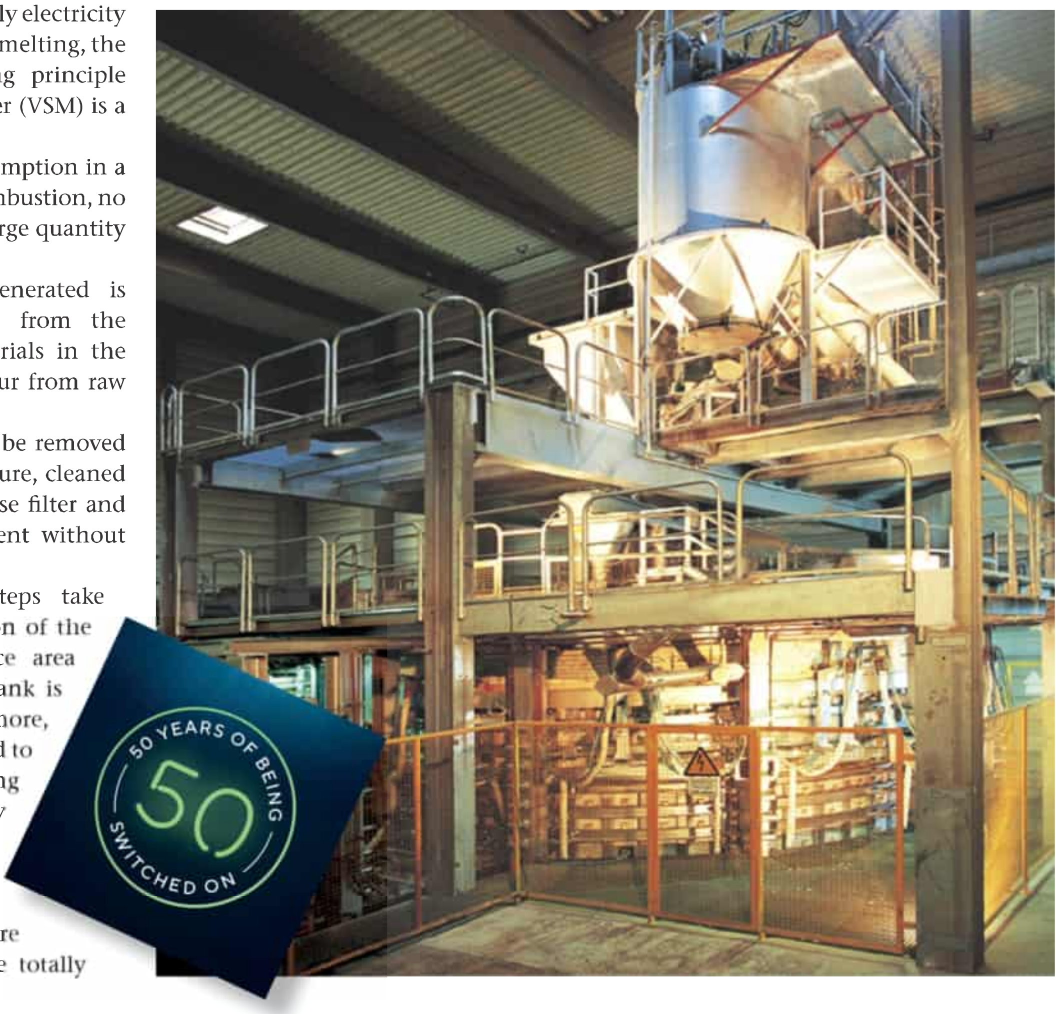
An all-electric melter for a variety of glass types

The cold-top vertical melting principle of an electric-fired furnace reduces energy consumption. And, with an increased focus on the environment, they are likely to enjoy a renaissance in years to come reports Volker Müller*.



For glass furnaces using only electricity as their energy source for melting, the cold-top vertical melting principle of Sorg's Vertical Super Melter (VSM) is a proven technology.

It can reduce energy consumption in a number of ways. With no combustion, no energy is lost in terms of a large quantity of waste gasses.

The only gas stream generated is a relatively small amount from the decomposition of raw materials in the batch, as well as water vapour from raw material humidity.

This waste gas stream can be removed from the furnace superstructure, cleaned by means of a small baghouse filter and released into the environment without any further treatment.

As the main process steps take place in the vertical direction of the furnace, the outside surface area of the cylindrical melting tank is relatively small. Furthermore, heat insulation can be applied to large parts of the tank, making losses through the refractory exceptionally low.

Other large components with high wall losses, such as a large superstructure or heat recovery system, are totally unnecessary.

Sorg's patented rotating crown batch charging system will achieve a perfectly even coverage of the melt with a layer of raw materials. This batch blanket acts as an insulating layer on top of the melt and an integrated batch preheater, resulting in superstructure temperatures of between only 150 and 300°C. The sealed superstructure also prevents dust within the factory.

Relatively easy to operate, all-electric melters also benefit from less maintenance and a shorter repair downtime. And with more than 100 VSM furnaces installed since 1971, all kinds of special glasses have been successfully produced, including everything from borosilicate glass to tableware.

The early days

The first widely-used application of all-electric melters was in producing glasses with volatile components. Due to the cold raw material cover, these components can be reabsorbed in the batch blanket and not lost to the environment.

One example is opal glass, with a fluorine content of up to several percent, often used for cosmetic containers and jars, dinner plates and lamp shades. The hydrogen fluoride emissions are greatly reduced, protecting the safety of workers around the furnace, and also the environment.

Glasses containing boron are another example, including C-glass for insulation and technical fibers, as well as borosilicate glass for lab and cooking ware. Avoiding the evaporation of sodium borate stops superstructure corrosion, furthermore,

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boron components have lately been classified as harmful to human health.

Classic soda-lime glass has been frequently produced by the VSM too – but mainly for special applications with high to very high glass quality requirements. These include lighting ware, such as

headlight covers, lamp shades and tubing for fluorescent lamps. Together with drinking glasses for wine, beer, water or liqueur, and perfume flacons and cream jars.

Present day possibilities

In recent years there has been an increased demand for all-electric melters in localities with high environmental requirements. A glass producer located in an urban setting or in close proximity to a recreation area may only be allowed to extend production capacity by switching to a furnace technology that avoids emissions of air pollutants like sulphur dioxide or nitric oxides. In certain cases, electricity can be the cheapest energy available – particulalry in areas with high hydro-power potential or limited / no supply of natural gas.

Simplicity of operation is one of the biggest advantages of all-electric melters. Without the need for combustion and waste gas treating equipment, only a small number of auxiliary aggregates have to be installed, operated and maintained. Just two main control loops are required – the electric heating power and glass level.

Plus, there's no need for fuel, oxidizer, ratio or furnace pressure control, no complicated waste gas treatment, no more cleaning burners and so on.

Once raw materials are adjusted to the cold-top process and as long as they're of a stable quality, day-to-day furnace operation is benign and can be broken down into relatively simple rules for the operators.

Maintenance work is mostly limited to the batch charging system as well as inspecting and exchanging worn electrodes, whenever necessary.

Current limitations

As with every technology, the cold-top vertical melting process has certain limitations, the first of which is in possible meter size and pull.

Since the cold-top process requires an even layer of batch to be spread across the whole surface of the melt, the possible size of batch charging equipment becomes a limiting factor.

No matter if an articulating boom charger, standing beside the furnace, is used – or a rotating crown batch charging system introducing the batch from above – all electric melters reach a size limit of around 200 metric tons per day.

The production of reducing glasses, most commonly used for amber and certain green containers, is difficult since the chemical reactions in the rough melting phase lead to a hardly controllable behaviour of the closed batch blanket.

Non-reducing colouring mechanisms for amber glass do exist, but they would have to be developed for large-scale application and potentially increase raw material cost.

Neutral glasses, especially tubing with an expansion of around 50x10-7 K-1 used for pharmaceutical containers and ampoules, have a limited absorbance for dissolved gases.

A refining cell between the melter and glass conditioning system can improve the glass quality – but since such a cell requires additional space and energy, hardly any neutral glass is produced with all-electric melters today.

Glasses for continuous reinforcement fiber (E/ECR/alumo-silicate glass composition) have a very low alkaline content and therefore a high specific electrical resistance. All-electric melters of a reasonable size would need to operate at dangerously high voltages.

Also, the quality requirements of the continuous fiber drawing process demand an additional refining/ conditioning system, with similar drawbacks to the ones mentioned before.

Future plans

The fight against man-made climate change and containing the growing global catastrophe make a drastic reduction in carbon dioxide emissions unavoidable. As long as there is a sufficient supply of carbon-neutrally generated electric energy, the solution for future glass production is electric melting.

For glasses mass-produced by fossil-fired furnaces today, especially container glass, the limitations mentioned earlier will require a certain transformation of the whole production process.

The limited furnace capacity means that a single all-electric melter might only supply one or two production machines.

However, this will also lead to higher flexibility in production and less furnace repair downtime impacting the overall output of the plant.

A shorter total lifetime of the all-electric melter is compensated by shorter glass-to-glass repair time and considerably lower refractory cost.

Also, the 'economy of scale' works in less favour of all-electric melters. Going from a medium to a large furnace (e.g. 140 t/d to 200 t/d) will only lead to a minor increase in wall losses – so the larger furnace is only slightly better in its specific energy consumption.

Finally, the limitation of possible glass colour remains – but why shouldn't a climate-neutral, 'green' beverage container actually be green instead of amber? Different decoration possibilities, such as printing or spray coating, can supplement the bottle design, at least for one-way bottles.

Here to stay

The future of glassmaking requires sustainable melting technology. Legal guidelines like emission trading and increasingly strict limits on air pollutants will force glass producers to change their furnace technology.

Classical combustion technology, like the regenerative firing principle that has been used for more than 150 years now, will soon demise.

At the moment, there's a lot of research and discussion on hybrid melter concepts and alternative combustion fuels, such as hydrogen.

These developments still have a long way to go – and due to the high capital cost and long lifetime of glass melting furnaces, the process is slow, with the conservative glass industry hesitant to advance in these new fields.

All-electric melters on the other hand, have proven technology and been in use for decades.

Such furnaces will see a renaissance in the production of special glasses, and by implementing certain process changes, will be the go-to alternative for mass produced glasses like containers.

With our own 50 years of experience in all-electric melting, clever equipment design and proven concepts – Sorg can supply a suitable furnace for existing plants and greenfield projects alike. ■

Visit our brand-new sustainable melting microsite to find out more: www.sustainablemelting.sorg.de

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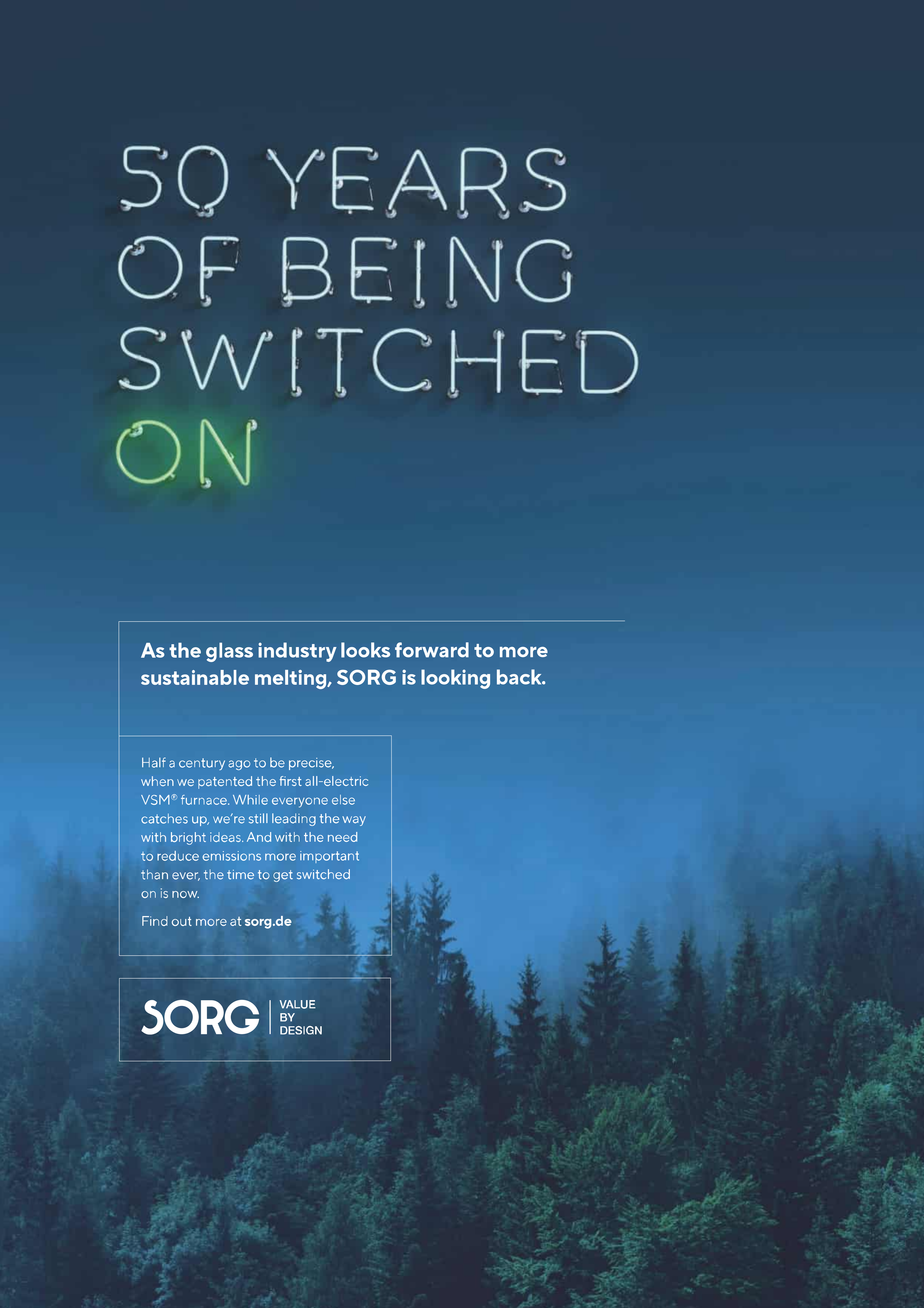
50 YEARS OF BEING SWITCHED ON
As the glass industry looks forward to more sustainable melting, SORG is looking back.
Half a century ago to be precise, when we patented the first all-electric VSM® furnace. While everyone else catches up, we're still leading the way with bright ideas. And with the need to reduce emissions more important than ever, the time to get switched on is now.
Find out more at sorg.de
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