Glass loses its shine

The glass industry was among the sectors which suffered from the beginning of the financial downturn. Mainly depending on the construction, automotive and consumer goods markets, it was affected as early as Q4 2008, all segments included.

“The financial crisis has had a direct impact on the trust of consumers and we suffered from the general decrease of consumption,” Michael Delle Selve, communications and operations manager at the European Container Glass Federation (FEVE) told IM.

Although the glass industry has suffered as any other industrial sector from the financial crisis during 2009, the impact was less dramatic than for others with an average 10% decrease at a European scale.

“The industry is quite stable, although suffering from the aggressiveness of competing materials in some market segments such as wine, mineral water, fruit juices, and baby food,” Delle Selve added. Competition from China also remains a source of concern.

However, recovery is still far away and the first months of 2010 saw a slow improvement. As a consequence, most of the players in the industry remain cautious and tend to see the glass as half empty, notably in Western Europe where growth remains low. According to FEVE data, all main European glass producers (containers) saw a dramatic decrease in their production at the fall of 2008.

Germany, Europe’s leading producer, saw its output decline from 4.1m. in 2008 to 3.8m. tonnes in 2009. The scenario was identical for other leading producers such as Italy, France, the UK and Spain.

The market is now evolving slowly, looking at new opportunities to develop with a trend to focus on energy efficiency of production with CO₂ targets. The other main concern is to develop technology in order to modify the basic properties of the glass through post-treatments (surface, temper, others), chemistry modifications, and nanotechnologies. “It is expected to generate potential new applications in traditional and new sectors like PV [photovoltaic cells], energy saving flat glass and so forth,” refractories for glass consultant Carlo Ratto explained to IM.

Flat, containers and fibreglass

The glass market is very heterogeneous, with a large variance and many different segments, the main ones being float, containers and fibreglass (see panel Main types of glass p.35). Those different sectors performed differently during the crisis as they all depend on different end markets.

About 75% of the glass produced goes to the building industry and 20% to the automotive.

“Container is the worst being under attack of alternative packaging, particularly in the North American Free Trade Agreement (Nafta) [between the USA, Canada, and Mexico] where there is clear over capacity and a more recent trend to import cheap containers from China,” underlined Ratto who believes that container is a viable business only in South America and East Asia.

With flat glass depending on the building sector, it comes as no surprise that it is performing significantly in rapidly growing economies such as Brazil, China, and India. It is however still struggling in Europe.

As a leading European glass mineral producer described to IM, 2010 is expected to be better than 2009 but there is still pressure in flat glass, container and insulation. However, fibreglass reinforcement is performing better, due to increasing application of insulation in buildings all over the world.

Beside optical fibres, glass substrate for TFT LCD (Thin Film Transistor Liquid Crystal Display), and plasma screens is seen as possibly the best niche. “But again, the game is mostly played in East Asia,” Ratto highlighted.

E-Glass, mostly linked to electronic industry, is therefore mostly localised in Asia.

One of the other growing segments is solar glass. Although just 5% of the glass produced in Europe is used for solar glass, it is seen as one of the most promising sectors as the market is developing significantly. According to some people in the industry, glass produced for solar applications could even become a bigger sector than automotive by 2025-2030.

Asian competition

One of the main concerns in the glass industry, as for other sectors, is the rising competition from Asia, mainly China and India.

As Ratto underlined, the financially driven industrial companies left without long-term strategic planning have been unable to make fast and sound decisions under attack of Chinese competition.

Big corporate have pursued delocalisation as the single action to secure survival and profitability, pressing down on western economies and generating unemployment and depression.
Main types of glass

Float glass
- Term ‘float’ glass derives from the production method, introduced in the UK by Sir Alastair Pilkington in the late 1950s in the UK, by which 90% of today’s flat glass is manufactured
- Composition: silica sand, calcium oxide, soda and magnesium

Soda-lime glass
- The most common
- Used for the manufacture of flat glass, most containers, electric light bulbs and many other industrial and art objects
- More than 90% of all glass produced is soda-lime glass
- All glass container manufacturers use the same basic soda-lime composition and generally employ only three basic colours, so-called flint (clear), green and amber (brown)
- This greatly simplifies the recycling process and allows the different manufacturers to recycle one another’s products without difficulty, other than the need to practice colour segregation
- Composition: silica sand (72%), sodium oxide from soda ash (13%), calcium oxide from limestone (11%), minor ingredients (about 4%)

Fiberglass
- Made from extremely fine fibres of glass
- Used as a reinforcing agent for many polymer products good thermal insulation, with a thermal conductivity
- Uses for regular fiberglass include mats, thermal insulation, electrical insulation, sound insulation, reinforcement of various materials, tent poles, sound absorption, heat- and corrosion-resistant fabrics, and automobile bodies
- Composition: mainly silica

Borosilicate glass
- Heat-shock resistant
- Better known by such trade names as Pyrex or Kimax
- Although not strictly a glass, commonly known as a glass-ceramic, this material is glass-like in appearance, and is used to make items subjected to high temperatures including cookware such as Visionware, cooker doors and hob tops
- Not recyclable as pyroceramics melt at a greater temperature than soda-lime glass.
- Composition: 80% silica, boron trioxide (13%), sodium oxide (4%), alumina (3%) [4% pyroceramics]

Lead glass
- Commonly called crystal glass
- Made by substituting calcium oxide with lead oxide and often for part of the silica used in soda-lime glass
- Optical properties widely used for the finest tableware and art objects

Cathode Ray Tubes (CRT)
- Found in televisions and computer monitors
- Made essentially from four different glass component parts.
- A typical CRT tube comprises the screen, the funnel, the neck and a glass frit or solder used to join the component parts together
- The screen is the heaviest component, lead oxide free
- Composition: high levels of barium, strontium, and zirconium
- Other glasses all of similarly complex compositions but contain varying amounts of lead oxide
- The consumer change in TV screens has significantly impacted the production and the waste stream in this sector. Consumption is falling

Optical Glass
- Can be designed to meet almost any specified combination of optical properties of which the most important are the refractive index (representing the bending of a ray of light striking the glass at an oblique angle) and the dispersion (the dependence of the refractive index on wavelength resulting in colour separation)
- Glasses with high dispersion relative to refractive index are called flint glasses while those with relatively low dispersions are called crown glasses
- Flint glasses are lead alkali-silicate compositions whereas crown glasses are soda-lime glasses

Special Glass
- Glasses with specific properties and may be devised to meet almost any imaginable requirement, the main restrictions normally being the commercial considerations, i.e. whether the potential market is large enough to justify the development and manufacturing costs
- Specialised applications in chemistry, pharmacy, the electrical and electronics industries, optics, the construction and lighting industries, glass + glass ceramics which include pyroceramics
- May be the only practical material for the engineer to use

Sealing Glass
- Another application for which large varieties of glass compositions are used i.e. sealing to metals for electrical and electronic components such as in light bulbs
- Here the available glasses may be grouped according to their thermal expansions, which must be matched with the thermal expansions of the respective metals so that sealing is possible without excessive strain being induced by the expansion differences
- Where the requirement for electrical insulation is paramount, as in many types of vacuum tube and for the encapsulation of diodes, a variety of lead glasses (30%-60% lead oxide) can be used

“Governments, in the hand of multi-national global companies and in need of Chinese resources to buy the debt, have been and are incapable adopting measures aimed to protect our jobs and strategic know-how. Glass like most commodities, of course,” he added.

However, competition from China will vary depending on the segment. For instance, containers can be easily exported from China to end users in Europe. However, it becomes a more challenging task when it comes to flat glass, which is more difficult to transport.

Other major competition comes from North Africa which became a major glass producer during the last decade. Almost all North African production is exported, mainly to Europe.

“Their costs are very low compared to Europe which is why they attract end users,” a source from the industry told IM.

As an example, only one float glass project is planned in Europe (Italy) within the next five years whereas more than ten projects should flourish in North Africa and neighbouring countries to EU such as the Ukraine.

India also sees its glass production rising significantly along with other sectors such as ceramics or refractories.

“India is one of the world’s fastest growing economies. The growth in its population and higher standard of living are driving forward in particular the subcontinent’s construction and automobile sector, while the demand for consumer goods is also rising,” Jasdeep Singh, from the Confederation of Indian Industry (CII), told IM.

“In all these areas the material glass plays a superior role, for example as a modern construction material in architecture, as packaging material for foodstuffs and pharmaceutical products, as vehicle glass or the basis for displays and communication cables in the electronics industry,” he added.
Recycling vs. raw material
As in many industries, scarcity of resources and resource efficiency remain some of the main concerns. But as the main glass raw materials – sand, soda ash and limestone (see table p. 37) – are abundantly available in Europe, it is not seen as a major challenge. Although “there is now an increasing demand for stricter quality,” as a leading European producer for glass minerals highlighted to IM.

One of the major assets in the debate is the recycling factor, notably for containers.

“Recycling is the answer to the raw materials crisis,” said Delle Selve as “glass can be recycled without loss of quality all over again, meaning it can completely replace the need for virgin raw materials”. In the container industry, an average of 1kg of cullet (recycled glass) can replace 1.2kg of raw materials. Glass bottles, fully recyclable, can be reused up to 50 times (see Glass at a glance). “Thanks to this feature, glass could regain some market shares in the future,” Delle Selve said.

As a consequence, the recycling and resource efficiency issues have become one of the main themes for the EU which wants Europe to move towards a recycling society in the coming years. The EU has therefore decided to focus during 2011 on how it could become more resource efficient.

Delle Selve however warns that “recycling is not the same as down-cycling!”

If in the recycling process a material loses its quality and original properties, or is used for another purpose than the original one, then it is down-cycling and the next stop is essentially landfill. “It is clearly not as good as having a material which maintains its properties and quality infinitely, and can run into a ‘bottle-to-bottle’ loop like glass,” Delle Selve explained.

Challenges
On order to stay competitive, the glass industry has to innovate, and generate new applications and new products with adjunct value. In addition, it has to be capable to absorb western labour costs and generate a stream of financial resources to devote again to research and development to keep wheels turning.

“If today’s miserable resources are only devoted to utilise cheap and low-quality raw materials to fight the invincible Chinese (and not only!) competition, we will never be able to innovate and therefore we will compress downward our companies toward unavoidable failure,” Ratto said.

“In my opinion, every company should be able to sell around 20% of their product through new products and new applications every year, with a five-year turnover of the portfolio, so as to keep riding the wave of innovation against commoditisation. This is the big challenge,” he added.

Environment became on of the main focus for the glass industry which is looking at producing in the long run in an environmentally sustainable way, using less energy and less resources.

“This is not just good for the environment but it is also good business,” Delle Selve believes.

<table>
<thead>
<tr>
<th>World top float glass producers</th>
<th>Industries</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilkington Plc / NSG Group</td>
<td>• automotive • construction</td>
<td>Invented the float glass process</td>
</tr>
<tr>
<td>Saint-Gobain</td>
<td>• flat glass manufacture • building • automotive glazing</td>
<td>Markets: France (17%), other Western European countries (46%), North America (%), Asia and emerging countries (36%)</td>
</tr>
<tr>
<td>Guardian Industries Corp.</td>
<td>• automotive • exterior products</td>
<td>Leading Japanese glass manufacturer</td>
</tr>
<tr>
<td>Asahi Glass Co. Ltd.</td>
<td>• automotive</td>
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</tbody>
</table>

Glass at a glance

**Flat glass**
- World production (2008): 53m. tonnes
- European capacity (2009): 12m. tonnes

**Glass container (Europe)**
- Production (2009): 20m. tonnes; down from 22.5m. in 2007
- Main producers (in tonnes, 2009): Germany (3.8m.); Italy (3.3m.); France (3.1m.); UK (2.1m.); Spain (1.9m.)

**Main minerals**: Silica sand, limestone and soda ash are main raw materials used by the industry and recycled cullet is used as much as possible (see table p.37)

**Water**: The industry is not a large user of water, >1m/tonne glass produced

**Energy**: Glass manufacturing is an energy-intensive process; 47 MWh/tonne glass melt (down from 94 MWh/tonne in the 1980s)

**Recycling**: The amount of glass recycled in 2006 was 1.3m. tonnes, accounting for 54% of the total waste stream. The container industry recycled a record 751,845 tonnes of cullet back into new bottles and jars. Remelting waste glass uses 25% less energy than making glass from raw materials

As the industry can recycle almost all of its own rejected production, very little solid waste is produced. Furnace rebuilds produce a large amount of refractory waste but this in turn can be recycled and a typical furnace has a life in excess of 10 years

**Main uses**
- packaging (containers for food and beverages, pharmaceutical glass, etc.)
- building (windows, security glass, safety glass, mirrors, etc.)
- automotive (glazing, lighting, etc.)
- glass wool for insulation
- reinforcement fibres for composite materials
- household glass (tableware, ovenware, furniture, etc.)

**Other applications**
- biomedical (artificial kidneys, prostheses, laser operations)
- energy (solar and heat control glass, fuel cells, laser glass, solar cells, etc.)
- art (handmade glass, vases, etc.)
- optics and optoelectronics (optical fibers, optical devices, lenses, mirrors, etc.)
- electronics (insulators, display panels, integrated circuits, etc.)
- lighting
Investments in the glass industry, which are long term as about 10 to 15 years are needed for a furnace, have to be planned well ahead.

As a consequence, glass producers are today looking at what environmental improvements can be made, what kind of efficiencies are needed and what kind of technologies will be around in 2025. “The challenge is to get that right,” underlined Delle Selve adding that in 2011, the EU will look at how the industry could become more resource efficient.

EU policies have added pressure on the glass industry. The Emission trading Scheme, the new Glass BREF, and the end-of-waste criteria are among the biggest challenges. As Delle Selve explained, although those regulations have their own cost for the industry, “their cumulative impact represents a hardly bearable burden, with high risks of re-location outside Europe where the legislative pressure is less penalising.”

Outlook

Even though glass is slowly moving toward recovery, the industry does not see the future through rose-coloured glasses, above all in Europe. During the last years, glass has been a growing market, but the growth was less rapid than competing materials. Delle Selve does “not expect any major changes of this trend for the coming decades”.

“Six months ago there was generally a more positive expectation for a faster recovery. Now the feeling is that there will be a mix of recoveries and stagnations, and that in some major businesses, like containers in the West, we will never get to the ante-crisis level,” Ratto forecasted.

A source from the industry confirmed to IM that the levels of 2007, which was historically recorded as the best in the glass industry, could take as long as five or six years to be reached again.

In the short to middle term, the glass market is expected to get to a new quasi-equilibrium with a trend like in most industries such as cement, ceramics or steel, to focus on Asia, owing to the dramatic growth of the region which will be mostly a market of consumers, until there will be resources to spend in exchange of cheap goods.

“When resources are dried up, then who knows what will happen. I will be glad to be not here by then,” Ratto said.

### Top glass minerals

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Properties</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica sand</td>
<td>• Main ingredient (50-60%)</td>
<td>$20-26/tonne for silica sand, glass sand, container, ex-works USA</td>
</tr>
<tr>
<td></td>
<td>• Often combined with oxides to form silicate minerals</td>
<td></td>
</tr>
<tr>
<td>Soda ash</td>
<td>• Primary source of sodium oxide (Na₂O), which is used as a primary fluxing agent in the melt</td>
<td>The most expensive ingredient in glass making $150-300 depending on grade</td>
</tr>
<tr>
<td></td>
<td>• 12-15% but amount can be reduced by using feldspar and nepheline syenite</td>
<td></td>
</tr>
<tr>
<td>Limestone/ dolomite</td>
<td>• The 3rd largest constituents</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Included to introduce calcium oxide (CaO) as a flux into soda-lime-silica mixes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• CaO increases insolubility factor of the finished material</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• improves material strength</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• reduces brittleness</td>
<td></td>
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<tr>
<td>Magnesia (MgO)</td>
<td>Dolomite = partial replacement of limestone when magnesium is desired in the batch</td>
<td></td>
</tr>
<tr>
<td>Feldspar/ nepheline syenite</td>
<td>Contain high content of alkalis and alumina</td>
<td>$70/tonne Feldspar, Turkish, Na feldspar, Glass grade, -500 microns, bagged, FOB Gulluk</td>
</tr>
<tr>
<td></td>
<td>Alkali acts as a flux</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alumina acts:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• as a matrix former by reducing the tendency for glass to devitrify</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• as a stabiliser which improves the chemical durability of glass as well as its physical resistance to scratching, bending, breaking and thermal shock</td>
<td></td>
</tr>
<tr>
<td>Borates</td>
<td>• Essential constituents in fiberglass for reinforcement and insulation purposes as well as in borosilicate glass.</td>
<td>$350-830/tonne depending on grade</td>
</tr>
<tr>
<td></td>
<td>• Boric oxide introduced as refined chemicals (borax, boric acid) or as natural minerals (colemanite, ulexite, tinca), depending on whether pure or anhydrous borates are needed or wether certain impurities contained in the naturally occurring minerals can be tolerated.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Powerful solvents (or fluxes) for many metal oxides used in glass manufacture</td>
<td></td>
</tr>
<tr>
<td>Lithium</td>
<td>Lithia acts as a powerful flux, especially when used with sodium and potassium feldspars</td>
<td>Particularly valuable component in glasses with a low thermal expansion as it helps the total alkali content to be kept to a minimum</td>
</tr>
<tr>
<td></td>
<td>• allows production of glasses with high electrical resistance and desirable working properties, and glass capable of transmitting ultraviolet light</td>
<td></td>
</tr>
<tr>
<td>Cullet (recycled glass)</td>
<td>• usually added to the traditional mixture of glass raw materials in the furnace</td>
<td>With the introduction of bottle banks in Europe about 30 years ago, the volume of recycled glass has increase sharply. In many container, glass production plants recycled glass has become the major raw material</td>
</tr>
<tr>
<td></td>
<td>• helps to reduce the energy required to melt the raw materials as it acts as a flux</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• also reduces atmospheric emissions from the melting tank</td>
<td></td>
</tr>
</tbody>
</table>

Source: IM, various