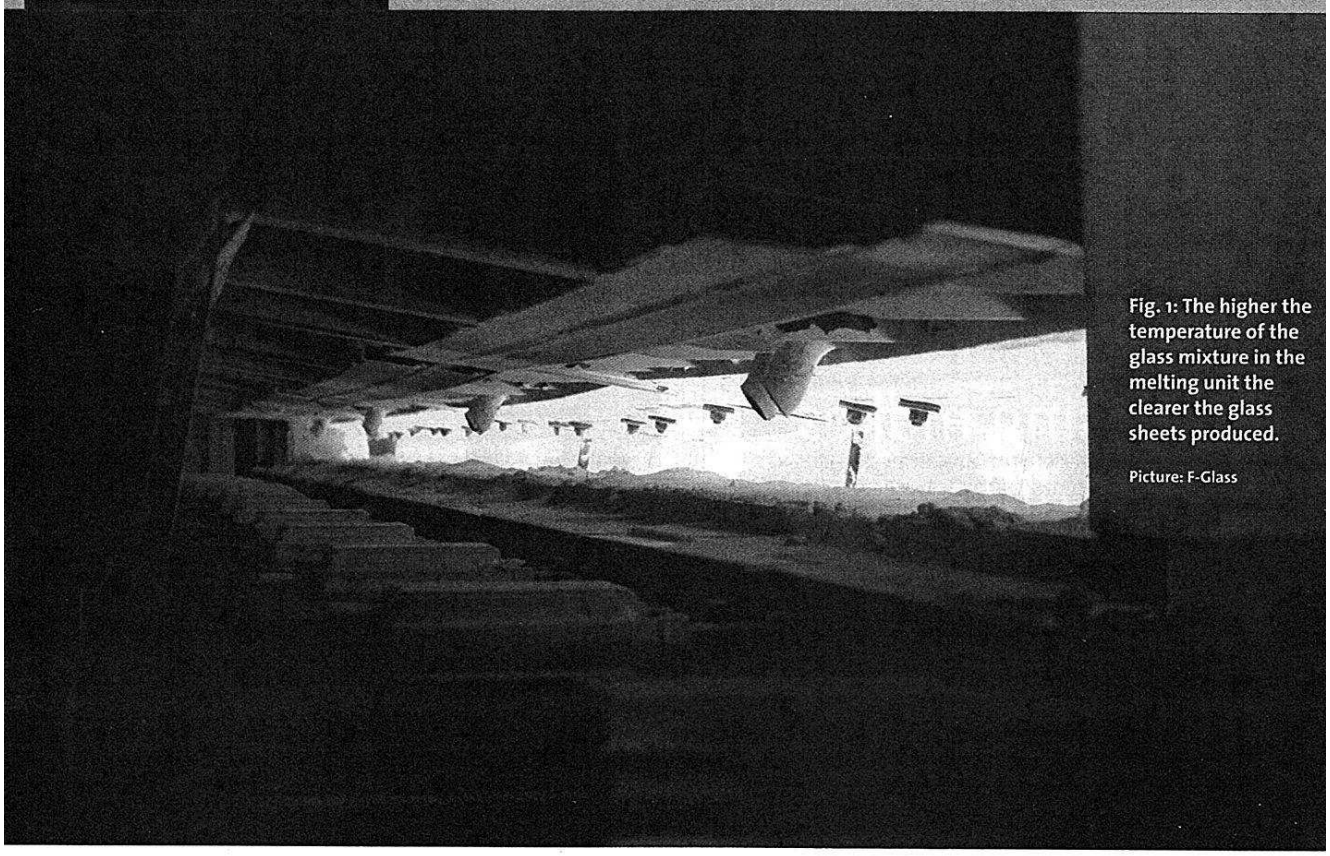

Fig. 1: The higher the temperature of the glass mixture in the melting unit the clearer the glass sheets produced.

Picture: F-Glass

FOCUS ON THE SUN

Glass Industry Discovers Profitable Growth Market Flat glass producers have discovered photovoltaics as an important sales market: they are investing in new solar glass manufacturing sites, developing more efficient production workflows, and improving their products. This in turn benefits module makers: sheet glass prices are coming, down permitting higher yields.

Flat glass producer Interpane has hitherto produced mainly automotive and window glass. But since the automotive and construction industries prove to be less consistent buyers in times of crisis, the Lauenförde-based company entered the photovoltaics (PV) market in 2009. Together with Dutch glass and solar systems producer Scheuten, they have invested € 190 m in building a fully integrated glass factory in Osterweddingen near Magdeburg which is geared to PV needs. The factory produces translucent white glass and finishes the sheets so that they can be used directly for module production. Immediately after production they are cut, polished, drilled to accommodate power supply lines, and coated with an anti-reflective film. Commenting on this, Thomas Keyser, Sales Manager of the joint venture now bearing the company name F-Glass, said: "Osterweddingen is a win-win operation. Solar system producers receive top-quality glass for higher module outputs and we participate in the growing PV market."

F-Glass is synonymous with a rethinking process in the glass industry. For many producers PV has until now been just a niche market catered to as a sideline. Of the 38 million tons of flat glass manufactured in 2009 at the world's float and rolled glass plants, module producers only required about 630 000 tons for frame and carrier glass, i.e. not even two percent. It was therefore hardly worthwhile for glass producers to refit their existing lines for PV production, to say nothing of building new plants for this purpose. Refitting alone generates tremendous costs. Since solar glass must transmit as much light as possible, it may only contain one eighth of the amount of iron present in plain and simple window glass. Such quality requires purer silica sand and higher melting temperatures.

The lower the iron content of the glass, the faster it cools down, and such rapid cooling produces obstructive bubbles. To avoid these bubbles the molten glass must be heated to 1 600 °C. The crux of the matter: a switchover to PV glass production means that a line would have to be shut down, and companies are very reluctant to do so. "The investment cycle in flat glass production amounts to approx. 15 years. Throughout this period the float line must be in operation 24/7 to be profitable", explains Interpane spokesman Marc Everling.

Key to low module costs

Since glass producers have only recently turned their attention to PV, sizeable cost reductions for solar glass have so far

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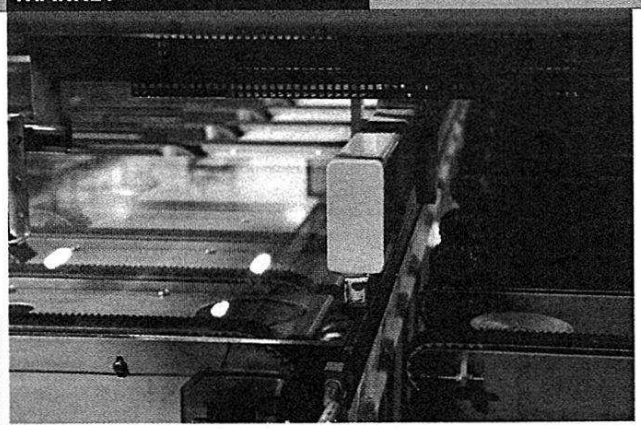
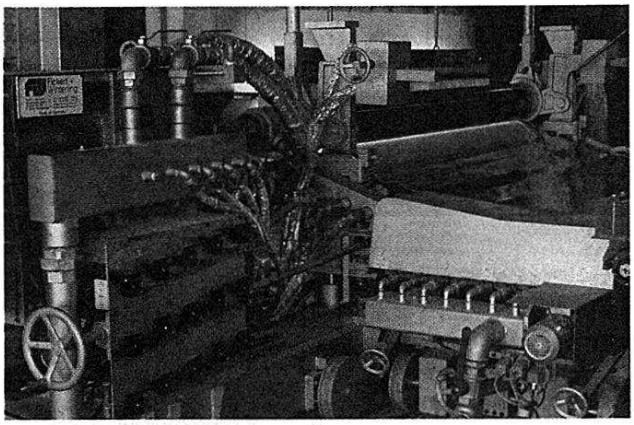
failed to materialise. While It is true that module prices have come down by 40 percent over the past two years, this drop is primarily due to economies of scale generated by higher production volumes, optimised production equipment for cells and modules, as well as tumbling silicon prices. In contrast, solar glass at some ten euros per square metre still costs as much as it did four years ago when the solar boom took off. According to Sabine Hönig of the Technical & Mining University Freiberg, glass accounts for about five percent of the costs for silicon modules, and as much as 15 to 25 percent in thin-film panels where carrier and cover glass is needed. If module producers reduced their costs by another third over the next three years, the cost of glass might even account for 60 percent of total cost. "Glass can become the bottleneck for a further reduction in production costs", warns the expert.

But there is hope for better and less expensive material. "Solar energy is becoming more and more important to us", says Keyser. This statement is confirmed by facts and figures: While float glass producers recently operated their lines at only up to 90 percent capacity utilisation on account of falling demand from the crisis-struck automotive and construction sectors, demand from module makers has been rising consistently. If the installation of solar systems continues unabated, PV is forecasted to require almost 1.7 million tons of special glass in 2012 – nearly three times as much as in 2009. F-Glass will be one of the suppliers. The company plans to sell more than 100 000 tons of special glass to the sector annually – enough for some 1,300 megawatts of module output. The main focus of the East German facilitiy is on cost efficiency. The smelting furnace in Osterweddingen holds 2 000 tons of molten glass. At just under 1 600 °C the melt containing silica sand, lime, soda, and cullet finally attains the quality required for PV glass. To save energy, engineers have insulated the melting furnace with 2 000 tons of refractory stone. "This allows us to reduce our energy requirements by 15 percent", explains Keyser. Subsequently, the melt flows onto a liquid tin bath, giving it a surface as smooth as a mirror. Then the glass is cooled down to 60 °C in the annealing lehr and cut. The resulting products are four millimetre thick sheets, which allow 90.5 percent light transmission thanks to their low iron content of as little as 80 ppm. Anti-reflective coatings increase light transmission even further up to 96.2 percent. For customary solar glass the transmission lies between 90 and 95 percent on average. By undertaking these processing steps on site F-Glass saves further costs. Usually such glass is processed at a different site and product



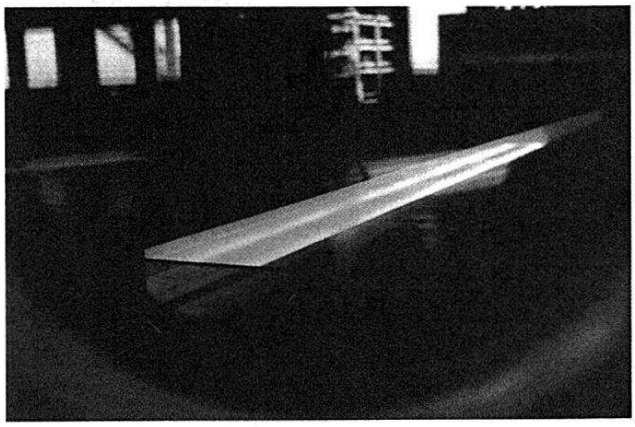
Picture: F-Glass

Fig. 2: After production the sheets are visually inspected and sized in a cutting line.



Picture: Fickert + Winterling

Fig. 3: Rolled glass is in great demand in the PV industry due to its low manufacturing costs and favourable properties.



Picture: F-Glass

Fig. 4: A coating line applies functional layers to the glass under vacuum for improved light transmission.

prices are increased by transportation over long distances and glass breakage. Scientist Hönig estimates that transport and processing account for three quarters of the cost of solar glass. F-Glass supplies module producers with finished products right away. "This allows us to offer high-quality glass at competitive prices", says Keyser.

Costly processing

Float glass suppliers have to expect strong competition because rolled glass manufacturers also have big plans with PV. Rolled glass is of minor importance on the marketplace since it is not as even as mirror-like float glass. Architects and automobile makers are not prepared to accept this unevenness but rolled glass actually has advantages for use as PV for cover glass. The unevenness acts like a light trap, thereby increasing the power yield of modules. Furthermore, rolled glass is cheaper to produce than float glass. "Quality requirements for raw materials are not that high and less energy is consumed because there is no need for the hot tin bath", says Hönig.

The same quality produced more cost-efficiently – this makes rolled glass very attractive for PV. Which is also why demand for the relevant equipment is rising, as Werner Haag of Fickert + Winterling from Marktredwitz in Upper Franconia points out. He reports that his firm's rolling mills are currently in great demand, going on to say: "We especially receive orders from glass producers in China." No fewer than 25 glass rolling lines have been installed in that country in just the past 12 months.

The glass module factory

In fields where plenty of money is made there is financial scope for innovation. This is why the plant builder from Upper Franconia has joined forces with other suppliers in the Solarvis network to develop a concept for a distinctly smaller and lower-cost factory. A daily output of 30 to 50 tons is planned, i.e. just one fifth of the usual glass rolling mill capacity, but at only half the cost, i.e. € 15 to 20 m. This would make it attractive for module producers to invest in their own glass factories. Companies could produce glass sheets according to their own specifications while saving transport costs at the same time. Float line operators counter this argument by saying that their 1 000 ton lines are perfectly geared to meet the fast growing PV demand. Furthermore, researchers and engineers have developed many new coating and processing strategies for large-batch production. "With small rollers a giant sputtering line is of no use", Bernd Szycka of the Fraunhofer Institute for Layer and Surface technology in Brunswick adds for consideration.

Emerging competition in the glass market should stimulate innovation. The development potential of solar glass is far from being exploited. "If the glass industry is prepared to invest, cost reductions of up to 50 percent will be possible by 2015", Hönig believes. Integrated glass production and processing or glass and module production plants can avoid transport costs. Likewise, thinner glass and new anti-reflective layers will also bring down costs. Quality sheets currently allow some 95 percent of the light to pass, future ones are expected to transmit 99 percent of the incident photons. Cells located behind such glass sheets would also bring 4 percent more yield. ■

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FACTS FOR DECISION MAKERS

New options, well-known technique

- Solar glass at some ten Euros per square metre still costs as much as four years ago when the solar boom took off.
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- Rolled glass is of minor importance on the market since it is not as even as mirror-like float glass. But as cover glass for for PV the unevenness acts like a light trap thereby increasing the power yield of modules.