	15,557	16,264
	'75-'76	17,113	18,704
	'76-'77	18,824	21,510
	'77-'78	20,707	24,736
	'78-'79	22,777	28,447
	'79-'80	25,055	32,714

(a) PICIC "A Report on the Glass Industry," February, 1975.

(b) Foreign Trade Statistics of Pakistan, Statistical Division Ministry of Finance, Planning and Development

Bulbs and Tubes for Lamps

In this area, correlation regarding quantities of final products is much closer and is reported in million pieces per year units. This final production correlation is between the quantities stated by the manufacturers during our visits and those given by PICIC's report cited earlier. However, some discrepancies still exist between furnace melting capacities and actual production figures used to estimate yearly production capacities.

Combined production figures for bulbs were stated by the manufacturers to be 40 million pieces per year--15 million for Elmpak and 25 million for Philips--compared to 37.2 million reported by PICIC.

Later, PICIC's report stated production capacity for Elmpak as being 25 million pieces per year. This would bring total capacity to 50 million pieces per year. However, the melting capacity of Elmpak is 5 tons per day which, on a 300 days basis, results in a total of 1,500 tons per year. This is almost four times the 400 tons of glass that is required to manufacture 15 million pieces and would place the capacity of Elmpak, alone, at 50-60 million pieces.

If we consider that Philips manufactures bulbs on a part-time basis (because it also makes glass tubing on the same furnace) a conservative estimate of the total production capacity for bulbs would lie somewhere between 75 and 85 million pieces per year. These estimated capacities include the assumptions that Elmpak manufacture bulbs on a full-time basis and Philips continue on a part-time basis.

Tubes for electrical lamps are manufactured mainly by Philips Glass at a stated capacity of 6 million pieces of TL tubes per year. Production was reported by PICIC at 1.6 million pieces. Therefore, capacity appears ample for this market for the foreseeable future.

Ampoules and Vials

Before discussing production capacities for ampoules and vials we feel an explanation is necessary to dispel a very erroneous belief in the type of glass used for the manufacturing of these products.

For some reason some people consider neutral glass satisfactory and soda-lime glass unsatisfactory for the manufacture of ampoules and vials. There is no such thing. Both are soda-lime glasses and of very good quality for most chemical and pharmaceutical product's requirements. All soda-lime glasses have the problem of releasing the sodium ions in their composition. This is the reason feldspar is added to the batch formula to make the glass more durable against weathering by moisture.

Some pharmaceutical products used for human consumption cannot tolerate this reaction or contamination either temporarily or over long periods of storage in the glass ampoules and vials. Neutral glass, a modified soda-lime glass that passes required tests of sodium ions release or leaching as called in the trade, was developed to help these products in particular and to minimize the amount of reaction or contamination. It is a better glass only in that respect but also more expensive and thus used only as required and not on all chemical packaging.

Pakistan's production capacity for both soda-lime and neutral glasses appears to be adequate. Corning Glass and Philips Glass both manufacture soda-lime glass tubing for production of ampoules and vials as well as other uses. Corning Glass also manufactures neutral glass and soda-lime tubing for the necessary market requirements for these glasses. Prince Glass also manufactures ampoules and vials using the equipment and processes of its container operations. Nevertheless, value of imports in these categories totalled over 7 million rupees during 1973-1974, and further investigations are necessary to clarify the apparent discrepancy between local production capabilities and the nature of imports. At present the production capacity for the industry, in these categories, is impossible to calculate or be deduced from the available information. The two local sources of tubing manufacture on a part-time basis; imported tubing quantities are unknown; and local tubing processing may not be totally used for ampoules and vials.

Table 1

SUMMARY OF ESTIMATED GLASS PRODUCTION CAPACITIES

Quantities in tons/year (Basis: 300 operating days)

Containers	120,000
Sheet Glass	36,000
Rolled Flat Glass	9,000
Bulbs for Lamps	2,100
Tubing (all kinds)	4,200
TOTAL	171,300

These figures are estimates based on available information from the manufacturers visited and data given by FICIC's, "A Report on the Glass Industry in Pakistan."

Ampoules and vials tonnages are included in tubing.

The total figure does not include tableware, decorative ware, and miscellaneous glassware not included in statistical reports.

GLASS IMPORTS

Census statistics are a very unsatisfactory data base for the glass industry on both a world-wide and individual country basis. Containers are reported by grossage; flat glass by the case or by square surface area units; tableware, tubing, vials, and others are in number of pieces of undetermined size and weight; glass fiber is reported as mineral wool, insulation, etc.; some duplication between primary glass articles and reprocessed products also exists. Therefore, estimates and conversions are necessary to arrive at general figures which must then be categorized for a particular information requirement.

This report deals with Pakistan's glass industry in general. Such a broad scope, however, makes it difficult to tie the minor products and all processes into an all-encompassing picture. To avoid confusion, we had to establish a basic rationale to guide us in the conduct of our work. Although our choice may be considered arbitrary, because many other systems may arrive at similar conclusions, it is a rationale that has served us well in the past and also lent itself to the situations encountered in this study.

The following quotation from Foreign Trade Statistics of Pakistan, in their explanatory notes, indicates the basic reason for this rationale as well as the reason for selecting the commodity classification system that we used.

> "From July, 1960 data were compiled and classified on commodity Trade Classification which was based on Standard International Trade Classification (S.I.T.C. Original). Because of revision in S.I.T.C. Original, the commodity trade classification of Pakistan was also revised. This revised classification which was named P.S.T.C. (R) was introduced from July, 1963 and is in force with modifications and expansions at 6 digit level."

To be able to analyze the import data in the perspective of present and near future circumstances it was then necessary to standardize the value of the rupee at its present value because it underwent three changes during the period in question. The figures for 1973-1974 will reflect a 10% increase due to the last change in 1973.

Keeping this basis in mind, the data and charts included in this report reflect these modifications.

Except for glass tubing manufacturing, Pakistan's existing glass industry is apparently fulfilling the internal demands of the country. The real bulk of the foreign exchange expenditures on glass articles appears to be in those products which are not manufactured or reprocessed in Pakistan. There is no doubt, though, that government policies regulating and restricting glass commodity imports are also helping to reduce foreign exchange expenditures and will continue to do so in the future.

The above statements do not mean that importation will stop completely when pertinent processing operations are introduced into the country. There will always be, to varying degrees, a fringe area of specialty products whose demands will have to be fulfilled by imports. Examples of such specialty items are: certain mirrors, coated plate glass, and other products in small quantities for the flat glass sector; special mold containers and small quantities of packaged glass container products, i.e. perfumes and certain beverages; miscellaneous institutional tableware and various other small quantity specialty products of any category.

General Net Glass Import Comparison

Table 2 which follows provides a good historical view of Pakistan's glass imports showing the rate of imports from 1951 through 1964.

The tabulation depicts three separate periods which may have slight variations but do not affect the general trends being visualized. The first period (up to 1960) includes earthenware along with glassware as these apparently were not classified separately at the time.

Imports drop sharply for the first few years, and then with an occasional dip, rise fairly steadily to a peak during 1965-1966. Since this peak period there has been a steady decrease in imports. The trend lines have deviated only as a result of monetary re-evaluation. Also, it has become evident that there is a need to expand glass products' availability through local manufacturing. This would result in an expanded national economy and in reduction of foreign exchange expenditures from the present levels of 40-50 MM rupees/year. This becomes even more evident, when one realizes that a fairly diversified glass industry already exists in the country, an industry that could gear itself to realize these objectives.

Table 2

GENERAL NET GLASS IMPORT COMPARISON

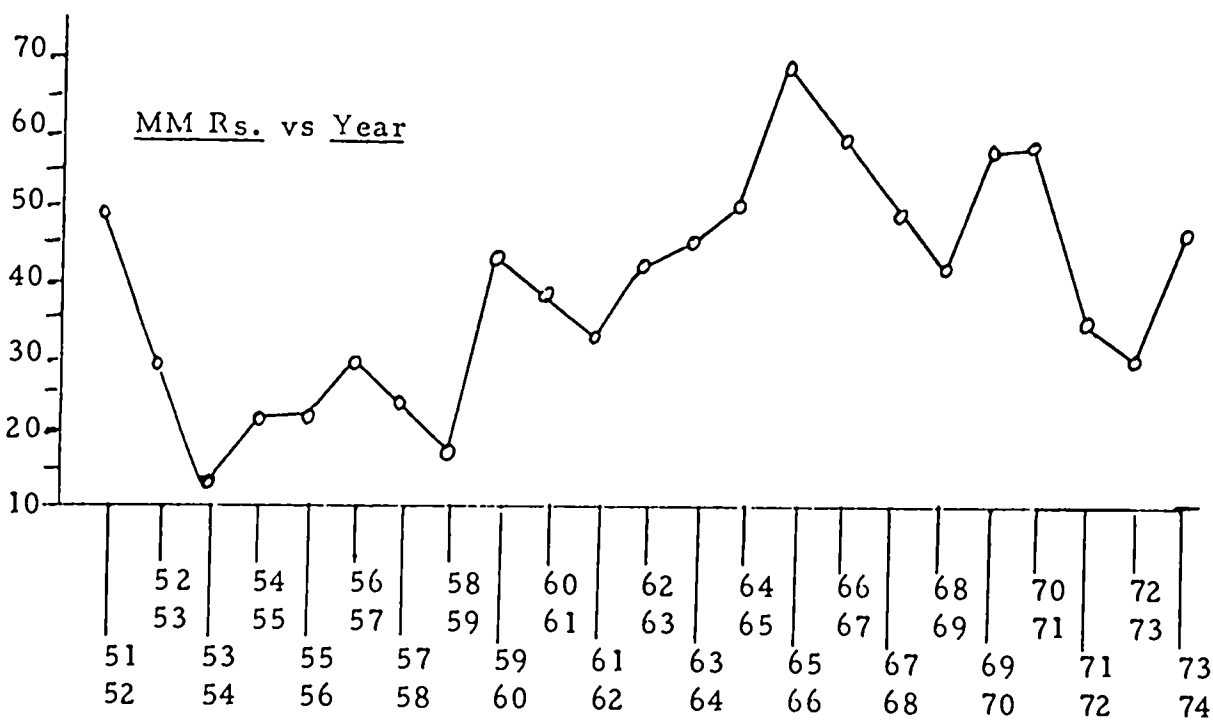
(Values in 1,000 Rupees of $10.10)

1951-1952	47612	1960-1961	36978	1970-1971	55644
1952-1953	29405	1961-1962	31432	1971-1972	32708
1953-1954	12078	1962-1963	40538	1972-1973	28045
1954-1955	20721	1963-1964	42818	1973-1974	43954
1955-1956	21690	1964-1965	47867		
1956-1957	28106	1965-1966	66055		
1957-1958	23000	1966-1967	56904		
1958-1959	15838	1967-1968	47233		
1959-1960	41700	1968-1969	40327		
		1969-1970	55231		

Source: 1951-1960 CSO Tables 18.04-18.05 pp. 402-405. Includes Glassware and Earthenware.

1960-1970 CSO Table 18.06 pp. 412-413. Glass & Glassware, excludes Earthenware. "25 Years of Pakistan in Statistics" 1947-1972 CSO Government of Pakistan, Karachi (1972).

1970-1974 "Foreign Trade Statistics of Pakistan" CSO (1970-1974).



Net Import Data for Glass

There are 73 commodity items classified as glass which are active in the foreign trade statistics of Pakistan; see Table 3. Four of the active commodities listed were not used in our data tabulations namely: 724101 Television sets complete; 724102 Parts of television; 729304 Tubes of wireless radios; and 729305 Tubes electric. This is because we considered the total value of the whole commodity was far greater than the glass value portion of the total. This would cause an aberration of category values in this report.

Television glass components, for example, form their own category in today's market and many glass plants are entirely devoted to their manufacture. It has grown, in the developed countries, to the point where it has become a separate section of the glass industry.

The classification of commodities into categories is most important both for grouping of items as well as for comparative purposes. The number and type of categories we ultimately selected is but one of many combinations that were possibilities. In developing this selection we started by following the industry's existing glass forming processes, followed by the best combination of the general use of the product and the final market distribution.

Twelve categories (Tables 4 and 5) finally emerged which suited this study and correlate closely with the general glass industry sectors.

Sensible judgment must be applied in discussing the first two categories--lighting bulbs and decorative & household--as their total values should be reduced proportionally by the non-glass value of many items included. The groups were selected because, in the future, it will be possible to make the assemblies in Pakistan in much the same manner as lamp bulbs are made today.

In the case of ampoules and vials it was observed that the total values of each item were large enough to be included as individual categories. This was reinforced by the fact that the pharmaceutical industry also recognizes them individually. Otherwise they would have been included in a general tubing and pipe category.

Table 3

NET IMPORT DATA FOR GLASS

(Quantities in Units Given; Values in 1,000 Rupees of $10.10)
(Explanatory Notes at End of Data)

CODE	COMMODITIES	UNITS	'70-'71 QUANT*	'70-'71 VALUE	'71-'72 QUANT*	'71-'72 VALUE	'72-'73 QUANT.	'72-'73 VALUE	'73-'74 QUANT.	'73-'74 VALUE
651802	Yarn of Glass Fiber	Lbs	5539	79	--	4	600	6	--	471
664101	Enamel Glass	Cwt	1894	576	2224	620	1756	547	934	976
664102	Glass Unworked	Cwt	5285	1499	4212	1453	2710	986	250	1845
664111	Glass Waste	Cwt	--	52	588	169	--	--	(58)	(14)
664200	Optical Glass Elements	Cwt	823	806	186	448	326	503	895	1499
664300	Drawn or Blown Gls Unworked	Cwt	1265	137	--	--	--	--	--	--
664400	Rolled Drawn Gls Unworked	Cwt	1976	137	1654	166	--	--	--	475
664500	Cast or Rolled Gls Unworked	Cwt	2066	143	1078	146	48	26	268	116
664600	Brick Tiles etc. of Glass	Cwt	888	220	560	420	79	73	200	-0-
664700	Safety Glass	Cwt	6774	2350	2267	1014	1054	387	335	1458
664801	Glass Plate Coated	Cwt	568	97	431	38	1386	264	414	83
664802	Glass Sheet Coated	Cwt	7042	942	2537	618	4442	682	2818	307
664803	Glass Mirrors	Cwt	7882	1363	2420	631	1437	169	1332	439
664911	Glass Plate Worked	Cwt	270	23	NA	NA	(72)	-0-	--	--
664912	Glass Sheet Worked	Cwt	1774	115	651	19	751	128	2246	(480)
664919	Gls. Rolled Drwn or Blwn NS	Cwt	281	128	--	71	--	--	403	32
664921	Envelope of Elec. Lamp etc.	Cwt	865	343	121	94	57	90	26	33
664931	Glass Wool	Cwt	994	478	161	102	283	220	291	262
664939	Glass Fibres NS	Cwt	7993	3325	1778	1902	239	327	434	449

Table 3 (Continued)

CODE	COMMODITIES	UNITS	'70-71 QUANT*	'70-71 VALUE	'71-'72 QUANT*	'71-'72 VALUE	'72-'73 QUANT.	'72-'73 VALUE	'73-74 QUANT.	'73-74 VALUE
665101	Bottles for Perfumery	Grs	631	33	NA	NA	173	-0-	44016	417
665102	Bottles NS	Grs	234792	9498	100788	4454	40968	1220	(6148)	1645
665103	Carboys	Grs	NA	NA	NA	NA	--	--	11	10
665104	Flasks	Grs	(25)	13	NA	NA	21	16	(425)	(722)
665105	Jars	Grs	(396)	29	NA	NA	4157	98	(1104)	4
665106	Phials (Vials)	Grs	217293	3307	158336	749	29690	1461	148635	2863
665107	Stoppers Glass	Grs	702	79	1284	12	--	--	111	32
665109	Gls Containers Commerc. NS	Grs	1789	182	1066	131	1252	20	652	52
665111	Inners for Vacc. Flasks	Grs	35	20	6	12	(2)	(2)	104	5
665119	Inners for Vacc. Vessels NS	Grs	71429	721	366	19	1277	33	173	104
665201	Glass Ash Trays	Grs	688	118	160	38	49	10	--	17
665202	Glass Bowls and Dishes	Grs	18	4	7	27	--	1	--	--
665203	Glass Tubmlers	Grs	475	68	11	1	978	(4)	32	118
665204	Glass Vases	Grs	(1)	(4)	2	1	NA	NA	(5)	(5)
665209	Glass Tableware NS	Grs	706	509	2032	393	1463	143	(260)	(50)
665801	Glass Ampoules	Cwt	5861	3657	1621	1536	1014	1553	1137	4313
665802	Glass Beakers	Cwt	5	10	NA	NA	--	--	--	4
665803	Glass Cylinders	Cwt	--	4	4	4	--	--	--	5
665804	Glass Funnels	Cwt	--	6	NA	NA	--	--	--	14
665809	Laborat. Glassware etc. NS	Cwt	7734	4218	1053	1559	2248	2259	167	2870
665811	Glass Beads	Cwt	1842	1363	2218	1499	4084	3841	271	3453
665812	Glass Bangles	Cwt	(16)	(10)	49	42	(1)	(2)	(79)	1
665814	Imitation Glass Pearls	Cwt	50	75	31	65	50	31	--	66
665815	Semi-Precious Glass Stones	Cwt	66	110	96	291	261	1772	77	3050
665819	Decor. Gls Small Wares NS	Cwt	561	480	476	1303	90	99	213	451
665829	Glass Articles NS	Cwt	5318	2767	806	985	(50)	606	(5711)	422

Table 3 (Continued)

CODE	COMMODITIES	UNITS	'70-'71 QUANT.	'70-'71 VALUE	'71-'72 QUANT.	'71-'72 VALUE	'72-'73 QUANT.	'72-'73 VALUE	'73-'74 QUANT.	'73-'74 VALUE
724101	Television Sets Complete	No.	6427	4310	1663	943	3152	2120	18927	15086
724102	Parts of Television	Cwt	4660	6371	473	3385	4727	10374	26042	33832
729201	Bulbs for Automobiles	Grs	18046	905	11202	1122	13185	1132	15518	1241
729202	Bulbs for Flashlights	Grs	124402	708	19155	720	18829	612	68963	2175
729203	Bulbs for Floodlights	Grs	629	79	446	33	--	2000	34	52
729204	Bulbs for Lighting	Grs	70735	2732	31717	1767	18380	1106	34022	1168
729205	Bulbs for Photo Flash	Grs	992	56	1405	60	1523	19	6	15
729206	Bulbs & Lamps for Med. &Labs.	Grs	2424	110	2048	58	856	72	(1)	126
729208	Fluorescent Tubes	Grs	422	296	7433	300	504	241	2188	242
729219	Electric Lamps NS	Grs	131003	4561	51954	4313	964	1766	16609	2350
729301	Cathode Ray Tubes	No.	6	1	1643	139	243	113	256	134
729304	Tubes of Wireless Radios etc.	No.	78519	298	52153	747	45435	141	6278	801
729305	Tubes Electric	No.	32966	1002	129170	1143	39589	1165	38572	1621
812402	Gls Elements not Optical	No.	2126	27	710	12	(7271)	(20)	1120	46
812403	Glass Light Globes	No.	1464	41	6194	37	--	--	(23916)	(22)
812409	Illum. & Signal Glassware NS	No.	81614	346	9866	112	568	23	677	39
812411	Torches	No.	1361856	2102	1255283	2400	868745	1354	2036454	4790
812422	Hurricane Lanterns	No.	90209	551	4904	8	(7878)	15	(5323)	37
861102	Lenses Gls Optical Unmounted	No.	886593	474	804934	439	1964729	1346	2361914	1862
861104	Optical Elements Unmounted	No.	6521	19	17374	27	23526	15	2545	10
861111	Lenses Gls Optical Mounted	No.	173423	108	54918	146	103623	165	99757	152
861112	Mirrors Optical Mounted	No.	--	21	58	6	--	--	31379	3
861119	Optical Elements Mounted NS	No.	12281	261	7172	48	3267	44	342	17
861203	Spectacles Corrective	No.	NA	NA	77	1	80000	64	(894)	(10)
861204	Spectacles NS	No.	(1)	(21)	48t	--	(12684)	(141)	(284)	17
861912	Thermometers Clinical	No.	234665	404	87707	191	159146	284	682704	1536
861913	Thermometers Meteorological	No.	38281	64	1940	44	26	2	144	74
861919	Thermometers NS	No.	366880	1729	63382	672	51578	270	67229	810

Source: Foreign Trade Statistics of Pakistan: Imports, Exports and Re-exports, Central Statistical Office, Government of Pakistan, Karachi, 1970-1974.

Notes: Refer to Table 6.

Table 4

CLASSIFIED NET GLASS IMPORT DATA

(Quantities: See Footnotes; Values in 1,000 Rupees of $10.10)

GROUPS	UNITS	'70-'71 QUANT*-	'70-'71 VALUE	'71-'72 QUANT*-	'71-'72 VALUE	'72-'73 QUANT.-	'72-'73 VALUE	'73-'74 QUANT.-	'73-'74 VALUE
Lighting Bulbs	Grs[2]	348653	9790	125360	8467	54241	7038	137339	7402
Decorative & Household	Ton[5]	347	6513	157	5354	80	2621	(204)	6649
Custom Jewelry	Ton	87	1538	107	1897	196	5642	12	6570
Laboratory & Scientific	Ton[3]	345	6515	47	2621	100	2928	7	5479
Ampoules	Ton	262	3657	72	1536	45	1553	51	4313
Optical	No.[4]	1078817	1668	884581	1115	2162461	1996	2494759	3550
Vials	Grs	217293	3307	158336	749	29690	1461	148635	2863
Sheet Totals:	Ton	1278	5298	493	2703	404	1656	349	2430
Rolled etc.	Ton	193	408	122	383	2	26	30	623
Drawn & Plate	Ton	1085	4890	371	2320	402	1630	319	1807
Misc. Industrial	Ton[1]	332	2281	239	1183	125	1062	18	1916
Containers	Grs	308255	10496	102226	4616	47846	1385	37279	1515
Fibres	Ton	395	3882	67	2008	24	553	32	1182
Tableware	Grs	1887	699	2210	459	2490	150	(228)	85
TOTALS:			55644		32708		28045		43954

Source: Same as "Net Import Data for Glass." Data shown here is in sequence according to descending Net Import Values for 1973-1974.

Footnotes 1 through 5: Denote mixed Quantity Units, where only one is shown. Values are for total group.

Classification Groups: Composed of items coded by P.S.T.C. (R) numbers. Shown in Table 6.

Notes: Refer to Table 6.

Table 5

COMMODITY GROUPING INTO CATEGORIES

Commodity Coding by P.S.T.C. (R)

Lighting Bulbs	664921, 729201, 729202, 729203, 729204, 729205, 729206, 729208, 729219.
Decorative & Household	664101, 665204, 665819, 665829, 812403, 812411, 812422.
Custom Jewelry	665811, 665812, 665814, 665815.
Laboratory & Scientific	665107, 665802, 665803, 665804, 665809, 729301, 861912, 861913, 861919.
Ampoules	665801.
Optical	664200, 861102, 861104, 861111, 861112, 861119, 861203, 861204.
Vials	665106.
Sheet Rolled	664400, 664500.
Drawn	664700, 664801, 664802, 664803, 664911, 664912.
Misc. Industrial	664102, 664111, 664300, 664600, 812402, 812409.
Container	665101, 665102, 665103, 665104, 665105, 665109, 665111, 665119.
Glass Fibres	651802, 664931, 664939.
Tableware	665201, 665202, 665203, 665209.

Net Import Data: Other Articles and Materials

Table 6 (following pages) contains basic commodity import data and should be self-explanatory. This is data included for illustrative purposes and to indicate import trends. However, brief discussion of a few commodity groupings is in order as they eventually will have both direct and indirect impact on the glass industry. For example:

The groupings beginning with "glass working machinery," "lathes," and "clay & refractory materials" are directly related to the glass industry as the industry's heavy capital investment in original materials and equipment falls in these areas. In the refractory area, for instance, except for firebrick and the more common mortars, the glass industry historically has been a major consumer.

The same relationship eventually will exist with item 514359, "precious metals." As soon as Pakistan acquires technical know-how for the improvement of glass quality, an inventory of the platinum-rhodium alloy will be essential. Today, in the developed nations, this alloy is in general use by the industry for this purpose.

Table 6

NET IMPORT DATA: OTHER ARTICLES & MATERIALS

CODE	COMMODITIES	UNITS	'70-'71 QUANT*	'70-'71 VALUE	'71-'72 QUANT*	'71-'72 VALUE	'72-'73 QUANT.	'72-'73 VALUE	'73-'74 QUANT.	'73-'74 VALUE
718511	Glass Working Machinery	No.	22	7207	23	1261	3	571	4	1166
718519	Gls Working Machinery Parts	Cwt	927	5579	1242	2396	734	248	202	1069
719619	Bottle etc. Cleaning Mach. NS	No.	1140	2127	708	741	69	1880	115	131
689304	Filaments Tungsten	Cwt	15438	793	360	1032	81	1550	918	1755
722207	Starters for Lamps & Tubes	No.	194841	381	273077	206	299908	323	1345541	909
722208	Chocks for Fluorescent Tubes	No.	14329	191	272030	89	76702	51	54697	301
276239	Clay & Refractory Materials	Ton	1275	1137	625	774	612	798	1115	1226
662309	Heat Insultating Brick etc. NS	Cwt	6909	847	--	1472	6155	667	1008	241
662311	Firebrick Refractories	Cwt	163171	10040	41638	6062	81816	13394	71195	10137
662319	Refractory Blocks etc. NS	Cwt	23409	3448	9390	1663	4801	1260	13670	5222
662321	Refractory Cement Mortar	Cwt	4496	708	319	1072	181	684	1903	519
663709	Refractory Products NS	Cwt	911	414	3133	585	179	227	(564)	(357)
719103	Furnace Burners etc.	No.	74	69	7673	1420	2	6	373	643
719105	Indust. & Lab. Furnaces	No.	9	3334	4373t	252	15	97	8	42
641952	Cardboard All Sorts	Cwt	69476	11233	16710	3368	11119	1854	22708	13423
642102	Boxes of Paper & Paperboard	Cwt	1727	420	663	377	986	474	(1615)	(119)
642109	Pkg. Contr. Paper & Board NS	Cwt	3064	1042	3132	939	1964	1860	3065	1440
514359	Precious Metals Comp. NS	Cwt	16587	2307	8729	1055	841	126	329	164
641600	Bldg. Board of Wood Pulp etc.	Cwt	(5774)	140	20473	2564	14314	1701	5837	5374
732809	Parts of Motor Vehicles NS	Cwt	63296	48361	32602	59536	50503	116525	381844	167909

Table 6 (continued)

CODE	COMMODITIES	UNITS	'70-'71 QUANT*-	'70-'71 VALUE	'71-'72 QUANT*-	'71-'72 VALUE	'72-'73 QUANT.-	'72-'73 VALUE	'73-'74 QUANT.-	'73-'74 VALUE
715107	Lathes	No.	58	4869	79	4396	21	84	(20)	303
715108	Milling Machines	No.	75	4527	25	500	17	629	56	1277
715119	Mach. Tools for Metals NS	No.	4348	37551	36889	18501	2757	7968	2168	5613
715205	Parts of Metal Workg. Mach.	Cwt	17453	10897	780	824	56289	2289	10434	15698
715209	Metal Working Machinery NS	No.	813926	22017	1083	3689	10	1186	(22)	739
719501	Mach. Tool for Wkg. Machinery	No.	303	37	19	38	11	107	37	269
719505	Accessories of Mach. Tools NS	Cwt	4063	12270	4577	3000	748	2075	(69)	2067
719919	Parts & Access. of Mach. NS	Cwt	255627	135863	52133	108803	60186	10062	51088	96608
718402	Excavating Machinery NS	No.	11	1421	4	187	--	24	159	202
718405	Mining Machinery NS	No.	130	1593	3	52	50	305	218	1126
718411	Parts of Constr. Machinery	Cwt	87164	60372	34750	41088	14783	24329	31180	33779
718419	Constr. & Mining Mach. NS	No.	21387	25205	5160	9542	1839	4420	3522	(21091)
718502	Mineral Crushing etc. Mach.	No.	752	2255	100	5739	13	76	301	177
718503	Mineral Crshg. Mach. Parts	Cwt	8501	3092	509	706	75	57	747	1606
661812	Asbestos Cement Pipe & Fittgs.	Ton	198	295	--	--	(134)	(153)	(956)	(1652)
678100	Tubes & Pipes of Cast Iron	Ton	3991	12916	6355	10406	906	2401	720	1938
678200	Iron Tubes & Pipes Seamless	Ton	4449	11917	3870	11423	5009	14465	15[illegible]1	6939
678300	Iron Tubes & Pipes Welded	Ton	25467	49375	27289	63876	11998	29859	7164	28869
684205	Aluminum Tube Pipe & Blank	Cwt	1675	781	137	106	9	75	99	97
692103	Tanks & Vats of Iron or Steel	Cwt	17500	4439	743	443	147	380	(80)	(14)
053300	Jams Marmalades & Jellies	Cwt	391	76	239	65	(75)	(12)	(2466)	18
053501	Fruit Juices	Cwt	317	58	157	96	(581)	(118)	(1201)	(392)
111009	Non-Alcoholic Beverages NS	P/gal	41292	(1038)	5106	231	(77550)	(242)	(53586)	(715)

Table 6 (continued)

CODE	COMMODITIES	UNITS	'70-'71 QUANT*-	'70-'71 VALUE	'71-'72 QUANT*-	'71-'72 VALUE	'72-'73 QUANT.-	'72-'73 VALUE	'73-'74 QUANT.-	'73-'74 VALUE
112104	Sherry	P/gal	2678	63	492	37	174	10	268	16
112109	Wines Fresh Grapes	P/gal	60668	1387	11681	751	25163	453	12932	863
112302	Beer	P/gal	171186	1646	55886	1322	22726	246	46016	877
112401	Brandy	P/gal	4100	576	2583	491	3610	241	5556	440
112403	Gin	P/gal	2563	112	1566	144	5814	146	2311	170
112406	Spirits Alcoholic	P/gal	6999	387	2189	171	2311	148	(256396)	(2633)
112407	Vodka	P/gal	845	56	755	44	395	36	352	14
112408	Whiskey	P/gal	35940	3602	25800	3316	3405	447	240191	1880
112411	Wine Distilled	P/gal	(154)	(9)	81	2	95	14	798	32
112419	Distilled Alcohol. Bev. NS	P/gal	5521	490	2390	206	2046	86	4654	332
273300	Sand, Excl. Metal Bearing	Ton	51	151	5	12	124	20	1	93
276211	Dolomite	Ton	NA	NA	NA	NA	11	23	42	87
513396	Silica	Cwt	161	27	495	65	230	42	758	161
513531	Cobalt Oxide & Hydroxide	Cwt	--	12	91	131	236	99	35	179
513689	Inorganic Bases Oxides NS	Cwt	10997	3315	2178	1045	4195	1440	2465	987
514259	Nitrites & Nitrates NS	Cwt	18851	1508	16825	1569	7719	571	9664	1093
514321	Borax Refined	Cwt	3631	269	18162	1062	32793	991	53834	3071
892101	Books	---	--	10588	--	5031	--	5111	--	4800
892202	Periodical Magazine or Journal	---	--	1301	--	1303	--	726		

Notes: Refer to following page.

Table 6 (continued)

NET IMPORT DATA FOR GLASS AND OTHER ARTICLES AND MATERIALS

EXPLANATORY NOTES

NET IMPORT:	Import figures modified by Exports and Re-exports that show net figures in Quantities and Value.
VALUE:	In 1,000 Rupees of standard value of $10.10 (1973 to date). Factors used: 1970-1971 = 2.0709 1971-1972 = 1.9246 1972-1973 = 0.9375 1973-1974 = 1.0000
QUANT*:	Estimated quantities, calculated proportionally from available data. Full quantity data was not available for 1970-1971 and 1971-1972. Export and Re-export figures were not available for 1971-1972.
NA:	Figures not available.
t:	Actual figures--not an estimate.
--:	Nil amounts.
( ):	Excess of Exports and Re-exports over Imports for year shown.
CODE:	Numerical Commodity Trade Classification according to the revised Standard International Trade Classification by Pakistan. P.S.T.C. (R) July 1973.
SOURCE:	Foreign Trade Statistics of Pakistan; Imports, Exports and Re-exports Central Statistical Office, Government of Pakistan, Karachi (1970-1974).

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Volume 8 No. 4	April-June	1973
Volume 7 No. 4	April-June	1972
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