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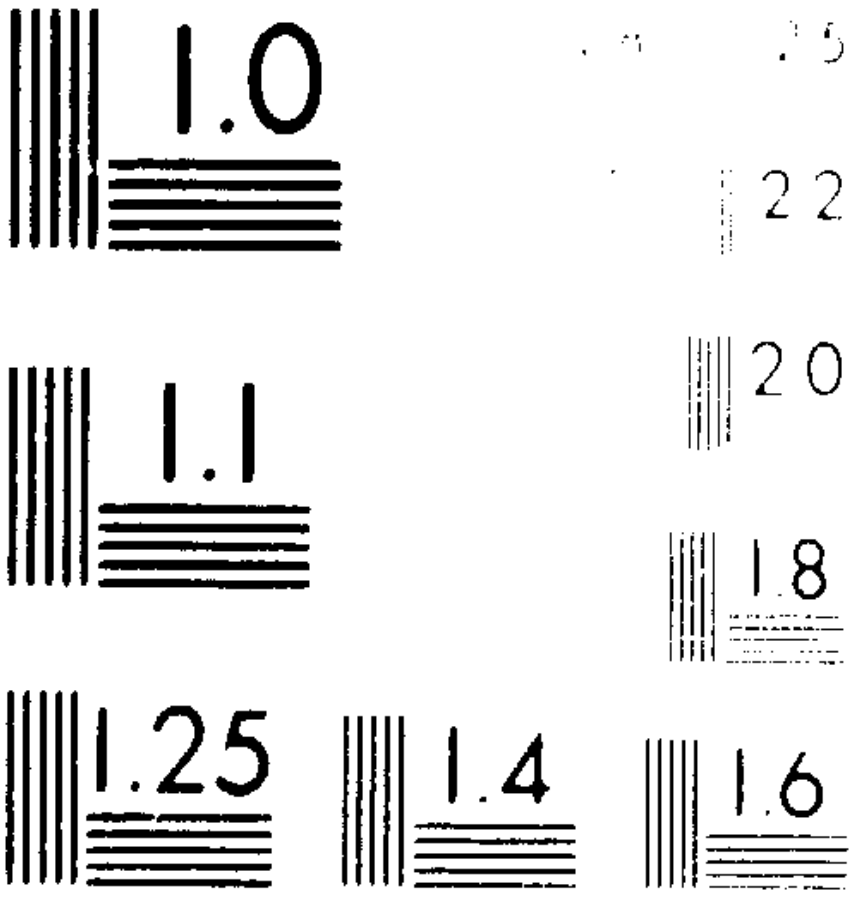
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English

KOREA DESIGN AND PACKAGING CENTER, PHASE II

DP/ROK/78/008

REPUBLIC OF KOREA

Technical report: Glass packaging design*

Prepared for the Government of the Republic of Korea
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of H.R. Persson,
glass packaging design expert

United Nations Industrial Development Organization
Vienna

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C O N T E N T S

SUMMARY

The expert spent about 5 weeks in his second mission to the Republic of Korea. He has once again enjoyed a very good co-operation with the personnel at KDPC.

The programme for the mission was discussed and planned with personnel from KDPC and Korea Glassware Industry Cooperative. It was also discussed with the UNIDO coordinating industrial adviser in Seoul before a final decision was taken.

Visits were arranged to 11 glass plants. Some of these plants used manual methods and some automatic methods for the manufacturing of glass products. Most of the plants manufactured glass containers. The containers were used for cosmetics, pharmaceuticals, milk,beer, soft drinks, liquor and some other products. Lectures and technical discussions were arranged at all the glass factories. These discussions covered manufacturing problems, technical development, modern design of containers, quality control and other interesting aspects.

At some of the glass factories, tumblers, cups, plates and similar table ware were produced.

A KDPC counter part was present at almost all of the visits. Recommendations regarding technical improvements were given at all the glass factories.

Visits were also arranged to two bottling plants one brewery and one soft drink plant. The handling of the containers on the processing lines, the ressons for bottle breakage and other technical items were discussed. Representatives of the glass suppliers were present at these meetings. It was recommended at these meetings by the expert, that the glass supplier and the glass user should meet regularly to discuss the quality of the containers. The two parties should agree not only regarding the quality of the bottles but also regarding the acceptable quality level (AQL). Recommendations regarding some minor re-design of some bottles were given by the expert.

Lectures regarding quality control, design and packaging of glass containers were given to the KDPC personnel. A seminar regarding the same topics was arranged by the Korea Glassware Industry Cooperative. This seminar was attained by 55 representatives of the glass industry and some other organizations.

The recommendations given by the expert at his 1981 mission to KDPC have in principle been followed. The two counterparts were sent abroad for further training in the packaging field. Recommendations given to the glass industry have also been followed. In particular this is true for the control in the plants of the glass container quality. It is therefore now recommended that KDPC should not start too many activities regarding control and testing of the quality of glass containers.

The following activities should be increased and improved :

1. Design of glass containers and similar glass products
2. New development in the packaging of glass products
3. Revaluation regarding the design of new glass containers and their suitability for the modern packaging lines.

Personnel from KDPC should be trained at the glass industry and at the bottling plants in the Republic of Korea. When needed some further training may be obrained abroad.

After some further training has been given to the KDPC personnel it is recommended that a line simulator should be installed at KDPC. Such a line simulator will give valuable information regarding the design and quality standard to the glass producer as well as to the user. The line simulator will give a quick information regarding the suitability of new bottles in the packaging lines. With such equipment KDPC will be able to act as an informative bridge between the glass supplier and his customers.

It was suggested by KDPC and the Glassware Industry Cooperative, that the glass packaging expert should come back to Korea in about one year for a new two months mission. The expert believes there are great possibilities for Korea to increase the export of glass products and would be most willing to come back to help the industry to increase its export.

1. JOB DESCRIPTION

Post Title : Consultant in the Design of Glass Packaging

Duration : One month

Duty Station: Seoul, with possibility of travel within the country

Purpose of project

The Government is anxious to increase and to substitute imports by improving the quality and increasing the supply of nationally manufactured goods.

The Korea Design and Packaging Center is expected to assist the industry to improve the design and quality of packaging, for multiple purposes of presentation, protection and handling, through the transfer and adaptation of advanced packaging technologies and the establishment of quality standards and testing procedures.

Duties

Reporting to the co-ordinator of UNIDO's projects in the UNDP Head quarters and assigned to the Korea Design and Packaging Center(KDPC), the expert will be introduced to the counterparts and acquainted with the details of the mission.

More specifically, the expert will be expected to :

1) Investigate, analyse and improve the various problems derived from designing glass containers such as:

   - cosmetic containers

- bottles for beverages
- cups, etc.

2) Offer information and advice on the latest glass technology and recommend the possible application of glass containers suited to export markets.

3) Give practical and theoretical advice to the KDPC and industrial designers on bottle design process:

this will include the following:

a) setting up design concept
b) creating the idea sketch
c) rendering
d) selection of idea
e) moulding
f) redesign
g) drawing
h) dummy

The expert will also be expected to prepare a final report, setting out the findings of the mission and recommendations to the Government on further action which might be taken.

Qualifications

Glass technologist, with University degree or equivalent theoretical formation; specialisation in glass containers, technological and design research.

Language

English

Background Information

Under the fourth Five-year Economic Development Plan, the Government is counting to place heavy emphasis on the promotion of both light and heavy industry and on the export of industrial products.

The total value of exports, which increased from US$1,624 million in 1972 to 12,500 million in 1978, is projected to rise to approximately US$20,200 million in 1981, while an estimated 92% of this total will be composed of manufactured goods. In order to reach this target, the country will have to continue to improve the quality of its exports and diversify its markets. At the same time, emphasis will also be placed on import substition by increasing the supply of high quality manufactured goods to the local makret.

An important requirement for increasing the marketability of local products, both at home and abroad, is the continous improvement of packaging for both presentation and handling purposes. The Korea Design and Packaging Center is expected to play an important role in this respect by continuing to assist industry in improving design and quality of domestic packaging through the transfer and adaptation of advanced packaging technologies and the establishment of quality standards and testing procedures.

The improvement of the glass design is expected to contribute very positively towards the increase of the national products appeal and success on the international market.

2. INTRODUCTION

In 1981 the expert worked at KDPC from January to March as a UNIDO glass packaging consultant.

In his report from March 1981 the expert has given a general review of the glass container industry in the Republic of Korea. Some different glass plants were visited and in particular the expert gave recommendations how to improve the quality of the manufactured glass containers.

Visits were also paid to bottling plants. The reasons for the breakage of bottles were discussed with the technical managers of the bottling plants.

Recommendations were given how to improve the handling of glass containers on the packaging lines. Several discussions and lectures were given to the research and design people at KDPC.

Instruction were given how to evaluate glass containers as a packaging material. The importance of physical testing and dimensional control was stressed.

Guide lines were given how to design a glass bottle. It was proposed by the expert that some research workers at KDPC should be trained in the glass packaging field.

It was also suggested that a small exhibition of glass containers should be arranged at KDPC. It was demonstrated how glass containers can be tested in a simple way by using equipment already present in the KDPC laboratory.

In particular it was very satisfying for the expert to find in 1982 that his two counterparts from 1981 had been sent abroad for thorough training and education in the packaging field at technical institutes and uniersities.

During his second visit to the Republic of Korea the expert has again visited glass factories and bottling plants. At almost all of these visits the KDPC counterpart has been accompanying the expert.

3. VISITS ARRANGED WITHIN THE PROJECT

An Seong Glass Industry Co., Ltd., Anseong

Jeil Glass Industry Co., Ltd., Anyang

Sung Jin Glass Industry Co., Ltd., Kyungkido

Kyung Ki Glass Industry Co., Ltd., Kyungkido

Pacific Development Co.,Ltd., Suwon

Doosan Glass Co.,Ltd., Head Office, Seoul

Doosan Yeongdeungpo Glass Plant, Seoul

Doosan Gunpo Glass Plant, Gunpo

Doosan Kwangju Crystal Ware Plant, Kwangju

Oriental Brewery Co.,Ltd., Seoul

Hanyang Food Co., Ltd., Seoul

Korea Glass Ware Industry Co-operative, Seoul

Ministry of Science and Technology

Ministry of Commerce and Industry

Chang Hee Co.,Ltd.

Sam Kwang Glass Ind. Co.,Ltd. Seoul

4. GLASS MANUFACTURING

A general information about glass manufacturing of containers and table ware was given in the 1981 export.

No fundamental changes have been made since then.

One company has, however, started to manufacture tumblers and similar table-ware using automatic machines.

A Lynch MDP machine and in d-l machine were used. Both these machines originate from USA.

Most of the glass companies in the Republic of Korea experience economic problems. Some smaller glass plants stopped operation during 1981.

According to information from the Glass Association, there are now 60 glass plants in Korea. In 25 plants glass containers are manufactured. This is a very high figure.

It can be estimated that by the end of the century there will be less than half of them remaining as individual companies. It is quite possible, however, that the production of glass containers in Korea within 10 years will increase by 50%.

During his two missions to Korea the expert has discussed export of glass containers with the different companies.
It has been stressed that improvement for quality is most important in order to succeed with the export.

According to Korea Glass Association the export of glass containers has been as follows :

In 1977	$3.6 million
In 1978	$1.6 million
In 1979	$2.0 million
In 1980	$1.2 million
In 1981	$6.3 million

It is most satisfactory to see the increase of export in 1981.
The domestic market has decreased, however.
Some companies utilize only 60% of their total capacity at present.
All the glass companies, that were visited, showed a great interest in discussions with the expert.
There is an enormous ambition for technical improvements at the plants.
Many problems were presented by the technical managers of the plants.
The expert advised how the problems may possibly be solved.
A short summary of the different problems are given below.

A. Manual Plants

The most serious problem in most of the smaller plants were lack of technical knowledge regarding glass technology. In general there were too many different raw materials used for the melting of the glass.
Some of these raw materials are quite expensive.
The same quality of glass can be obtained by using cheaper raw materials.
Some glass plants used a high proportion of cullet bought from dealers.

The composition of this cullet was not known.

In addition the cullet used was not very clean.

The melting of the glass was usually quite satisfactory.

Recommendations how to improve the fuel efficiency were given.

The blowing and forming of the glass products was also quite satisfactory.

In most cases the annealing was a problem. The temperature of the annealing lehrs was not well controlled. As a result some products were cracked when arriving at the cold end of the lehr. Other articles, that were not cracked, contained too much strain. This could give a problem during engraving or at the normal handling of the products. Some of the plants could not control the strain in the glass by a good quality strain viewer.

Decoration and labelling of the products presented no problems in most cases. The temperatures in the lehrs should be controlled better, however.

In general it was found that there was an excessive amount of people working with inspection and packaging.

Part of this could be solved by using more modern types of cartons. The work would also be more efficient if the inspectors and packagers circulate between different stations.

Time studies should be carried out for this part of the processing line.

B. Automatic Glass Plants

The quality of the products produced by the glass plants using automatic machines is quite satisfactory. In order to keep abreast with the modern development in the glass field, however, it is necessary for the glass plants to improve many of their operations.

The handling of raw materials and the batch mixing are usually quite satisfactory. In some plants the cullet should be kept more clean. It would be an advantage to use moistened batch (3-5%). In addition the composition and the homogeneity of the batch should be controlled.

A better control should also be applied to the furnaces. By having more controlled conditions in the furnaces, it will be possible to obtain better efficiencies and to decrease the volume of the fuel used for melting the glass.

The operation of the forming machines was usually quite satisfactory. The same is true for the operation of the annealing lehrs. Some of the lehrs were not up to modern standard, however, and should be replaced.

The inspection at the cold end of the lehrs was not satisfactory. A few automatic inspection machines were installed at a few lehrs, but they did not function too well.

It is not enough today to apply a visual inspection only at the lehrs. Inspection machines must be used as well. In addition it is

impossible for an inspector to sit at the same inspection station for four hours. The maxinum time at the station should be 30 minutes. There should then be a circulation of the people to different duty stations.

In general the glass companies are well aware of their weaknesses. In most cases it will be necessary to make considerable investments in order to modernize the operations and the plants. These investments may be difficult to make at present but the glass companies should include them in their future planning.

A few of the glass companies have agreements regarding technical assistance with glass companies in USA and in Japan.

There are good potentialities for the manual glass plants as well as for the automatic glass plants to develop into well qualified glass products suppliers.

Many recommendations have been given by the expert and it would be worth while to follow up these recommendations.

It is therefore suggested that the expert should be asked to come back to the glass industries and to KDPC.

It is preferable if a new visit could be arrange at the beginning of 1983.

With a satisfactory technical development of the glass industry in the Republic of Korea it can be turned into an export industry.

5. GLASS BOTTLES IN THE PACKAGING PLANTS

The brewery and soft drink plant, that were visited have modern, fast working filling and capping machines.
The speed of the machines very between 400 and 800 bottles per minute.

The brewery used 200 million bottles for the distribution of the beer. There were four different types of bottles. According to the records by the brewery the following breakage of bottles was experienced.

New Bottles

Inspection before washing machine	0.2 %
In washing machine	0.05%
Filling, capping, pasteurization	0.1%
Total breakage	0.35%

Old Bottles

Broken when returning to brewery	0.38%
Dirty bottles and wrong type of bottles	0.32%
Breakage in bottling lines	1.0%
Total breakage	1.7%

It is thus seen, that the breakage of new bottles in the bottling line is 0.35% and that of old bottles is 1.0%.

After a more careful study and discussions with the technical personnel it was found that most of the breakage in the processing lines occured in the pasteurizer.

The following temperatures were kept in the pasteurizer.

At entrance	35°C
First heating	45°C
At pasteurization	63°C
First cooling	40°C
Second cooling	35°C

It appears from these figures that the maximum thermal shock is given to the bottles when they leave the pasteurization chamber and enter the first cooling shower. This thermal shock is 23°C.

The glass producer will test glass bottles for thermal shock at a temperature difference of 42°C.

Good quality new bottles will with stand this thermal shock. Old bottles having been abused in handling will have less resistance for thermal shocks.

It was suggested that the brewery should look into the possibility of decreasing the temperature differencies between the various chambers in the pasteurizer.

In the soft drink plant approximately 120 million of bottles were used. The total loss of bottles were 2.6% per year. This included 0.2% breakage in the processing line and 2.4% breakage and loss during the distributing.

The breakage figures in the plant indicated that most of the problems were found at the filling station. The hydrostatic pressure applied to a bottle was 4.0 kg/cm^2. It is evident that this pressure was enough to break some of the bottles. In the glass plant new bottles were tested at a pressure of 17.0 kg/cm^2.

After being used for the distribution of beverages, the bottles will be weaker. The pressure when filling the bottles with beverages was 4.0 kg/cm^2 and this could not be lowered.

There was not reason to suspect that a higher pressure would break. It must therefore be accepted, that weak bottles will break at the filling station.

General discussions were held in the bottling plants regarding the breakage of bottles. It was suggested by the expert that they should check the quality of new bottles as they arrived from the glass plant. They should also register the breakage of bottles. If abnormal figures were found it was suggested that they should consult the glass supplier.

It was also recommended that the technical people of the bottling plants should meet with people from the glass supplier in order to discuss the quality of the glass containers. Quality standards should be agreed upon and in addition acceptable quality levels (AQL) should be determined for the different defects of the bottles.

Quite often the following AQL values are acceptable by the glass plants as well as by the bottling plants.

Critical defects	AQL = 0.0
Major defects	AQL = 0.65 - 1.0
Minor defects	AQL = 2.0 - 5.0

6. GLASS PACKAGING ACTIVITIES AT KDPC

In his 1981 report the expert gave some recommendations regarding glass packaging activities at KDPC. The two KDPC counter parts from 1981 have both been sent abroad for practical training and ecucation in the packaging field, including glass packaging.

One of the major glass compaines sent one engineer to Japan for the study of mould design and manufacturing.

These activities will help to promote the glass manufacturing and the glass packaging technology in the Republic of Korea.

During 1981 the glass industry in Korea has improved its quality control of glass products. It seems therefore not necessary for KDPC to engage itself in the quality control of glass containers and similar glass products. It is recommended that KDPC should train its personnel and have activities in the following fields:

1. Design of glass containers and similar glass products
2. Packaging of glass products
3. Give recommendation regarding the design of new glass containers and their suitability for the modern packaging lines.

All these points have been discussed and evaluated with the personnel of KDPC.

There are good designers at KDPC and they have been very interested in the lectures given by the expert. It is recommended, however, that they should be given further training in the design of glass containers.

Further contacts regarding such training abroad can be taken with any of the packaging institutes and organizations working with glass containers, that were mentioned in the 1981 report.

The same packaging institutes can also give advice regarding training of engineers in the field of glass packaging. It is possible, however, for KDPC personnel to get a good training in Korea. The domestic glass industry and bottling plants have good knowledge regarding glass packaging and can give a good basic training to the KDPC personnel. There is already a good contact between KDPC and Korea Glassware Industry Cooperative and it should therefore be no difficulties in sending personnel from KDPC to the glass industry and to the bottling plants for further training. The expert has already taken the initiative for such discussions.

After such training it should be possible for personnel from KDPC to give adivce to the glass industry and the bottling plants regarding packaging problems.

It is often an advantage to be able to test bottles of new design or design modifications in an accelerated laboratory test. This is now possible by using a line simulator. Such line simulators can be supplied by some of the suppliers of glass testing equipment mentioned in the 1981 report. The price of such simulators are US$1500 - 2000. When the KDPC personnel has received further training regarding glass container quality and glass packaging it is recommended that KDPC should be equipped with a line simulator.

It is suggested that the expert should come back to KDPC after about one year for another mission for further training of the KDPC personnel in glass design and packaging.

7. APPENDIX

Summary of a lecture presented by H. R. Persson at the Korea Glassware Industry Co-operative on February 12, 1982

A. New development regarding the manufacturing of glass containers

There is a continuous research and development in the glass field to make lighter and stronger containers.
To obtain this it is necessary to have a very even wall thickness of the containers. In addition, it is an advantage to strengthen the outside surface by a protective coating or by creating ion exchange reactions on the surface.

With increasing fuel prices it is necessary for the glass industry to improve the fuel efficiency of the glass melting furnaces. A typical heat balance for a 100 ton per day furnance was presented.
Fuel efficiencies have increased in the last 10 years from 20% to 30%.
The most advanced furnaces have fuel efficiences approaching 40%.
The importance of furnace design, refractory materials, furnace temperature, gas pressure, glass level and combustion conditions were stressed.

Most manually operated glass factories are of the opinion that installation of automatic equipment does not pay for itself when manufacturing high class decorative ware and table ware. To minimise labour cost, it is important, however, to use skilled labour for such functions only, where their skill is required.

With the increasing speeds of the packaging machines in the food and beverage industries it is very important to improve the quality of glass containers.

More advanced automatic inspection machines are beeing developed

In addition the most modern glass factories have now installed micro processor systems for industrial and process control. It will now be possible to have a full control of all functions in a glass plant. This means that the quality of the glass containers will be improved and the speed of the forming machines can be increased.

B. Quality control of glass containers

In order to obtain high quality glass containers it is necessary to have a full control of the complete processing line of glass manufacturing. The following control should be carried out on the glass containers.

Visual inspection
Grade of annealing
Weight
Volume
Dimensions
Colour
Glass homogeneity
Seeds, blisters, stones, crack, checks
Hydrostatic pressure
Thermal shock strength
Vertical load
Impact test

At the inspection of glass containers it is advisable to use automatic inspection equipment.

In addition to the normal quality tests, some glass companies also carry out a delivery test when delivering containers to the customers. Many customers make similar tests when receiving the bottles.
It is an advantage to have an agreement regarding quality between the glass supplier and the customers.
This agreement should state what tests that should be carried out on the bottles and the required quality level for each test. It is also necessary to indicate how the bottles for testing should be sampled and how many.

The agreement should also cover what number of bottles that can be rejected in a sample lot before the total shipment must be rejected. This is the Acceptable Quality Level (AQL) of the containers.
Normally the defects are classified in there different groups with the following AQL values;

Critical Defects	: AQL =	0
Major Defects	: AQL =	0.65 - 0.1
Minor Defects	: AQL =	2.0 - 5.0

C. Recommendations to producers and users of glass containers

a) Define the quality of the most important types of glass containers
b) Arrange regular meetings between producers and users of glass containers
c) Keep KDPC informed about packaging activities
d) Make agreements regarding AQL values of different types of bottles
e) Use more automatic inspection equipment
f) Study the breakage of bottles in breweries and beverage industries
g) Consult KDPC regarding design and packaging problems.