

Technical Report

Glass industry in the Netherlands

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The first reports on "industrial" glass production in the Netherlands date from the 15th century, at that time a factory in Middelburg produced mirrors and blown glass articles. The first bottles in the Netherlands were manufactured in Delft, at about 1713. Crystal and container glass production started in 1756 in Leerdam and in Maastricht in the year 1829. Today, these cities still host important glass plants. Flat glass production has been reported around 1900 in Vlaardingen, and the company for electronic equipment, Philips has produced lighting glass bulbs since 1916. Flat glass production (Pittsburg process) started in Tiel 1963 and in 1984 the begin of the float glass production took place there, respectively.

The glass production in the Netherlands has shown an annual growth of 4% in the period from 1989 to 1999. The net annual production in 1999 was 1.36 mill. t, this includes float glass, glass fiber, insulation wool, tableware, container glass, glass tubes, sodium silicates. Container glass is manufactured by BSN glass pack (three plants), Rexam Glass (one plant), Heye Glas Nederland (one plant). Float glass is produced by Glaverbel Nederland and insulation glass wool by Saint-Gobain Isover Benelux. PPG Fiber Glass produces E-glass reinforcement and textile fibers in Hoogezaand and Akzo PQ melts water glass (sodium and potassium silicates) in Winschoten. Philips Lighting manufactures glass products for lighting applications: tubes, bulbs and quartz glass in Roosendaal and Winschoten. All glass companies operating in the Netherlands are affiliated to large international enterprises.

There are 11 large glass production facilities in the Netherlands with 29 continuous running glass furnaces. In 1999, five oxygen-fired furnaces were in operation, 11 regenerative furnaces, 13 recuperative glass melting furnaces. The major product accounting for about 74% of the total glass production is container glass. Figure 1



Figure 1. Locations of glass production plants in the Netherlands; 1: PPG Fiber Glass, Hoogezaand; 2: Philips Lighting, Winschoten; 3: Akzo PQ Silica (waterglass), Winschoten; 4: Glaverbel Nederland (float glass), Tiel; 5: BSN glass pack (container, tableware, crystal), Leerdam; 6: BSN glass pack (container), Schiedam; 7: BSN glass pack (container), Maastricht; 8: Heye Glas NL (container), Moerdijk; 9: Philips Lighting (tubes), Roosendaal; 10: Saint-Gobain Isover Benelux (insulation), Etten Leur; 11: Rexam Glass (container), Dongen; 12: Rockwool International, Roermond.

shows the locations of the glass manufacturing plants in the Netherlands.

The net annual glass production (excluding rock wool) amounts to 82 kg glass per person (Netherlands population is 16.6 mill. people). This specific production level is among the highest in the world. Table 1 shows the production shares for the different sectors within the glass industry in the Netherlands. The recent development in the Dutch container glass production is presented by figure 2. The primary Dutch glass industry employs about 4500 to 5000 people with an annual turnover of about 600 mill. Euro.

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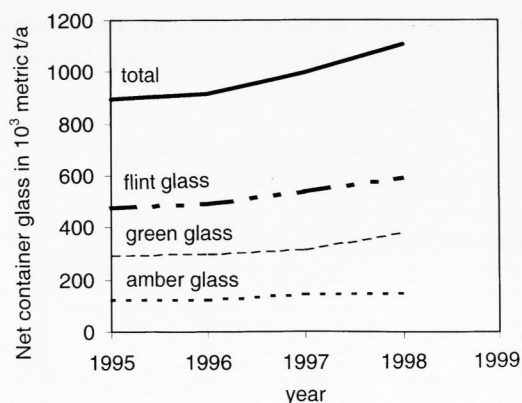


Figure 2. Development of the net container glass production from 1995 to 1998 in the Netherlands.

Table 1. Glass production shares of the Netherlands glass industry in 1999 (total production: 1 600 000 t molten glass, 1 360 000 t sold glass)

glass type	production of molten glass in %
float	11.9
container	74.0
fiber	8.0
lighting	1.9
sodium silicate	3.7
special	0.5

Note: The percentage base on data obtained from 5 oxygen-fired, 11 regenerative, 2 port and 14 recuperative furnaces, respectively.

Besides the production of the previously mentioned glass types, also glass frits (enamels, glazings) are produced at two locations: by Ferro B.V. in Rotterdam and by Johnson Matthey in Maastricht. Lead crystal glass articles at Royal Leerdam are produced by the use of pot furnaces. Stone wool for insulation and agricultural purposes is produced with the use of cupola furnaces in Roermond by Rockwool International.

The glass manufacturers are associated in the Vereniging van Nederlandse Glasfabrikanten (VNG), the association of Dutch glass manufacturers. This association established a foundation for research activities and education, the National Committee of the Netherlands Glass Industry (NCNG). The NCNG is a member of the International Commission of Glass (ICG). Every year, a glass technology course at academic level is organized by NCNG. Pre-competitive glass technology research is carried out under supervision of the NCNG.

Research is focused on melting technology, modeling of glass melting processes, environmental issues, sensors for glass furnaces and energy efficiency improvement in glass production. The NCNG and the Research Association of the German Glass Industry (HVG) exchange information on pre-competitive research projects in the Netherlands and Germany on a regular basis.

In the last 30 years a steady transition in the Dutch glass production from empirical approaches to improved technologies, based on an understanding of the chemical and physical processes has taken place. NCNG supervises about eight larger pre-competitive research projects, carried out by TNO TPD and partly funded by NOVEM (Dutch Agency for Energy and Environment). Major topics of research and development are:

- development of CO sensors for combustion gases;
- reduction of evaporation and foaming during glass melting;
- assessment of high-temperature glass melt spectra;
- primary NO_x reduction techniques;
- optimization of batch melting;
- sulfate chemistry and sulfate fining;
- mechanisms and kinetics of superstructure refractory corrosion;
- alternative raw materials for glass coloring and fining;
- model-based predictive control of glass furnace operation;
- new melting concepts;
- radiation heat transfer in glass melts and gobs.

TNO TPD and the Eindhoven University of Technology (TUE) are the main independent groups, investigating glass melting in the Netherlands. Other research groups focused on glass technology are Philips Development Lighting Components, Philips Basic Technology Glass, both in Eindhoven, and PPG Fiber Glass in Hoogezand. Academic courses on glass technology for university students are given at the TUE. About ten PhD studies on glass melting, waste vitrification, glass melt sensors, new melting technologies and glass melt properties provide fundamental understanding and knowledge to the glass industry and the related research institutes.

The Dutch glass industry achieved, within ten years time (1989 to 1999), a reduction in the specific energy consumption of 15%. Also the flue gas emission levels have been reduced drastically. The specific emissions of NO_x, for instance, decreased by about 50%. Glass recycling has been organized since 1972, in the year 2000 85% of the container glass is recycled. Recycling of flat glass, lighting glass and TV glass will become an issue of growing importance in the next decade.

New technologies introduced in the Dutch glass industry in the last decade are:

- light-weight container glass production;

- secondary heat recovery from flue gases: batch pre-heating and application of waste gas energy driven turbines;
- high-temperature sensors for exhaust gases and combustion control;
- semi-dry scrubbing of flue gases;
- all-oxygen fired glass furnaces;
- low-NO_x furnace designs;
- process-integrated control of emissions;
- new forming technologies in fiberizing of glass.

The Dutch glass industry will start the benchmarking of the energy efficiency of their glass furnaces against the best technologies in the world in the period from 2001 to 2012. Additional future developments will be focused on a further improvement of glass quality, light-weight glass articles, coatings and process-integrated measures for reduction of flue gas emissions and for a more efficient energy consumption.

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