Original Paper

Brief overview on glass industry and glass research in Spain

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The Spanish glass industry consists of about 60 production centres and more than 650 manufacturing and processing factories and workshops, with a total of 50000 employees. The overall annual turnover amounts to around 400 billion Pta. The most important sector is the hollow glass industry. It represents 67.2 % of the total glass production (more than 1.4 mill. t, and 69 billion Pta in 1991). The flat glass production is shared among two big companies. They have three float glass production lines (a fourth line is currently being built) and two cast-glass lines. In 1990 flat glass production was divided between 450000 t of float glass and 76000 t of cast glass. Sales amounted to 66000 mill. Pta. Furthermore, there are three factories for glass fibres and one factory for glass tubes.

The percentage distribution of the different glass products is very similar to that of the European Community countries. The Spanish quota on the total European Community glass production is 9 %.

The glass research in the state-owned sector is carried out by some scientists groups at different Spanish Universities and at the Ceramics and Glass Institute. Within the private industrial field of research there are two Research and Development centres which belong to Saint-Gobain group.

Kurzer Überblick über die spanische Glasindustrie und Glasforschung

Die Glasindustrie in Spanien besteht aus etwa 60 Produktionsunternehmen und mehr als 650 Manufakturwerkstätten mit etwa 50000 Arbeitsplätzen. Der gesamte jährliche Umsatz beläuft sich auf 400 Mrd. Pta. Der bedeutendste Sektor ist der Hohlglassektor, der 67,2 % der gesamten Glasproduktion (etwas mehr als 1,4 Mio. t und 69 Mrd. Pta im Jahr 1991) ausmacht. Die Flachglasherstellung wird von zwei großen internationalen Firmen getragen, die insgesamt drei Floatglas-Produktionsanlagen in Betrieb, eine vierte Anlage in Bau, und zwei Gußglasanlagen haben. Die Flachglasproduktion betrug im Jahr 1990 450000 t Floatglas bzw. 76000 t Gußglas und der Gesamtumsatz 66 Mrd. Pta. Außerdem gibt es ein Glasröhrenwerk und drei Glasfaserfabriken.

Die Prozentsätze der hergestellten Glasprodukte kommen denen der Europäischen Gemeinschaft sehr nahe. Der spanische Anteil an der gesamten Glasproduktion der Europäischen Gemeinschaft beträgt 9 %.

Die staatliche Glasforschung in Spanien wird von mehreren Arbeitsgruppen an verschiedenen Universitäten und vom Institut für Keramik und Glas betrieben. Im privaten Sektor existieren zwei Forschungs- und Entwicklungszentren, die der Saint-Gobain-Gruppe angehören.

1. The glass industry in Spain

In Spain the glass industry is structured in a similar fashion to other countries, i.e. capital is highly concentrated and there is strong economic and technological dependence on large European and North American groups.

The 400 billion Pta in total annual turnover is divided between 60 production centres and over 650 manufacturing and processing companies which employ 60 % of the workforce in the glass sector and account for approximately 35 % of the said total. 63 % of sales correspond to only 11 companies which belong to 8 industrial groups, of which Saint-Gobain-Pont à Mousson is the most important. However, most of the companies producing glass are small. Five companies have a staff of over 500 people, another 50 medium-sized companies have between 50 and 500 employees, and the remainder consists of over 650 small factories and workshops with fewer than 50 employees each. The majority of the companies in this third group process and manufacture glass products or are involved in installation or handmade products. This large number of small industries has its roots in the traditional poorly developed subsector of craftsmanship. Some of these small companies managed to survive while there was strong unselective demand and while they were not affected by competition from other more productive national and foreign companies, working on a superior level of technology or creating more attractive designs. However, the economic crises of the past few years were unfortunately sufficient to eliminate these factories from the Spanish glass panorama, and, even more regrettably, to put traditional age-old craftsmanship – which can never be recovered – in danger of extinction.

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The range of glass products manufactured in Spain is as follows:
hollow glass,
flat glass,
glass fibres,
insulators and other moulded glass,
domestic glassware and decorative glass,
technical glass,

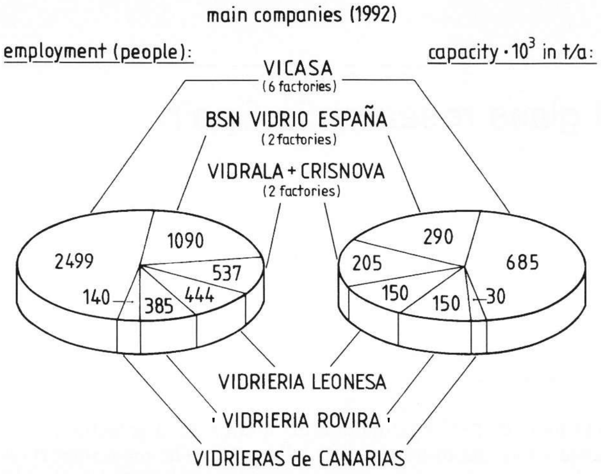
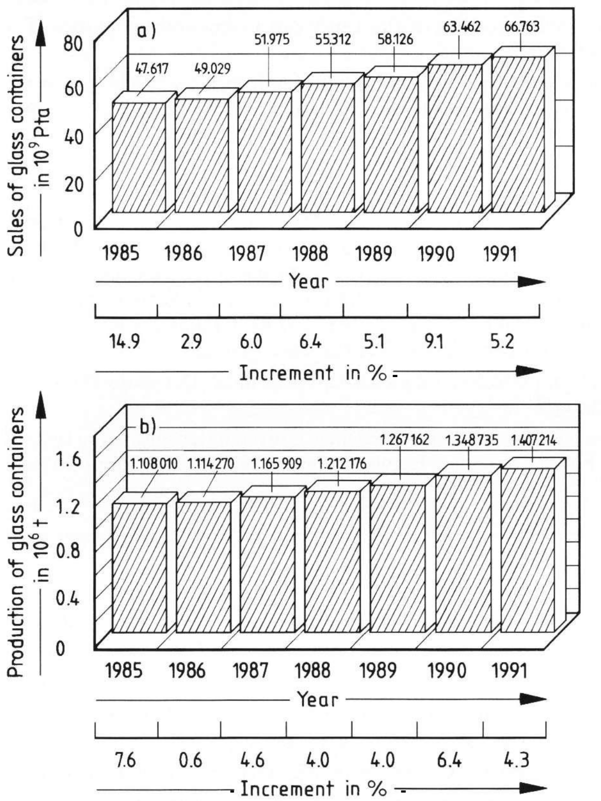


Figure 1. Employment in and production capacity of the Spanish hollow glass industry.



Figures 2a and b. Sales and production of glass containers in Spain from 1985 to 1991; a) sales in pesetas, b) production in tons.

optical glass (processing).

Within the Spanish glass sector, unfortunately, optical glass both for optical instruments and for ophthalmic glasses, and borosilicate glass for manufacturing laboratory equipment are not produced.

1.1. Hollow glass

Over 67 % of the total glass production in Spain correspond to the subsector of hollow glass. In this subsector there are 10 companies which make containers, including bottles (83 %), flasks (4 %) and jars (13 %). These

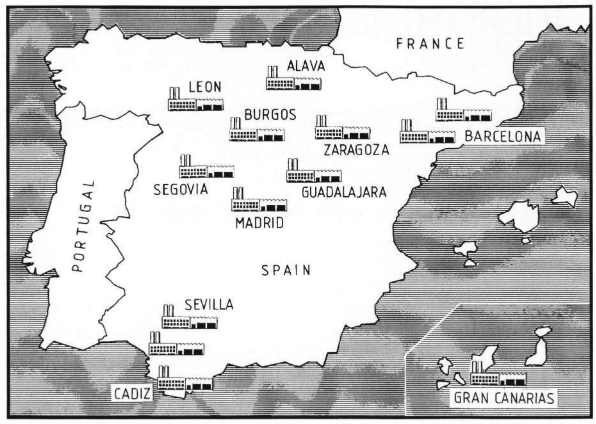


Figure 3. Geographical distribution of glass container companies in Spain.

10 companies came together in 1977 to constitute the Asociación Nacional de Empresas de Fabricación Automática de Envases de Vidrio (ANFEVI). This Association was founded with a view to establish a series of actions to study and solve all kinds of problems common to the subsector and to maintain a coordinated policy as regards the promotion of glass containers through campaigns in the media, publicity and marketing. The seven largest firms (figure 1) together have 13 factories and employ 5095 people. They have a glass production capacity of $1.51 \cdot 10^6$ t per year, which represents over 95 % of the total Spanish hollow glass production. The largest volume corresponds to VICASA which, with its 6 factories, accounts for over 40 % of the said total.

In 1991 the total turnover of glass containers amounted to 66763 mill. Pta (figure 2a) and corresponded to 1407214 t (figure 2b). This figure is equivalent to an average of 13 mill. containers a day. Production increased by 4.3 % compared to the previous year. Ex-ports amounted to 95000 t representing 7 % of the total.

Spain is in fifth position amongst the 12 countries in the European Community (EC), after Germany, France, the United Kingdom and Italy, but it ranks third in terms of production per capita.

The glass container industry is more disperse than that of flat glass, not only in terms of the greater diversity of companies in the subsector, but also from the point of view of geographical distribution since the companies are spread throughout Spain (figure 3).

Together with the glass manufacturers just mentioned, the manufacturers of pressed and blown glass, both for ornamental and industrial purposes, are also in this sector. These factories belong to 40 companies, with a total production of 200000 t a year including a wide range of products. The majority of these factories are in Catalonia, whose important and deeply rooted tradition of glass production dates from the Middle Ages. The second most important region in terms of numbers of factories is that of Valencia.

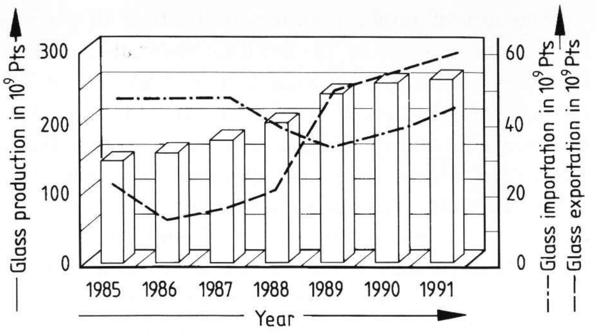


Figure 4. Evolution of turnover of the Spanish glass industry between 1985 and 1991.

Table 1. Data of the Spanish glass industry in 1991

total production	2197000 t
direct production	
sales	260000 mill. Pta
employees	20000 persons
processing and manufacturing	
sales	140000 mill. Pta
employees	30000 persons
breakdown of different glass products in %	
containers (bottles and jars)	67.2
flat glass	22.6
flasks	3.0
domestic glassware	2.7
fibres for insulation	2.3
fibres for reinforcement	1.4
other glasses	0.8

Given the diversity of production and the fact that these companies do not belong to any nation-wide association, it is very difficult to accurately evaluate production figures.

1.2. Flat glass

There are two companies involved in flat glass manufacture, namely Cristalería Española, S.A. (CESA), and Guardian Llodio, S.A. The first is under the majority control of the Saint-Gobain Group and the second belongs to Guardian Industries.

Cristalería Española has two float glass production lines in Avilés (Asturias) and Arbós (Tarragona) and one cast-glass line in Renedo (Santander). Guardian Llodio has one float glass line and a cast-glass line, both in Llodio (Alava). The company is currently building a second float glass line in Navarra.

A total of 3636 people are employed in the subsector of flat glass.

Production capacity available at present is 1700 t of float glass and 440 t of cast glass per day, with the possibility of supplying the motors industry with up to 2.4 mill. window-pane sets per year. In 1990 flat glass production was divided between 450000 t of float glass and 76000 t of cast glass. Sales amounted to 65716 mill. Pta in the same year.

1.3. Other subsectors

In the glass fibre subsector, there are two factories for insulation fibre which belong to Cristalería Española, S.A., and Poliglas, S.A., and a factory for reinforcement fibre, belonging to Cristalería Española, S.A.

The Spanish glass manufacturing scene is completed by a factory for glass tubes (ATEVI) for pharmaceutical containers, which belongs to the German firm Schott.

1.4. Distribution and evolution of glass production

In 1991 a total of 2.2 mill. t of glass was produced in Spain, corresponding to a turnover of 260 billion Pta. If the activities of processing glass products are also considered, the overall turnover amounted to 400 billion Pta. 20000 people were involved in glass production and 30000 in glass manufacturing and processing.

Table 2. Glass production in the European Community in 1990

total production	22480000 t
total value	22000 mill. ECU
employees	200000 persons
breakdown of different glass products in %	
containers	63.5
flat glass	24.7
domestic glassware	4.3
fibres for insulation	2.1
fibres for reinforcement	1.7
other glasses	3.7

In the same year glass production was distributed according to the percentages shown in table 1. The largest volume, 67.2 %, corresponded to bottles and jars, followed by flat glass with 22.6 %. None of the other products accounted for more than 3 %. This distribution of production is very similar to that of the EC countries as a whole (table 2). The main difference lies in the higher percentages of domestic glassware and of special glasses produced in the EC. Production and employment figures in the EC are approximately ten times higher than in Spain, which is in line with Spain's percentage (9 %) of representation in the Community (table 3).

To complete this picture, figure 4 shows the evolution of turnover from glass during the years 1985 to 1991. In this time the sales figures increased from 130 billion in 1985 to 260 billion Pta in 1991. The diagram also shows the evolution of exports and imports during the same period.

2. Glass research centres

The structure of the glass industry in Spain, which is characterized by the powerful groups controlling large

Table 3. Distribution of the glass production in the European Community

country	production in %
Germany	23.9
France	21.4
Italy	16.9
Great Britain	13.4
Benelux	12.6
Spain	9.0
Portugal	2.2
Greece	0.6

areas of production – often on a multinational level – in strong contrast with the large number of small scattered companies, implies that the interests of the sector on a national scale are very different and the heterogeneity of their technological problems means that there is a wide variety of research requirements, thus, making it impossible to undertake research following generally applicable criteria. In this situation the number of Spanish glass companies which have at least minimal financial resources at disposal to carry out their own research is very limited and, indeed, only the industrial groups with the strongest economic possibilities have their own research laboratories. However, it should be pointed out that the research potential of the private glass industry is much greater than that of public research centres.

In the public sector, worthy of note are the Institute of Ceramics and Glass, Madrid, which forms part of the Higher Council for Scientific Research and half a dozen laboratories belonging to different universities. The activity of the Institute of Ceramics and Glass, which is the only Spanish centre with research into glass as one of its specific purposes, is divided between research as such, which is its main object, and provision of technical assistance to both the public sector and private companies in the form of research contracts, technical reports and tests.

The rest of public research in the field of glass is carried out at some of the existing Materials Research Institutes (Madrid, Zaragoza and Seville) and in the Physics Departments of the Universities of Barcelona, Bilbao, Cádiz and the Basque Country. This research is based on a largely theoretical approach, much closer to academic criteria than to an approach which may be of interest to the industrial practice. Generally speaking, the study of physical phenomena manifested in a structurally disorganized material support predominates in this research rather than the study of conventional glass. The subjects chosen are very specific and curiously enough there is an overwhelming preference for the study of metallic and chalcogenide glasses.

Within the private industrial field of research, the Centro de Investigación y Desarrollo de Avilés (CIDA), belonging to Cristalería Española, S.A., and the Centro Tecnológico de Azuqueca (CTA), belonging to VICASA, should be mentioned. The first was created in 1952 as a factory laboratory to analyze and control raw materials and the finished product. Today, forty years later, with a staff of 150 people and a very strong infrastructure, it is the most important centre for applied research and technological development in the field of glass. The other private centre, the CTA, which was constituted in 1974, was specially conceived to study and develop glass containers and their manufacturing process, with an approach that was fundamentally technological.

As this brief overview of the glass sector shows, the result of the industrial structure of the glass sector in Spain is a clear lack of proportion between the big groups which have good research facilities, and the small and medium-sized companies, many of which do not even have the most elementary systems of control. This situation indicates the advisability of introducing a system of association or cooperation which would be the only way that small and medium-sized companies could enjoy the benefits of research which they cannot afford on an individual level. Moreover, only the benefits of clearly directed research would enable them to become more competitive, which in some cases is essential to their survival.

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