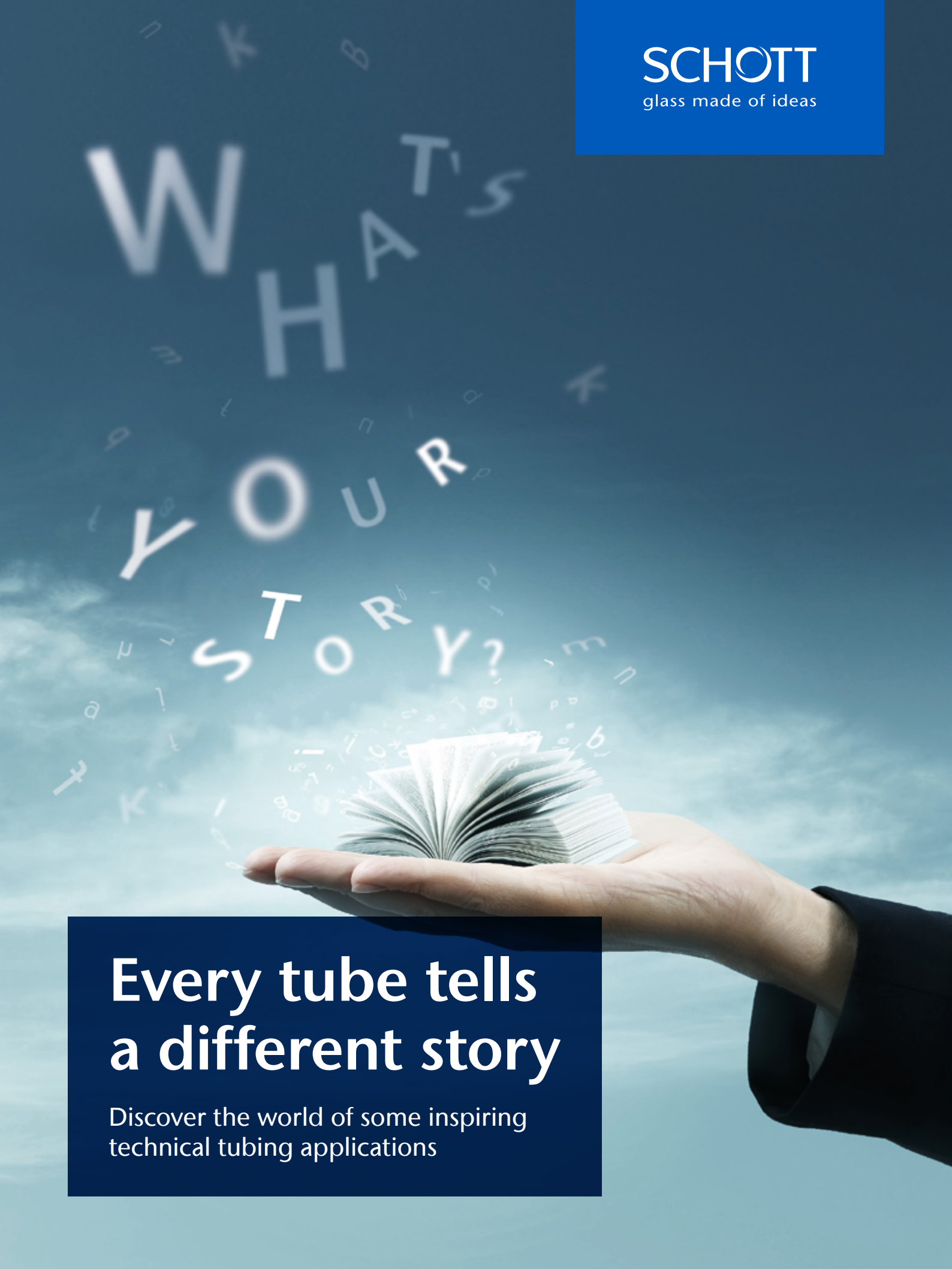
SCHOTT
glass made of ideas



Every tube tells a different story

Discover the world of some inspiring technical tubing applications

Where others say no, we say yes. Because at SCHOTT we believe that shared responsibility can release the energy to achieve the impossible. As a global material technology group, we are constantly exploring unique and innovative ways to make a difference for businesses and people. Being a foundation company, SCHOTT has anchored responsibility, scientific research, society and the environment deeply in its DNA. Represented in over 30 countries by 17,100 employees, we are a highly skilled partner for many high-tech industries. Whatever challenges the future might hold, we can't wait to come up with innovative solutions and turn visions into reality.

With a production capacity of round about 230,000 tons and production sites in Europe, South America and Asia, SCHOTT Tubing is one of the world's leading manufacturers of glass tubes, rods and profiles. More than 60 different glass types are produced in a large variety of dimensional and cosmetic specifications based on a standardized production process and a global quality assurance system. SCHOTT Tubing provides customized products and services for international growth markets such as pharmaceuticals and electronics as well as industrial and environmental engineering.

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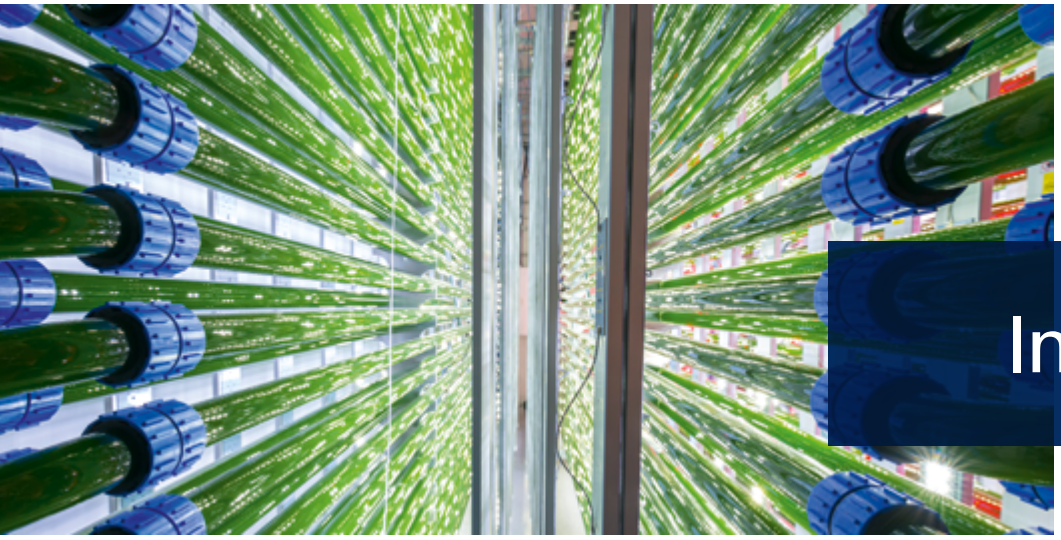
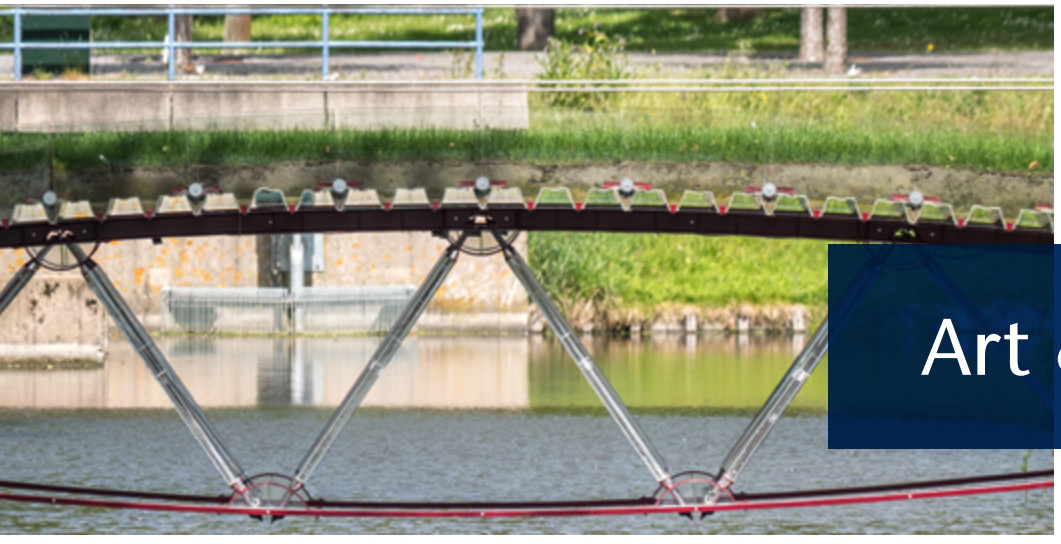


Industry

Lighting



Art & Design

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Art & Design

Glass tubing for a colorful world

Abrasion-resistant glass tubing made of DURAN® replaces steel cylinders in the dosing pumps of paint-mixing machines (dispensers) and makes them more maintenance-friendly and durable.

DURAN® glass cylinders for pumps for mixing paint.

The magic – and challenge – of paint mixing machines

Colors have a very different effect on people's psyche and body. In addition, people have their own preferences. That is why there are paint mixing machines in about 8,000 German DIY shops and specialist shops. Controlled by computer, they are able to create interior or exterior paints in one of 40,000 possible shades by coordinated mixing ordinary white with combinations of up to 36 different color pigments. These paint-mixing machines require a lot of maintenance. After just three to five years they usually need to be replaced because a defect means that the customer would have to wait several days instead of a few minutes for their "terracotta wall paint". However, scrapping the old system too early is not optimal either.

Don't replace – refurbish

"Refurbishment is far more sustainable," notes Uwe Michael Schlitt. He is Managing Director of OLDUS GmbH from Bensheim, a specialist service provider that not only maintains and repairs paint dosing systems, but also completely refurbishes them. "The objective is to restore a system's technology to its delivery condition in order to extend the service life of the machine by at least the previous operating period," Schlitt

continues. During maintenance the machine is dismantled to its basic structure. All assemblies and components are disassembled, cleaned and reassembled into their individual parts. Wear parts are replaced.


Photo: Maskot – Getty Images

Customers in DIY shops can choose a paint of their liking with a color fan, which is mixed in the desired quantity in a paint-mixing machine on site.

But OLDUS does not want to stop here. In the company's facility, there is a prototype of a system in which the color pigments are fed from bags under airtight seal, instead of filled into open containers. This makes preservatives unnecessary – as also required by the latest EU directives.

Long-lasting innovation

Another innovation concerns the 20 to 36 dosing pumps, which are constructed like an oversized medical syringe. Their task is to dispense a precisely measured amount of pigment into the base color. Today's cylinders are made of steel and are particularly affected by wear, as the pigment particles are highly abrasive and act like sandpaper on the polished metal of the cylinder liners and the Teflon seals of the pump pistons. This issue is becoming even more important in newer machines, as they are designed to work faster.

Uwe Michael Schlitt, Managing Director of OLDUS GmbH: "We are replacing the steel cylinders with DURAN® glass tubes from SCHOTT, whose durability clearly exceeds the typical operating time of a paint mixing machine."

The advantages of DURAN® glass tubing

The glass drawn from the melt is much harder than steel, so there is hardly any abrasion. It is also exceptionally smooth on its own, meaning that unlike the steel, it does not have to be elaborately polished. During maintenance work on the machine, paint pigment residue can be easily removed with conventional cleaning agents.

"We are carrying out stress tests here with the support of a well-known paint manufacturer who will install and operate the machine," explains the Managing Director. The glass must be able to withstand a continuous operating pressure of 2 bar and load peaks of 16 bar.

The cylinders shown above illustrate another obvious advantage of the glass: It is transparent. It is therefore possible to monitor the seals of the pistons and detect even the smallest leaks before they break through. The optical and mechanical surface properties of the glass, which are superior to steel, instantly lead to a higher durability and reliability in this application.

Used materials

DURAN® borosilicate glass tubing offers the ideal combination of high durability, low abrasion, and strong transparency with very tight geometrical tolerances. This results in highly accurate dosing of the paints for a very long lifetime. Strong mechanical and chemical resistance, as well an easy-to-clean surface add to its advantages for the latest paint-mixing machines.

SCHOTT Product: DURAN® tubing

Glass Tubes for Food Dispensers

One of the latest trends in food retail is the “unpacked” store, where packaging is replaced by glass silos filled with everything from flour to coffee. Customers fill their own containers and just pay for what they need. DURAN® glass tubing plays a key role in this highly sustainable solution.

The sustainable food solution

The world has a fundamental problem with plastic food packaging, which is growing at an alarming rate. One way to tackle this problem is the “unpacked” store, a zero-waste solution that’s growing in popularity. Selling a wide variety of foods and beauty products, these stores keep most of their products in glass silos – large transparent cylinders that not only provide safe and hygienic storage, but offer the retailer a stylish and attractive presentation device. The use of glass also results in minimal waste during production and surfaces that are easy to keep clean.

Photo: ©hawos Kornmühlen GmbH

hawos Kornmühlen – a European pioneer

Photo: ©hawos Kornmühlen GmbH

Elegant craftsmanship

Made of DURAN® glass tubing, the food silos in a hawos Kornmühlen store are fitted into beech wood multiplex frames with stainless steel outlet brackets.

A gallery of sustainable flavors

With rows and rows of sparkling glass slimline containers, the overall effect of an unpacked store is of a bright, vibrant art gallery. Without individual packaging, the foods and liquids really stand out, attracting the customer with their unique textures and colors. These colors are allowed to shine thanks to their glass containers, which provide an all-round view of the products within. Shopping in an unpacked store is a real experience, and one not many customers are likely to forget.

An all-round glass champion

Invented by Otto Schott in 1897, DURAN® borosilicate glass is known for its high temperature resistance and optical brilliance, as well as its tight geometrical tolerances. The glass is highly versatile and found in a wide range of applications from industrial and laboratory glassware to architecture and interior design. Available in a wide range of shapes and sizes, DURAN® is completely safe to store food and liquids, since it is certified as food grade standard.

“Everything that trickles”

The hawos glass silos store and dispense a vast range of dry goods, from cereals, muesli, and coffee, to beans, lentils, and rice.

Sustainability to your door

As well as its stores, hawos also operates small mobile stores and trucks with a selection of products stored in glass containers, bringing sustainability even closer to the customer.

Small space, big selection

The glass food containers not only provide robust storage during transportation, but ensure that the small space in the food truck is used effectively.

Refill and reuse

The high mechanical strength and scratch resistance of glass tubing mean the food dispensers can be reused and refilled over and over again for an extremely long shelf life.

SCHOTT Product: DURAN® tubing

A pinch of alchemy

Photo: www.valentinaverdesca.format.com

The assorted distillates for gin production are stored in 40 1.5-meter-tall CONTURAX® profiled glass tubes.

It looks a bit like a laboratory. The only difference is that not everything is white and instead of chemists immersed in handling the flasks, funnels and test tubes, it is gin fans. At Turicum Distillery's "Gin Lab", participants can create their own gin. The possibilities are endless. A whiff of alchemy fills the room in the Swiss spirits producer's industrial-style laboratory as participants drip, mix and stir their concoctions. The budding master distillers screw on lids and sniff glasses with juniper berries, coriander seeds, licorice or orange blossom. Once they have selected their flavors, they move on to the distillery's treasures. The assorted distillates for gin production are stored in 40 1.5-meter-tall CONTURAX® profiled glass tubes. Lined up as they are, the star-shaped borosilicate glass tubes bear a resemblance to organ pipes. The tubes are manufactured in Mitterteich, Germany, and then processed by SCHOTT customer GlasForm. They have small nozzles at the bottom, while a flange at the top makes filling easier.

Turicum offers workshops and group events – a tasting experience and visual highlight.

Photo: Sarah-Vonesch-Photography

"With SCHOTT's tubes, we have an absolutely elegant, secure and food-safe solution for storing and showcasing our distillates," proudly explains Merlin Kofler, one of the Turicum founders. The workshop participants are also thrilled with the tube design and the special profile. And, of course, by what's inside them! After three hours, everyone has their homemade gin in their hands.

Fine drops in a fancy bottle: the gin varieties in SCHOTT's CONTURAX® tubes are a real eye-catcher at Turicum in Zurich.

Made in Zurich for Zurich

The Turicum story stretches back to 2013. Four friends, two years and a love of gin sums up the simple recipe. A visit to English gin distilleries triggered a business idea among the four founders. They began developing a business model for producing a gin from Zurich for Zurich and thus giving homage to their native country's unique character. Two years later, Turicum was on the market. The gin is now distributed in Switzerland, Austria, Germany, Gibraltar and Hong Kong.

Photo: Sandra-Marusic-Photography

The first time CONTURAX® was used for the food industry was at Turicum.

Sharing their passion and having fun together at work: the four Turicum Distillery founders

When a start-up, an experienced craftsman and a major corporation team up

Josef Städler from GlasForm has been running his glassblowing business for 42 years, "but I've never worked with gin," admits the man from Herisau near Sankt Gallen, Switzerland. His company and SCHOTT have been working closely for several years. After he received a query from Turicum, Städler approached Thomas Falk, the head of SCHOTT's sales office in Switzerland. With CONTURAX® profiled glass tubes, Falk was able to collect all the right answers to the young start-up's query and the experienced craftsman.

"The star-shaped tubes are often used for light installations or other architectural purposes. The first time they were used for the food industry was at Turicum," explains Falk. Städler says that at first, due to the profile, attaching the filler flange and the outlet nozzle was a bit of a challenge, "however, as with all SCHOTT products, the quality and precision were perfect," praises the glass expert, who plans to take a trip to Zurich and see his work 'in action' at the Gin Lab.

SCHOTT Product: CONTURAX® tubing

Small part with high impact

Photo: Adobe Stock

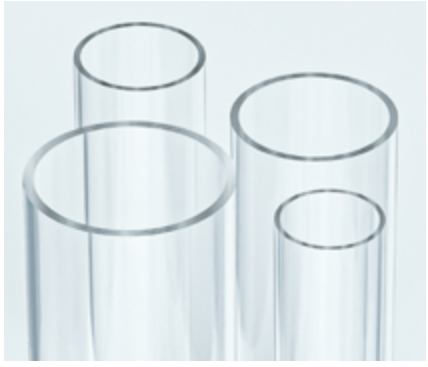
Used in a wide range of medical diagnostics devices, glass 8245 for X-ray tubes not only reliably ensures the required high vacuum but also forms a shatter-proof connection to metal and insulates anodes from cathodes, even at high voltages.

Linked by location and technology

A distance of just 40 km separates the home of SCHOTT AG in Jena, Thuringia from the Siemens Healthineers facility in Rudolstadt, Germany. Both tech companies can look back on more than 100 years of history and are now linked by close technological cooperation. Siemens Healthineers uses glass 8245 to manufacture vacuum components, X-ray tubes and X-ray beams, as well as detectors for diagnostic devices such as Computed Tomography (CT) scanners. The glass forms a gas-tight shield and insulator between the anode and cathode of the X-ray tube.

Task

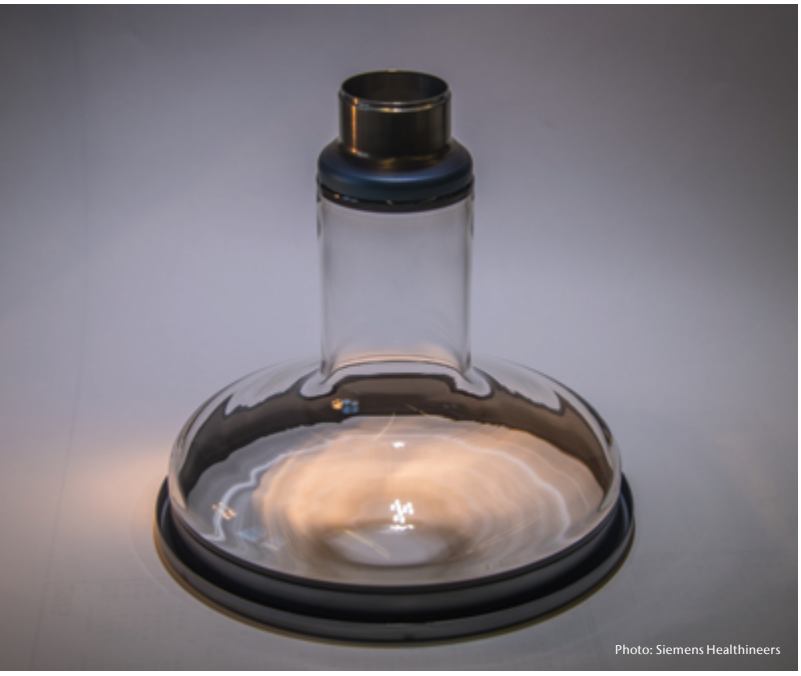
In an X-ray tube, a voltage of 25 to several hundred kilovolt (kV) in a high vacuum accelerates electrons from the cathode to the anode, where they are slowed down by several processes and emit the characteristic X-rays. Glass is ideal as cladding since it prevents the entrance of air molecules that would collide with the electrons, while the high ohmic resistance of the borosilicate glass SCHOTT 8245 (107.4 to 105.9 Ω cm even at temperatures of 250 °C to 350 °C) electrically separates cathodes and anodes.



Due to its electrical properties, the borosilicate glass SCHOTT 8245 is ideally suited for X-ray tubes.

Solution

Siemens Healthineers acquires the glass as cylinders in a variety of diameters, for example, 75.5 mm. The further processing includes bonding rings made of the nickel-iron-cobalt alloy Kovar being connected at both ends so that components such as anodes and cathodes can be attached later. The rings are first roughened and cleaned by sandblasting, then annealed. The glass is then heated, widened, and fused with the sealing rings, which creates a vacuum-tight glass-metal connection. Finally, the glass tube is blown into a mold to obtain the desired contour.



SCHOTT offers glass tubes in various dimensions to meet each customer's requirements.

X-ray tubes made from SCHOTT glass are vital for diagnosis in medical centers and hospitals.

Long-term stability and reliability

The stable vacuum-tight bond is particularly crucial to the long-term function of X-ray tubes. This is because high mechanical forces can occur around the glass tube and the glass-metal seal when the X-ray source is moved around the patient or the examined object in computed tomography. Moreover, unavoidable vibrations occur. "We need a glass of very high quality, without airlines or other impurities," explains Daniel Kutschbach, a process engineer at Siemens Healthineers in Rudolstadt, who's responsible for the cladding components of X-ray tubes and glass processing. "We ensure this by closely monitoring each processing step."

The high quality of the glass already meets our requirements. Nevertheless we have recently working with SCHOTT to improve yield in our production processes and save resources and costs.

Used materials

The permanent sealing of the borosilicate glass SCHOTT 8245 with a metal alloy is only possible because both materials have the same thermal coefficient of expansion as they are heated to 400 °C during operation. If the glass and metal expanded at different rates, mechanical stresses could occur and eventually lead to breakage.

> "We need a glass of very high quality, without airlines or other impurities"
>
> Daniel Kutschbach, Process Engineer/Production Management Vacuum Components, Siemens Healthineers

Unlike many applications, the optical specifications of the glass are irrelevant since radiation exits the tubes through a radiolucent titanium window. During a typical three-year service time the glass even turns brown, but this does not impair its functionality.

SCHOTT Product: Specialty Tubing

Tackling the Ventilator Challenge

In Spring 2020, the UK government issued a nationwide "call to arms" to produce medical ventilators needed to treat critically-ill COVID-19 patients. A consortium of industrial, technology and engineering businesses from the aerospace, automotive and medical sectors came together to manufacture 15,000 units. Amongst them, MPB Industries stepped up to the challenge to supply flowmeters – a critical component of ventilators.

What role did MPB specifically play in the UK Ventilator Challenge?

MPB had to produce all the variable area flowmeters needed to produce 15,000 ventilators from the medical device company Penlon. This comprised of 30,000 flowmeter tubes in total. We also produced several hundred flowmeters that were used to check the performance of the ventilators whilst going through the production lines.

Why are flowmeters needed for ventilators?

To put it simply: When used in ventilators, one tube delivers oxygen and the other supplies air to the patient. Actually, a variable area flowmeter is a very simple device. A float is placed inside a tube that has an internal taper and as more gas or fluid passes through it the higher the float rises. The flow rate is indicated by a permanently fired enamel scale that we apply to the outside of the tube.
In practice, the tolerances involved to produce these instruments are down to microns and both the glass tube and float are made to these exacting standards.

What are the main challenges in producing and supplying a product that helps in the fight against COVID-19?

The project was of such a large scale that it involved everyone in our company and we called on the assistance of five engineers from Ford to join us for the duration of the project. Typically, we would produce around 0 pairs of these particular flow tubes in a normal working day. However, by developing more tooling, improving production processes and working a 2 x 10 hour shift pattern for six days per week, we were able to increase this output 10-fold to 500 pairs per day. When the original order for 10,000 tubes was trebled to 30,000, it was a relief to hear that SCHOTT could move the production slot forward and deliver the glass tubing in time for us to be able to keep up with the three assembly lines that were building ventilators 24 hours a day for 12 weeks.

Why do you use glass tubing for the flowmeters?

We use glass because of its transparency, the fact that we can form and cut it to our requirement and add a permanently fired enamel scale.
We find that the glass tube that SCHOTT provide us with is dimensionally accurate and stable all while being scratch-resistant, which is important for a visual instrument. Nearly every product that we produce features a glass tube for measuring gas or liquid flows or capacities.
"We are immensely proud of how our company was able to rise up and meet the challenge put to us and how the consortium all pulled together on this enormous task." – Jason Bennion, Managing Director at MPB Industries

Photo: MPB Industries

Jason Bennion is Managing Director at MPB Flowmeters, where he's worked for nearly twenty years over two periods.

MPB Industries was formed in 1986 by two partners and over the years has grown to 20 employees spread over three factories in Kent, England. The company was sold in 2019 to the SDI Group and now comprises ten sister companies.

Photos: MPB Industries

Flowmeters with DURAN® glass tubing form an integral part of a fully assembled ventilator machine.

Medical ventilators from Penlon featuring flowmeters from MPB ready to leave the warehouse.

SCHOTT Product: DURAN® tubing

How glass attracts sportswear

Tubing made of specialty glass is a genuine all-round and permanent magnet for innovative ideas and applications. Millimeter-thin DURAN® capillaries used in manufacturing elastic threads for textiles demonstrate how valuable and attractive they can be in current technical applications.

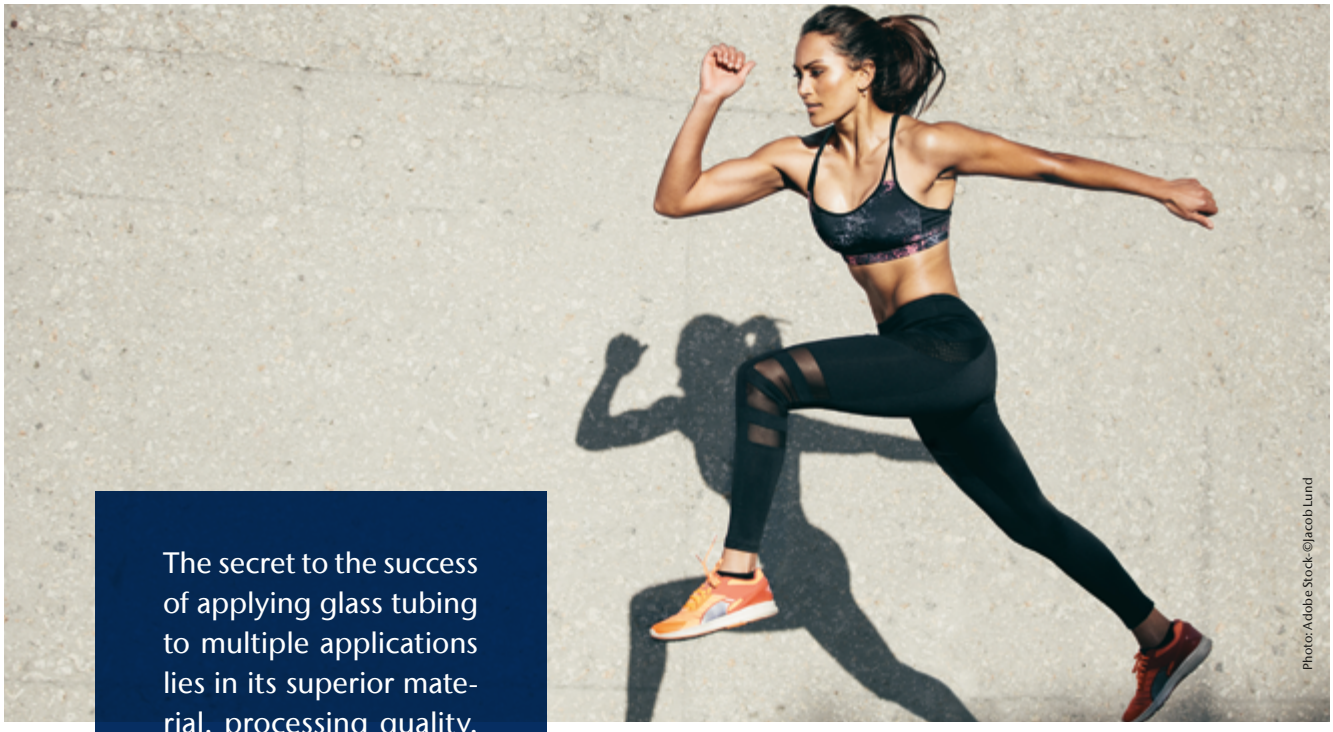


Photo: Adobe Stock-©Jacob Lund

The secret to the success of applying glass tubing to multiple applications lies in its superior material, processing quality, and flexibility.

They were first used in laboratory technology, but have been conquering a wide variety of markets for over 120 years: tubes, rods and capillaries made of many different specialty glasses which come in a wide range of dimensions. These all-rounders are quietly enabling truly amazing innovations.

Glass tube systems up to several kilometers long used in photobioreactors ensure the ideal cultivation of algae for food supplements or care products. In environmental technology, glass tubes are key elements for innovative air purification systems using UV light. Glass tubing products have even found their way into interior design, where they surprise us in modern design solutions.

The secret to the success of applying glass tubing to multiple applications lies in its superior material, processing quality, and flexibility. Although unobtrusive on the outside, glass tubing outperforms other materials many times over thanks to the advantages it offers. Glass tubing scores points compared to plastic and metals with its excellent optical properties, high temperature resistance, and superior resistance to corrosion. Tubing's good electrical insulation properties even make it ideally suited for high-voltage applications such as generating X-rays in radiology.

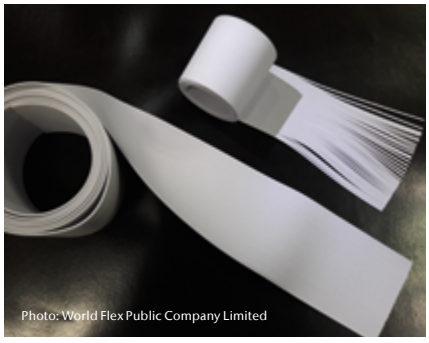
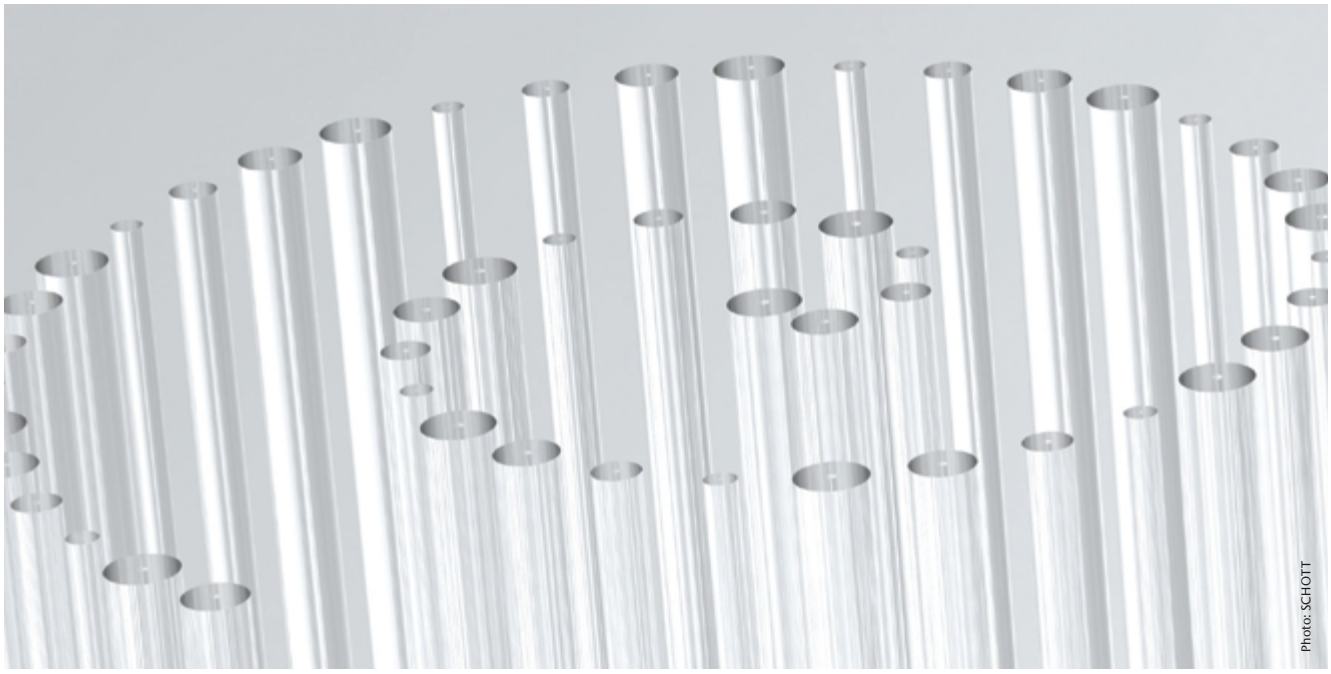


Photo: World Flex Public Company Limited

With the help of glass tubes, liquid natural latex is transformed into numerous threads.



Chemically resistant DURAN® glass capillaries withstand acid in continuous use and ensure precise thread strengths.

Permanent use in an acid bath

In yet another new application in Thailand, tubing's precision and robustness proved to be quite convincing. The Southeast Asian country is considered the world's largest rubber exporter, with major producers and processors of natural latex located there. The rubber material is processed into elastic threads, which provide the necessary textile flexibility in sportswear and underwear, for example. Liquid latex is injected through dozens of thin tubes to produce threads by machine, forming numerous continuous threads lying side by side, which are then passed through further processing stages by rollers. The tubes are permanently immersed in a liquid of sulphuric acid, which hardens the liquid latex immediately after injection. Stainless steel tubes which are typically used can rust over time. The process of replacing them can abruptly halt the 24-hour production cycle and cause delays.

First manufacturers are now using DURAN® glass capillaries instead. They are recommended, supplied and cut to size by SCHOTT's customer Triviwat Intertrade Co. a Thai glass processor. The chemically resistant borosilicate glass resists the acid even in continuous use. In addition, the narrow, stable tolerances of the inner diameter of the capillaries ensure precise thread strengths. This is necessary to achieve smooth textile surfaces after the threads have been woven into clothing fabrics. The narrow outside diameter tolerances also play an important role, as the tubes must fit into existing machines.

"The usage of glass capillaries leads to stable processes and saves us maintenance work and production costs due to less disturbances," concludes Mr. Suthep Numuean, Deputy of Production Manager from World Flex Public Company Limited, the leading producer of high-quality rubber thread based in Thailand. Now SCHOTT can once again ask itself: What is the next milestone for the extremely attractive best-sellers made of glass?

SCHOTT Product: DURAN® Capillaries

Perfect place for algae and biorefining

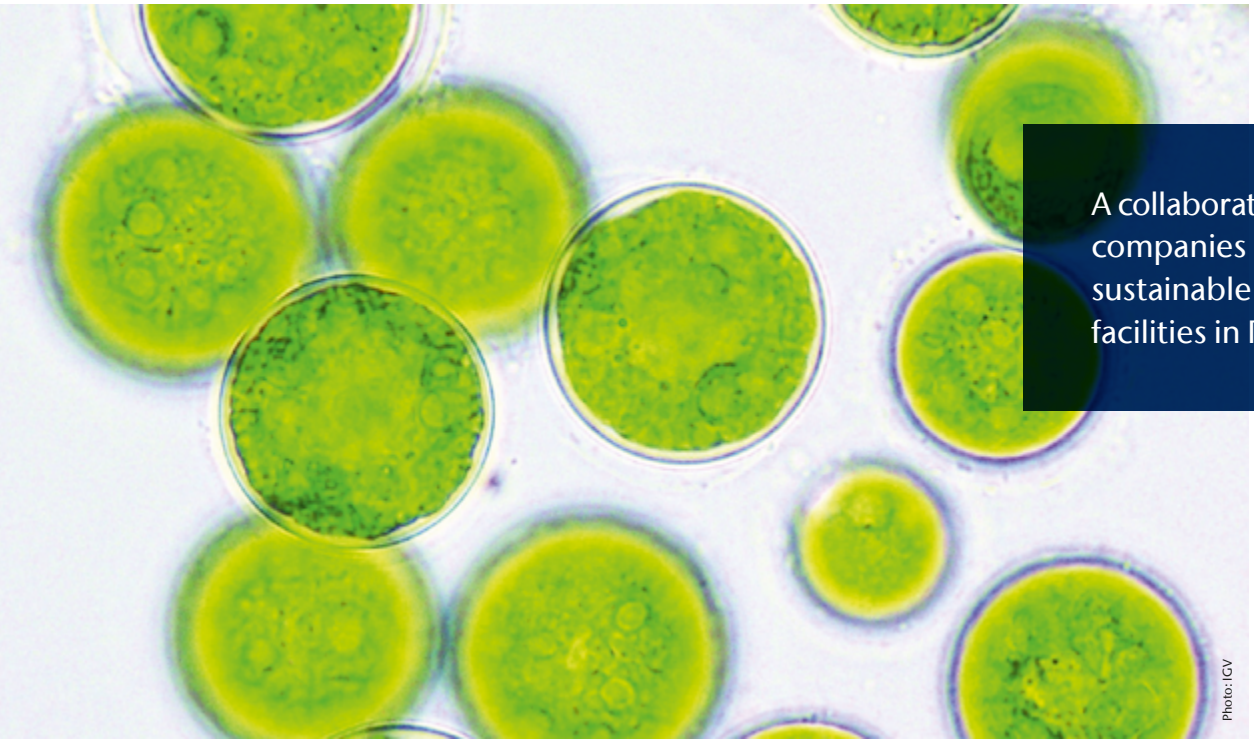


Photo: iGV

A collaboration of three companies advances sustainable algae facilities in Portugal.

Over the last two years, 15 kilometers northeast of the Portuguese capital of Lisbon, a new eco business park was created, called ALGATEC. As its name suggests, it has something to do with algae, or more exactly: the production and processing of microalgae. The construction of this new facility began in 2017, with the production starting in the spring of 2018. The complete implementation will be finished by 2021. With a production area of 14 hectare, the Eco Business Park will be the largest microalgae production platform in Europe including a microbiology laboratory and a biorefinery unit once completed. Its mission is to welcome and attract entrepreneurial companies and their projects in the field of sustainable algae business.

Here, the biomass of tiny algae (Nannochloropsis, Spirulina, Tetraselmis and others) – living and photosynthesizing in the water can be used in multiple applications such as, human nutrition, animal feed and for the extraction of added-value compounds (vegetable protein, omega-3 and omega-6 fatty acids, pigments and antioxidants). “The knowledge transfer process between applied microalgae research, technology and industrial growth is crucial for the development of new products and production technologies and therefore for the success of the business with this multipurpose raw material of the future”, says Edgar Santos, Director of ALGATEC EBP and Head of Industrial Projects at A4F – Algae for Future.

ALGATEC is the result of a partnership between three companies: LusoAmoreiras, the owner of the real estate rights and investor, Solvay providing the infrastructures and facilities and A4F, which stands for ´algae for future´. A4F is a Portuguese biotechnology company, with more than 20 years of accumulated experience in microalgae research & development and microalgae production. Their focus lies on the design, building, operation and transfer of commercial-scale microalgae production units, using different technologies that can better serve different customer needs. A4F has a proven experience of working with different species of microalgae, freshwater, saltwater, hypersaline water, autotrophic, heterotrophic and mixotrophic. Whilst gaining knowledge and working across a variety of the most advanced technological production solutions – from tubular and flat-panel photobioreactors (PBR) to open ponds, cascade raceways (CRW) and fermenters – harvesting and processing technologies.

In the microalgae production systems at the ALGATEC Eco Business Park, A4F also uses tubular glass photobioreactors.

In the microalgae production systems at the Eco Business Park, A4F will also use tubular photobioreactors with DURAN® borosilicate glass tubing from SCHOTT. Diana Fonseca, Head of Engineering at A4F: "Tubular glass photobioreactors are ideal for the production of high-value and high-quality products. They are also highly suitable for the production of microalgae strains that require strict production control, or that produce volatile compounds". More than 70 kilometers of glass tubes will be installed in ALGATEC's first phase of construction, specifically in A4F´s sophisticated UHT (unilayer horizontal tubular) photobioreactors and the well-known MHT (multilayer horizontal tubular) PBRs. "We are very proud to be part of this great project and supporting our customer A4F with more than 50 tons of glass tubes and more than 9,000 slim couplings", explains Fritz Wintersteller, Manager Business Development from SCHOTT Tubing.

There are numerous advantages of ALGATEC as an industrial complex, it benefits from high solar radiation at the site, the availability of raw materials and other utilities from a positive integration with the neighboring industry. Additionally there is easy accessibility to transportation and logistics, its proximity to universities and research institutes as well as synergies between project promoters and the industry nearby. €22 million are being invested into the largest European microalgae production platform. The aim is to produce 600 tons of microalgae per year, to reach a €10 million turnover, to consume 2000 tons of CO_2 and to create 100 direct and indirect jobs.

Aerial view of ALGATEC Eco Business Park production site. Under construction in Póvoa de Santa Iria (15 km northeast of Lisbon), this will be the largest microalgae production platform in Europe (14 ha). An Eco Business Park designed to welcome companies and entrepreneurial projects in the field of sustainable algae business.

SCHOTT Product: DURAN® tubing

Sustainable aquaculture


Photo: LGem

The Norwegian fish farming industry takes innovative approaches to fish feed with the help of algae produced in photobioreactors made of glass.

Fish not only tastes great but it is also good for you. It provides the body with important nutrients such as protein, vitamins and minerals. The omega-3 fatty acids in oily fish are good for the heart, brain and immune system. Most of the fish on our plates comes from fisheries or aquaculture. Farm-raised salmon are fed on marine resources such as fish-meal and fish-oil, which are both derived from wild-caught fish. However, the world's fish reserves are depleting due to overfishing. Norway´s aquaculture and the world´s biggest salmon-farming industry, together with researchers and innovative start-ups, will go to great lengths to secure feed for farmed fish. The goal is to create an aquaculture industry using sustainable sources of feed that will no longer require wild-caught fish while at the same time minimizing pollution from fish farms.

The Norwegian cities of Bergen and Stavanger have even become a Silicon Valley of the Sea. Here, the current research focuses on the use of algae in fish feed. Microalgae are rich in omega-3 fatty acids and other nutrients such as protein, vitamins and minerals, and therefore provide many additional health benefits. A pioneer in research is the University of Bergen (UiB), who operates together with NORCE (Norwegian research centre) and the company CO_2Bio AS a pilot plant for algae production (National microAlgae pilot Mongstad, NAM). The plant is co-located with the worlds' largest carbon capture


Photo: Adobe Stock ©Jan-Dirk

In Norway, salmon and trout grow in the same way as in nature: first in fresh water and then in the cold, clear salt waters of the Norwegian fjords.

Left to right some of the central people in the project: researcher Jeroen de Vree (LGem/Synalgae), head of project Hans Kleivdal (research director at NORGE and associate professor at the University of Bergen), senior researcher Dorinde Kleinegris (NORGE) and processing engineer Tom Roger Lid (CO_2Bio).

test plant Technology Center Mongstad, north of Bergen, and started operations in early 2017. The plant is designed to test and cultivate on a pilot scale different microalgae with high levels of omega-3, transforming CO_2 in the process. "The new research facility provides the basis for developing more knowledge about the full value chain in the sea, from the right choice of microalgae to the production of omega-3 fatty acids", explains Hans Kleivdal, Research Director at NORCE and professor at UiB, who is at the same time the academic coordinator for the project.

The team of scientists from UiB, NORCE and operators from CO_2Bio (a joint venture company owned by large aquaculture companies) have proved that the captured carbon dioxide from Equinor's refinery can be used to grow algae, which in turn can be used as a fish feed ingredient to replace fish oil. Svein Nordvik, Managing Director of CO_2Bio, is firmly convinced that "algae grown in greenhouses like this one could revolutionize fish farming".

The facility has two buildings, a greenhouse for biomass production and an operations building with a laboratory and processing equipment. At the heart of the project plant are photobioreactors (PBR) in which microalgae are produced through the process of photosynthesis, the combination of nutrients, water, light and CO_2. All the PBR systems used for research on algae cultivation come from LGem/Synalgae, a company based in Rotterdam in the Netherlands. Engineers at LGem/Synalgae are experts in the design and manufacture of tailor-made and turnkey microalgae photobioreactors that are scalable and easy to operate. "We are happy to see the wonderful job that our Norwegian partners are performing by using our systems in order to make their industries and aquaculture more sustainable", says

Sander Hazewinkel, Sales Director at LGem/Synalgae, hopes, that the tube systems will effectively support the algae project in Mongstad.

Sander Hazewinkel, Sales Director at LGem/Synalgae “We hope that our photobioreactor and process design with state-of-the-art glass components will bring a sustainable aquaculture an important step forward.” LGem/Synalgae uses DURAN® borosilicate glass tubing from SCHOTT in its closed PBR systems. It allows for optimum light input for the highest growth rates and provide reliable and long-lasting solutions for bio-secure algae cultivation. “The glass really makes a difference in the success factor of GemTube™ systems – additionally the Norwegian Silicon Valley of the Sea could benefit from this now”, says Hazewinkel.

The challenge for the microalgae team at the National microAlgae pilot Mongstad will be to continue to improve the production process and find even better algae to further decrease the cost price of production at industrial scale and consequently to make these microalgae a commercially viable ingredient for salmon feed. Furthermore, other higher value products within aquaculture are tested (e.g. feed for copepods and rotifers) to achieve a shorter-term commercially viable microalgae production. Gradually, this will contribute to the success of the Norwegian aquaculture.

With glass U-bends, manifolds and couplings SCHOTT pro-vides reliable and long lasting solutions for algae cultivation in photobioreactors.

The challenge of the National microAlgae pilot Mongstad (NAM) will be to harvest enough algae to make it commercially viable.

In the Silicon Valley of the Sea, which is currently under construction, the aim is to create an aquaculture with sustainable sources of feed by using photobioreactors.

SCHOTT Product: DURAN® tubing

Washing the air

The Bavarian Triplan Umwelttechnik is bringing fresh air to old buildings with an innovative idea: its engineers use UV light to banish moldy, musty smells from rooms. Special glass from SCHOTT Tubing helps remove the unwanted odors.

Photo: SCHOTT/ H.-J. Schulz

Corked wine and musty rooms: both are unpleasant – and both often have the same cause. The wood preservatives used in impregnated pallets and the wooden beams of old houses over decades release gases that cause moldy smelling aerosols to appear, the same molecules that accumulate on corks and give a once delicious wine that feared corked taste. Help comes in the form of photocatalysis – a process that decomposes the undesirable gases using a catalyst and UV radiation. But existing solutions have their drawbacks: "The present technology is neither very efficient nor particularly sustainable," explains Andreas Beck, Managing Director of Triplan Umwelttechnik.

Beck and his team of engineers have developed the TRIPLAN LightClean® ventilation solution. It uses glass instead of paper as the carrier for the catalyst. The device, a simple, stainless steel column with a built-in ventilator, first sucks up the polluted air in the room. "The contaminant molecules accumulate inside TRIPLAN LightClean® on a panel consisting of small glass tubes measuring about six inches in length," says Beck. The individual glass tubes are coated with a semiconductor material using a specially developed process. When stimulated by UV light, cold combustion converts the contaminants into carbon dioxide and water. TRIPLAN LightClean® then releases the cleansed air back into the room.

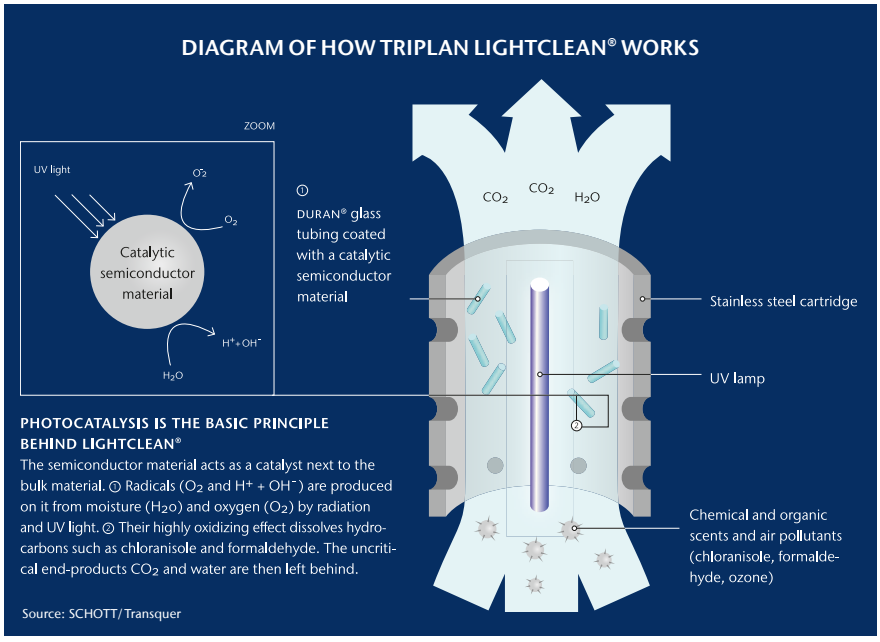
To achieve this innovation, the Harburg-based company employs DURAN® borosilicate glass tubing from SCHOTT. This special purpose glass offers key advantages that make it an ideal catalyst carrier: "It has a much higher level of efficiency than any other material," says Beck. "Because of the high transparency of the DURAN® glass tubing, the UV light can penetrate deep into the reactor and reaches a much larger activation surface using the same amount of energy," explains Dietmar Katlun, Area Sales Manager at SCHOTT Technical Tubing. This also makes TRIPLAN LightClean® highly sustainable: "Unlike conventional filters, the coated glass tubing can be used endlessly since it is not corroded by oxidation," says Beck. This is because

Engineers at Triplan Umwelttechnik have developed innovative photocatalytic ventilation systems that achieve a high level of efficiency. Special glass from SCHOTT is used as an ideal catalyst carrier.

this special glass is chemically highly resistant and can withstand major temperature changes.

The idea for the convenient air-cleaning system for old buildings came about more by chance than by design. "We originally wanted to develop a way to clean toxic exhaust air in laboratories," explains Beck. Photocatalysis turned out to be too weak for high concentrations of toxic contaminants. "But we discovered that it worked exceptionally well with lower concentrations like those that are common in prefabricated houses and old buildings," says Beck. The system is not only effective against so-called chloranisoles that cause corked wine, but also against formaldehyde (often used to glue together particle board and laminate) and ozone (produced by old printers). All of this would not have been possible without the help of SCHOTT, as Beck states: "Mr. Katlun and his colleagues did not just supply a product; they also supported us with their technical expertise." Prototypes of TRIPLAN LightClean® are currently in progress. "French winemakers and the old building renovation sector have already recognized the potential", states Beck. Over 30 large devices have already been delivered to wine cellars in France. "The first customers are all extremely happy with the performance of the devices, particularly regarding the reduction of chloroanisole odour", assures Beck. The managing director sees further uses in addition to stale old buildings and corked wine: "Fresh, clean air is also an advantage in medical practices and we have received inquiries for managing odours at workstations, such as acetic acid odours."

DURAN® tubes are an ideal substrate for the catalytic semiconductor material. In addition, they are also very durable.



Enjoy sustainably

Photo: SCHOTT

Three billion plastic straws end up in the trash. Every day. After a single use. This is now a thing in the past with SCHOTT straws.

Photo: SCHOTT

Photo: SCHOTT

Pure taste thanks to sustainable glass drinking straws

SCHOTT Straws can be reused up to

2,000 times.

Would you like to visit Hotel Sacher in Vienna? Besides the famous chocolate cake, there are also hot drinks, or maybe you would prefer a cocktail? Both are definitely sustainable treats because the traditional hotel serves them with drinking straws made of glass. SCHOTT Straws for hotels and restaurants, as well as for private households, are made of the same glass as drinking glasses and can be reused 1,000 to 2,000 times.

For safety reasons, the wall thickness of the glass tubes is 1.5 millimeters. This makes them more robust than conventional drinking glasses, i.e. they don't break in your mouth or dishwasher. In order to be able to clean them properly, SCHOTT exclusively manufactures straight straws without bends in lengths of 15, 20, 23 and 30 centimeters – ideally suited for any type of drink.

SCHOTT Product: AR-GLAS®

Security at your fingertips

Photo: DERMALOG

Biometric systems are constantly improving: a new scanner from innovator DERMALOG can read both fingerprints and electronic IDs for the first time. What's it made of? CONTURAX® glass from SCHOTT.

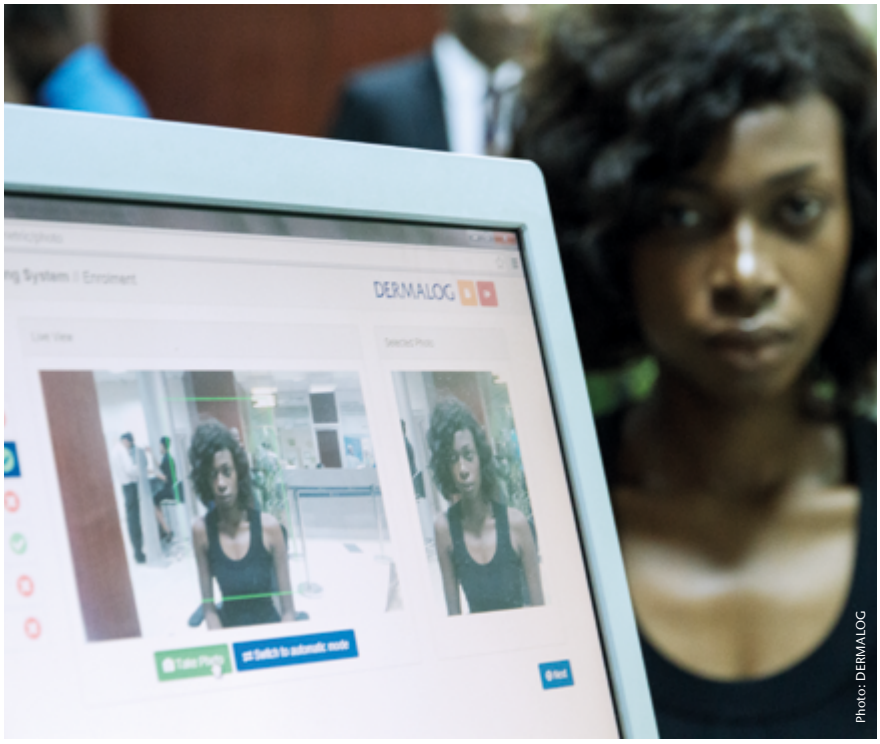
Brunei was one of the first nations in the world to introduce an electronic ID card integrating digital fingerprints. Arrivals in and departures from Singapore are recorded by fingerprint. 24 banks in Nigeria use fingerprint and facial recognition. Thousands of refugees in Germany have been registered with fingerprint scanners.

These examples are just a few of the more than 200 from 80 countries with two things in common: they're using digital biometric authentication to verify identity, and the technology is coming from the same company – Hamburg's DERMALOG. The pioneer in biometrics solutions development has been fueling technical progress for over 20 years and today is the largest German supplier in a future market.

Biometric recognition grants access control to smartphones and PCs, and with electronic identity cards simplifies law enforcement, election registration and payments. Studies predict that passwords will be a thing of the past in a few years. Indian market and biometric analysts expect the biometric system market to increase from USD 10.7 billion to USD 32.7 billion from 2015 to 2022.

Such opportunities also invite challenges. The biometric technique is only convincing with flawless, fast detection. This is where DERMALOG specialists excel. Their AFIS (Automated Fingerprint Identification System), for instance, based on independent TÜV analysis, uses a special modular server platform (standard blade server) to compare nearly a billion fingerprints per second. A world record without sacrificing accuracy. AFIS integrates other applications such as iris and facial recognition to achieve highly secure multibiometric software solutions. DERMALOG hardware such as scanners and e-gates for automatic access control also offers individual and comprehensive solutions for large database applications. "We are a developer, manufacturer and system integrator at the same time and see ourselves as leaders in innovation," sums up DERMALOG Managing Director Günther Mull.

DERMALOG scanner at CeBIT 2017: on the same scan area it can read fingerprints as well as electronic passports.



Banks in Nigeria use fingerprint and facial recognition systems from DERMALOG.

The company has developed the world's first scanner that can read fingerprints as well as e-passports, signatures, tickets and barcodes on the same scan area. It also enables instant comparison with fingerprints stored in the passports' RFID chips. "Our all-in-one scanner VF1 combines two devices in one and is particularly well suited for border controls, banks and e-gates," explains DERMALOG engineer Felix Lüers. A computer-aided manual, for instance, walks users through correctly placing their fingers, which are recorded in seconds – automated self-registration without any staff. Sensor technology enables live detection, preventing mistakes and deceptions and literally ensures safety to the fingertips.

The optical system with high scan resolution uses CONTURAX® glass from SCHOTT for homogeneous illumination of the touchsurface. A wise choice, says Felix Lüers: "The glass offers big advantages over other materials like plastic: it's scratch-resistant, highly transparent and durable in UV and IR light radiation and temperature-resistant to heat development in LEDs.

Production quality and dimensional accuracy are also required to support the device's necessary measuring accuracy. "These are all strong messages for SCHOTT account manager Dietmar Katlun: "We are fascinated by the technical applications that our decorative glass makes possible."

High-intensity scan with quality glass

The lighting unit of DERMALOG's optical fingerprint and document scanner VF1 initially consists of a printed circuit board with three LED types. These radiate in a spectral range from ultraviolet to near-infrared, bandwidths which allow security features to be optically read from electronic ID cards. Two glass components from SCHOTT above the LEDs ensure homogeneous illumination. A frosted glass diffuses the emitted light, which is then broken by two overlying cylindrical collecting lenses made of CONTURAX® profiled glass. Light rays finally hit a prism whose surface forms the touchpad for fingers or e-passports.

Photo: DERMALOG

The optical system of the VF1 scanner uses CONTURAX® glass from SCHOTT for homogeneous illumination of the touchsurface.

Photo: iStock

Biometrical data such as fingerprints are the passwords of the future.

More reliable: biometrics of the future

Biometrics, the science of measuring and analyzing biological characteristics, is considered much safer than PIN numbers and passwords. But is that correct? The European Chaos Computer Club seemed to prove the opposite when it hacked fingerprints and irises of German politicians years ago.

However, the safety and reliability of biometric procedures increase with the quality of biometric features and comparison data, the performance of the sensor and the computing capacity of the system. System manufacturers are also working on live recognition in features to foil forgery. Functioning live tests already exist for fingerprints, irises, faces and veins. High-performance sensor technology and special software, for example, detect the smallest movements and other living signals or detect non-living materials. The effort focuses on machine learning processes. “We’re heavily focusing on these topics to remain at the forefront of accuracy and speed, and to be compliant with current standards such as ISO/IEC 30107,” says DERMALOG developer Daniel Hartung.

Multibiometric procedures also boost security. Several features are simultaneously measured and compared, including fingerprints and irises. But the future could also belong to features considered “forgery-proof.” Methods are already being tested that recognize individual movement patterns such as walking speed, lengths of strides and hip movements. And that’s only the beginning: research is also underway on features such as DNA, body odor and salinity.

World record:

914,959,533

fingerprints can be matched by DERMALOG AFIS (Automated Fingerprint Identification System) within one second. This was measured with a standard blade server in late 2016 by German testing institute SGS-TÜV Saar.

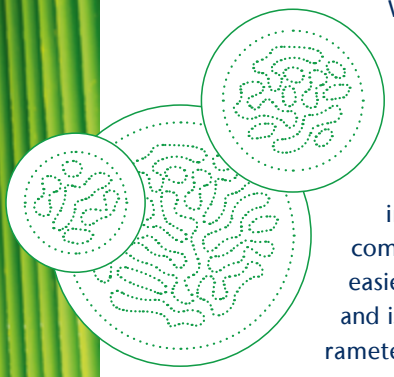
SCHOTT Product: CONTURAX®

Hanging gardens

Light is energy. This can be directly observed in the growth of microalgae in photobioreactors. The harvests increase significantly when glass tubing from SCHOTT is used.

Photos: Jongerius ecoduna

Microalgae offer the industry an interesting future market. These green unicellular organisms can convert light into biomass five times more efficiently than land plants. They are rich in valuable ingredients and are very versatile, for example, as a food supplement or in the field of cosmetics, food and feed, biofuel, fertilizer and even as ingredient substances for drugs. The market volume of algae production has already exceeded the one billion US dollar mark and continues to grow fast.



When it comes to harvest volumes, the material that the photobioreactors are made of plays an important role. Algae manufacturers are increasingly replacing plastic components in their photobioreactors with components made of glass. Glass is easier to clean, has a long service life and is very transparent, important parameters that affect output and the costs of large scale algae production. With plastic-based systems, however, a biofilm gradually forms on the walls over time. The reason is the bacteria that accumulate, grow and eventually lead to contamination of the biomass. To prevent this, regular cleaning is necessary and the production systems need to be switched off. High-quality DURAN® glass tubing from SCHOTT has very smooth inner surfaces that strongly reduce biofilm formation and make continuous cultivation possible on an industrial scale 365 days of the year. “Bacteria are algae’s enemies, and the scratches that are common on the

By using high-quality, round DURAN® glass tubing from SCHOTT, the light that algae need for photosynthesis can be put to better use in photobioreactors. Tubes and multiple distributors are also ideally suited for constructing state-of-the-art vertical photobioreactors.

inside of the plastic surface after many cleaning cycles make for the perfect breeding ground for those enemies. Thanks to the robustness of SCHOTT's glass tubing, the photobioreactors offer consistently good production conditions without the risk of contamination," says Lukas Neuwirth, Process Engineer at Jongerius ecoduna. The Austrian company produces and harvests different algae such as chlorella or spirulina, a blue-green algae used for dietary supplements and animal feeds, in vertical photobioreactors. The world-patented vertical photobioreactors, which Jongerius ecoduna also refers to as "hanging gardens," also eliminate pumps. CO_2 and nutrients are introduced continuously at the bottom. This is highly efficient and guarantees maximum purity.

Jongerius ecoduna recently changed its production technology at its plant in Austria from plastic to SCHOTT glass tubes 65 mm in diameter. The photobioreactors have been running continuously since the switch was made. For the company, this means higher yields and lower operating costs. The material's longevity is also one of its key advantages; Jongerius ecoduna says it used to plan to replace the plastic elements about every ten years. Now, thanks to an estimated 50-year lifespan of the glass tubing, having to replace the entire system is far less of a concern.

Why algae?

There is a huge range of applications for algae – from medicine to agriculture. Here are three particularly interesting examples:

1. In cosmetics: Algae contain a high share of proteins. They can provide the skin with energy and prevent it from drying out.
2. For water treatment: Inorganic substances like nitrates and phosphates can be removed by precipitation with the aid of chemical agents, or – in a 'greener' way – they can serve as nutrition for algae in a controlled manner and thus be removed before the water is discharged.
3. As dietary supplements: The active ingredient astaxanthin is extracted from algae and sold as a dietary supplement because of its health benefits.

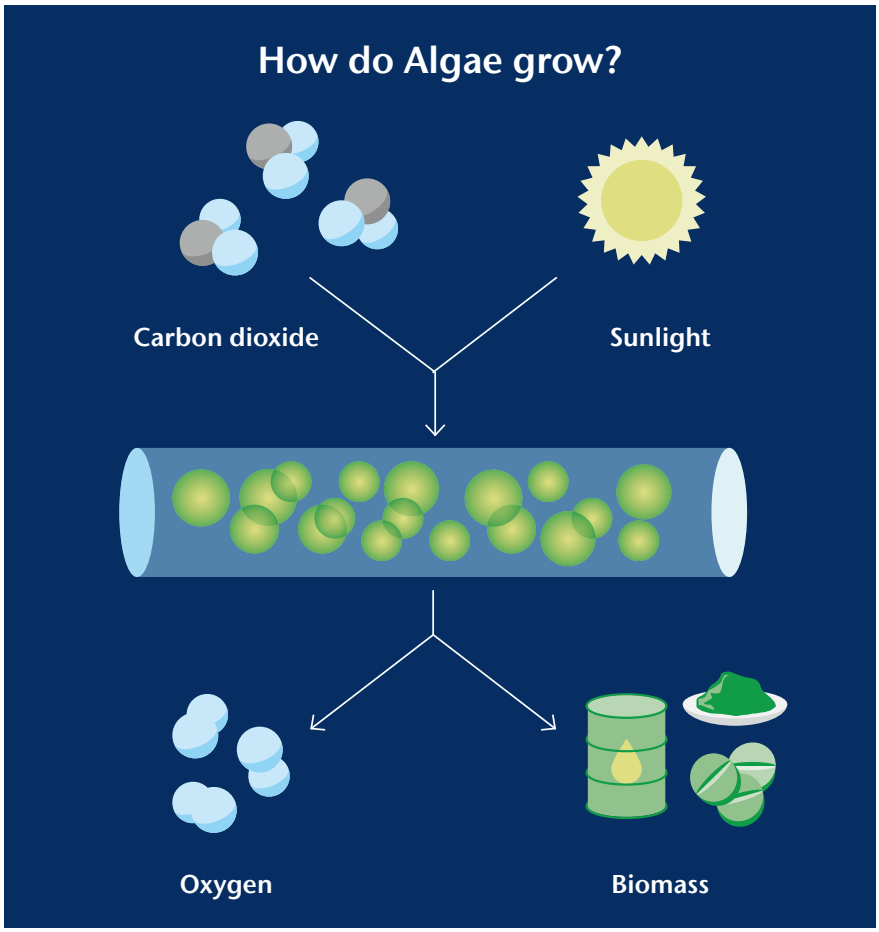
Photo: Jongerius ecoduna

"Using glass tubing in our 'hanging gardens' has proved to be a smart investment that lowers our operating expenses and practically eliminates replacement costs." – Lukas Neuwirth, Process Engineer at Jongerius ecoduna.

Higher output – lower costs

Jongerius ecoduna plans to use glass tubing at its new production facility in Austria and in another facility in Denmark that the company operates together with a partner.

Commercial algae producers constantly work to improve biomass yields and harvests. Glass tubing has proven to be extremely effective in both horizontal and vertical photobioreactors because its robustness and cleanliness extend the lifespan of these systems by multiple factors. SCHOTT will continue to work with companies like Jongerius ecoduna in the future to find ways to improve system efficiencies, boost algae growth, and increase biomass yields.



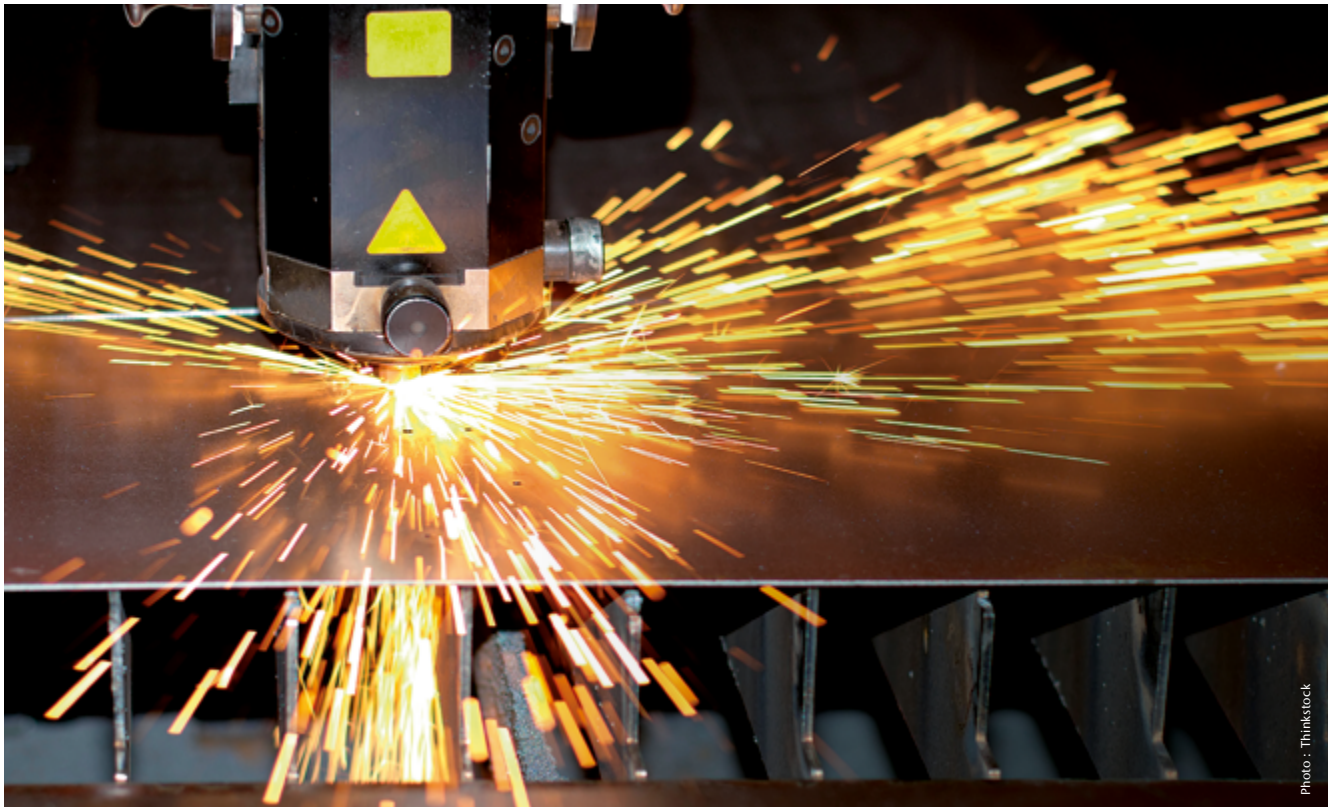
Algae need (sun-)light, water, carbon-dioxide and nutrients for growing. Photobioreactors aim to present optimum life conditions.

Algae are especially popular for the usage in cosmetics. They contain a high share of proteins, they can provide the skin with energy and protect it from draining.

SCHOTT Product: DURAN® tubing

Precise cuts

Laser cutting of metals, acrylics, wood and textiles has become a standard in manufacturing around the world. No modern automobile would drive today's streets without it, and today's clothing would certainly be a lot less fashionable. SCHOTT delivers glass tubing for RECI, one of the industry's market leaders.



CO_2 laser cutting has proven to be a very effective method in industry. Precise machining of materials means less material waste and reduces the costs.

An invisible beam cuts through a metal rod as if it were only butter. Sparks fly and seconds later a piece of the rod falls to the ground. The magical beam originates from a glass tube inside a laser-cutting machine. Therein, excited particles in a gain medium, such as carbon dioxide (CO_2) gas, emit photons that are reflected back and forth by mirrors. One of the mirrors is semi-transparent, and the particles eventually escape as a high-energy beam that can travel almost indefinitely. But the beam of light can also be put to great use in manufacturing. If it is focused into a tight spot, the beam can even vaporize solid steel. The aforementioned glass tube is also called a 'resonator.' It is the source of the laser and a central component of every laser-cutting machine. It is also the specialty product from the China-based company RECI. "We are focused on the production, research and development, and sale of CO_2 lasers. Today, we are the largest producer of CO_2 lasers in the world," says RECI's general manager, Lu Chundi. CO_2 lasers have particularly high efficiency and are regularly used in industry for cutting and welding. "RECI's CO_2 lasers are mainly used for non-metal cutting and carving in leather and other fabrics," explains Chundi. And although these applications do not require the same beam intensity as in cutting metal, all components must be of the highest quality.

One attribute of the glass tubes that make up the resonators chamber is particularly important: its straightness. “A laser beam represents a perfectly straight line. To avoid interference, the container it is traveling through must also be as straight as possible,” explains Jocelyn Jiang, Sales & Marketing Director Tubing China with SCHOTT in Shanghai. The problem is, the longer the glass tube, the greater its curvature. Standard resonator tubes have a length of one and a half meters. “So, although the deviation from a straight line is only on the scale of a few single millimeters, it can lead to malfunctioning of the machines if not handled correctly in tubes of this size,” adds Jiang.

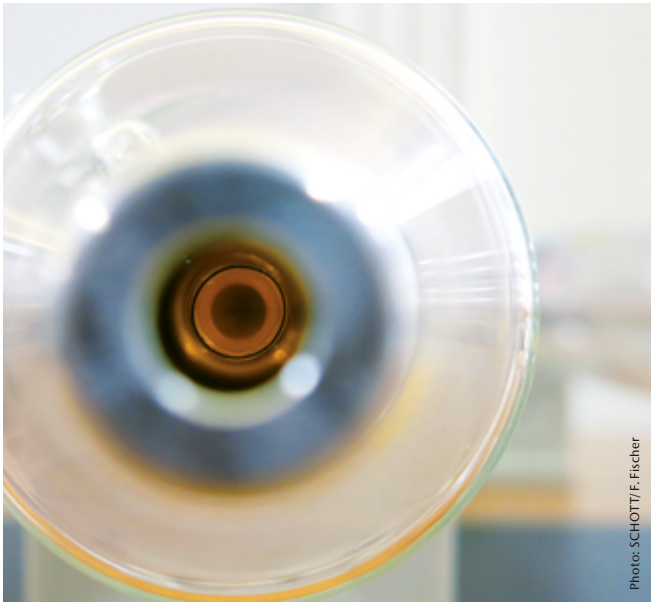


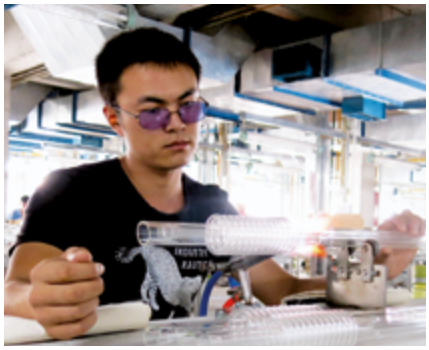
Photo: SCHOTT/ F. Fischer

This is precisely why DURAN® tubes from SCHOTT remain the first choice for RECI. “Their quality is good and reliable, and the tight tolerances we require remain stable over time,” says RECI’s General Manager, Chundi. And this preference for SCHOTT tubes remains true although there are several cheaper competitors on the Chinese market: “Despite the price per kilogram for DURAN® being higher than local Chinese tubing, the total costs for producing the glass laser tubes are lower with our products,” explains Jiang. This is because local products make it necessary to rework the straightness of the tubing in a very extensive and, thus, cost-intensive way.

“SCHOTT enables us to produce a laser tube that fulfills the high quality requirements of the global market. And because of this, we are one of the most important suppliers in the industry,” says Chundi. To strengthen their market advantage, RECI recently commenced with production of its third generation of lasers. It has several advantages compared to previous models: “fewer defects, higher stability and a longer lifetime,” summarizes Chundi. This and other developments in the laser industry paint a very promising picture of the future. SCHOTT’s Sales & Marketing Director Tubing China, Jocelyn Jiang, also agrees: “Lasers have come a long way and are constantly improving. SCHOTT will always be a part of this development, and we hope to contribute with our own innovations along the way.”


Photos: SCHOTT/ F. Fischer

RECI uses highly stable DURAN® borosilicate glass tubes in its lasers (obove and right photo). They ensure a precise optical path and make it possible to meet the high quality demands the global market places on CO_2 lasers, explains Lu Chundi, General Manager of RECI (left).



“DURAN® tubes from SCHOTT: Their quality is good and reliable, and the tight tolerances we require remain stable over time”

SCHOTT Product: DURAN® tubing

Recovering Energy intelligently

With an ATEC flue gas heat exchanger, households can now reduce energy consumption by retrofitting and using condensing technology without having to replace existing boilers. DURAN® glass tubes are key components of this new solution.

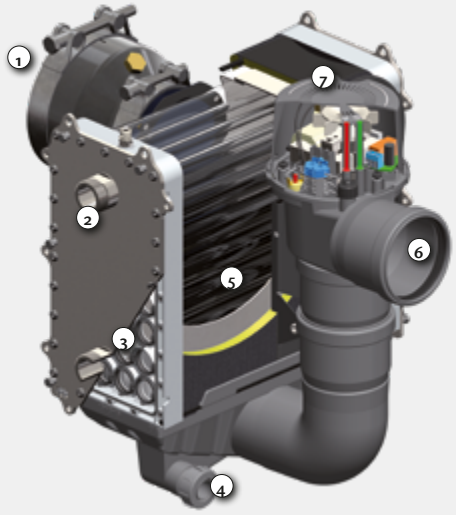
Photo: SCHOTT/S. Brüggemann

According to ATEC, the glass tube heat exchanger for retrofitting is the first of its kind that is suited for nearly all types of heating systems and has received approval for use.

Reducing energy consumption is a key objective of modern building refurbishment. To Guido Jobst, this simply isn't enough. "This also includes factors such as efficiency, conserving resources, and the overall energy balance of a measure," notes the Managing Director of the German company ATEC Abgas-Technologie who then offers a practical example of this. If a low-temperature boiler has already been operating in a single-family home for ten to fifteen years, the typical energy consultant would recommend replacing it with a condensing or combi-boiler, perhaps including solar support, to increase energy efficiency. "What they don't consider, however, is that boilers that are replaced are generally high-quality products that would do the job for up to another fifteen years," Guido Jobst explains.

The head of ATEC, who has been active in the flue gas technology industry for 25 years, therefore decided to convert a method taken from large boiler technology and adapt it to private homes. In industrial plants, condensing gas boilers are suspended behind the large boilers within the flue gas outlet in order to use the high flue gas temperatures to generate energy. By doing so, condensing boiler technology is upgraded, and the existing boiler can still be used. Up until now, this technology was not available for small boilers. However, ATEC developed a solution. To achieve these results for small boilers, a heat exchanger ensures that the water vapor condenses around the special glass tubes that contain exhaust gases of up to 270 degrees Celsius and does not escape through the chimney. The heat that is obtained through condensation then heats up the heating water that flows through the tubes.

The DURAN® borosilicate glass tubes that are used here serve as key components of this system. They are extremely strong and corrosion-resistant to sulfuric acids and other combustion residues that result from this process. "Neither metals nor plastics could be used in these components. And because we wanted to offer a high-quality product, we were looking for a premium supplier of glass solutions with experience in systems engineering," Jobst explains. SCHOTT convinced him thanks to its decades of experience as a supplier to the heat exchanger industry, which includes large brewery plants. In addition, the technology company provides



Source: ATEC

Glass Tube Heat Exchanger for Retrofitting

Depending on the power range, ATEC heat exchangers consist of 30 to 54 DURAN® glass tubes that are 301 mm in length and have an outside diameter of 24 mm and a wall thickness of 1.8 mm. Exhaust gases condense on these corrosion-resistant materials and transfer energy to the heating water that flows through them. The system is relatively maintenance-free and durable.

1 Universal flange (connects with nearly all boilers) · 2 Boiler return connection · 3 Heating circuit/Domestic water connection · 4 Condensation drain · 5 Borosilicate glass tubes · 6 Plastic exhaust gas tube · 7 Vacuum blower

precise and solid finishing of the glass tubes' ends and thereby made the system's much needed tightness and performance possible – a must for flawless operation and the product guarantees that are given to customers," adds Jobst.

According to ATEC, the glass tube heat exchanger for retrofitting is the first of its kind that is suited for nearly all types of heating systems and has received approval for use. A vacuum blower for active transport of flue gases to the outside makes this possible. This function allows for the heat exchanger to be connected to a boiler with a forced air burner for natural gas or fuel oil.

The investments necessary in order to use this innovative product are less than half of the costs of exchanging a low-temperature boiler with a condensing model. The bottom line is that, based on calculations for homes, installation of a heat exchanger pays for itself within four to nine years. And money is saved during operation as well. For example, annual consumption of 2,000 liters of oil can be reduced by 150 to 300 liters.

Guido Jobst also emphasizes the positive effect on the environment. "According to chimney sweepers' statistics, there are approximately 1.75 million fan-driven heating systems that are capable of supplying 25 to 80 kW and are up to 15 years old in Germany. If we were to retrofit only 500,000 of them, the environment would be positively affected by an annual reduction of 600,000 tons of CO_2 gases."

To tap into this market even further, ATEC now offers new systems comprised of a combination of a heat exchanger and CHP (co-generator). For the future, Guido Jobst plans to retrofit the heat exchanger so it can be used with pellet boilers. "The potential is there," he claims.

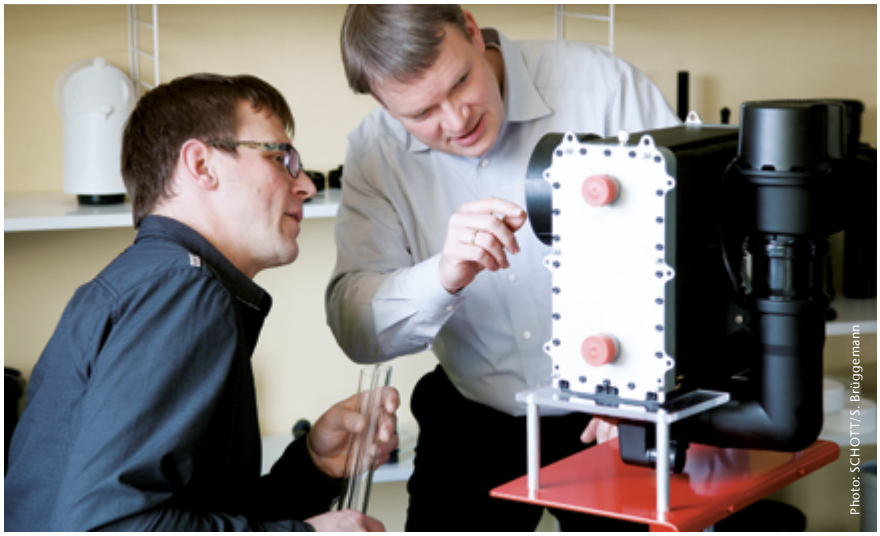


Photo: SCHOTT/S. Brüggemann

Managing Director Guido Jobst (right) sees great potential for his glass tube heat exchangers. ATEC offers the system for retrofitting oil and gas boilers with overpressure burners or in combination with new appliances such as CHPs.

SCHOTT Product: DURAN® tubing

Materials at the Limit

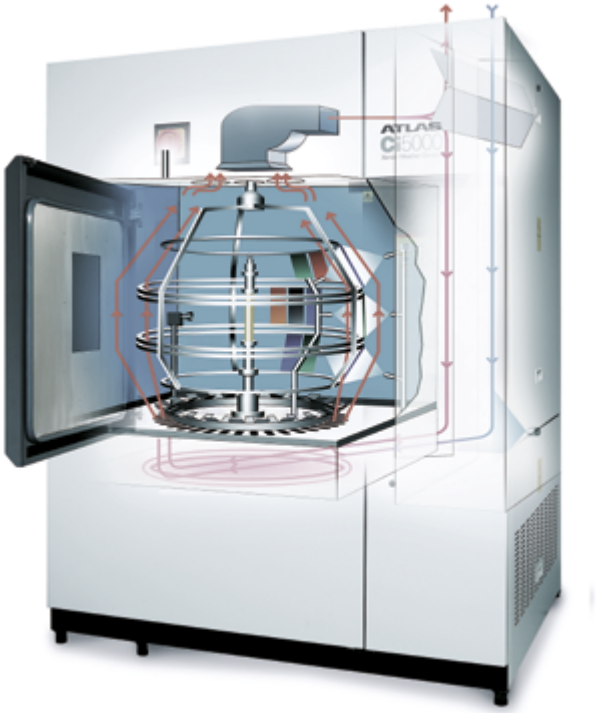
Materials can be analyzed in many different ways with weathering devices from the global market leader Atlas Material Testing Technology. Here, tube filters from SCHOTT allow for stress tests to be performed that imitate exposure to real solar radiation.

From the dashboard to the tires: a four by four's components are made to last – no matter if it's driven in the desert, a subtropical climate or an alpine region. The same applies to a tent, a sleeping bag or hiking shoes. To guarantee a product's durability, researchers around the world are always busy developing new materials. Atlas provides weathering machines that help predict the wearing properties of materials ranging from textiles and synthetics to car finishes and other coatings.

"All materials, not just human skin, are affected by sunlight," explains Rainer Eichholz, Lead Developer Glass, Melting and Drawing Technology for the SCHOTT Business Segment Tubing. Even varnishes, seat covers or synthetics age with constant exposure to sunlight. "In the past, an entire car was simply placed under the Floridian sun for a period of time," says Eichholz.

Nowadays, these tests can be sped up with weathering machines. For this, Eichholz and his colleagues developed special glass tubes. They filter the light from a xenon lamp inside the machine to simulate the sun's rays. And a built-in humidifier helps reproduce a climate that resembles the natural environment. "Weathering machines reduce trial times considerably and help accelerate the development and marketability of new products," says Eichholz.

The special filter is necessary because the sun's natural light spectrum is not entirely identical to what is emitted by a xenon lamp: "The two light sources differ at very short wavelengths," Michael Frigo, project head at Atlas emphasizes. In nature, the destructive UV spectrum between 280 and 315 nanometers is kept away from the earth's surface by the atmosphere. The light source in the weathering machine, on the other hand, emits the entire light spectrum at full intensity. "We have to



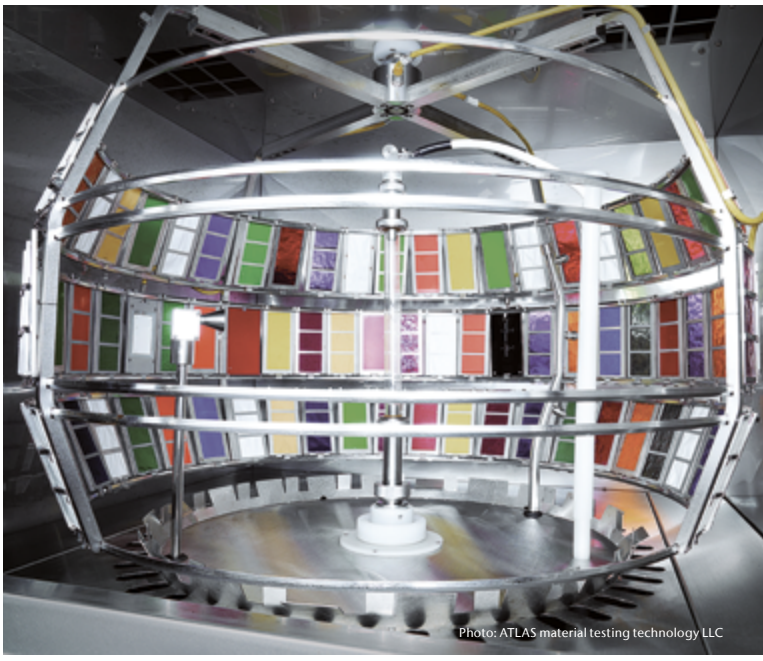
Source: ATLAS Material testing technology

Artificial Sunlight

The right light: True-to-life conditions are essential to an accurate and reliable weathering test. The Weather-Ometer® from Atlas simulates solar radiation using xenon lamps and SCHOTT's advanced filter systems.

use a filter to replicate authentic conditions," says Frigo. For several years, Atlas has relied on SCHOTT to supply the necessary tubular filters that can be exchanged for different tests.

In cooperation with Atlas, Eichholz and his colleagues are continuously enhancing the product. Besides its special transmissibility, the filter has to have a high life expectancy and other special properties. "Its qualities must remain stable for as long as possible," says Eichholz. Michael Frigo and his colleagues are very satisfied: "We can offer our customers a highly improved and diverse product," he says. "SCHOTT is the only manufacturer that can develop and guarantee tubular glass filters with the required characteristics."



Simulated environment: The xenon lamp is encased in a tubular filter (center). Over one hundred samples can be mounted on the sample rack inside the test chamber. Temperature and humidity can also be adjusted quite accurately.

SCHOTT Product: Specialty Glass

In a Case full of Cash

Bank robbers are in big trouble thanks to glass cartridges for ink made with SCHOTT CONTURAX® Pro.

Modern cash boxes make life extremely difficult for robbers (01): They not only trigger a loud siren, produce red smoke and send signals that allow for their position to be tracked when they are opened without authorization, they also use CONTURAX® Pro profile glass tubes from SCHOTT for rectangular ink cartridges (02) that burst when they are a ignited. This permanent ink makes the banknotes completely worthless (03).

Cash is king" is still in most people's mind; including criminals who are looking to "earn a little extra money" by robbing banks, retailers, cash machines (atm) or cash-in-transit companies. But, thanks to state-of-the-art cash carrying boxes, their life is becoming more and more difficult. These boxes are not just impossible to crack, they are also equipped with intelligent security systems. A highly sophisticated cash protection solution has been constantly further developed in France over the last 20 years. As of today, Oberthur Cash Protection, which is part of the Oberthur Technologies Group from Dijon, France, has supplied more than 50,000 safety boxes for the protection of cash to customers all over the world. Many cash-in-transit companies all across Europe currently use these secure containers. Their reliable security technology has been designed to scare off robbers even more efficiently than any armored money transport.

These cash boxes are equipped with time locks, multiple sensors and Radio Frequency Identification (rfid).

All non-expected events – i. e. forced entry, abnormal temperature variations, electromagnetic fields or electrostatic discharges, gas or liquid presence – will trigger a loud siren, accompanied by dense red smoke and positioning with the aid of GPS-GPRS locating signals. But that's not enough. Rectangular shaped ink cartridges made of CONTURAX® Pro glass from SCHOTT are at the heart of this security system. If the system that can be controlled electronically causes them to burst by activating a detonator, purple colored indelible ink will immediately saturate the bank notes and thus make them completely worthless. Easy come, easy go, as they say. "For us, quality means security based on reliability," explains Eric Hauw, Director of Sales and Operations at Oberthur Cash Protection. "Our products, the components

and technologies we are using must meet the highest standards. This is the only way to guarantee our customers one hundred percent protection in the critical phase of money transportation." Oberthur Technologies receives the prefilled ink cartridges from Société SAV, a company based in Joinville le Pont, near Paris, that specializes in chemicals and laboratory devices. SAV segments the glass tubing supplied by SCHOTT, molds it into containers and then fills them with dyes. The high chemical stability of the borosilicate glass ensures that the properties of the permanent ink are preserved lastingly.

"In order to be able to manufacture glass cartridges, we require glass tubing that has a rectangular shape and uniform thin side walls," explains Jean Luc Beutler, General Manager of SAV. "CONTURAX® Pro is the only product that meets these specifications. It has the ideal chemical and mechanical properties and can be processed extremely accurately, in addition to its good machinability," he adds.

SCHOTT manufactures seamless CONTURAX® Pro profiled tubes in a wide variety of shapes, including triangular, rectangular, hexagonal, and lots of others, with the help of a patented continuous drawing process. This allows processors to avoid costly conversion processes. The tubes are available in lengths of up to almost 4 meters and wall thicknesses of between 0.2 and 5 millimeters. Tubes with a wall thickness of 1.75 millimeters and extremely low tolerance of ±0.15 millimeters are needed to produce these ink containers made of glass. The rectangular shape of the ink cartridges allows for space-saving integration into the cash box. At the same time, the square shaped profile tube breaks more easily and evenly than a round tube when the trigger is pulled inside this security application.

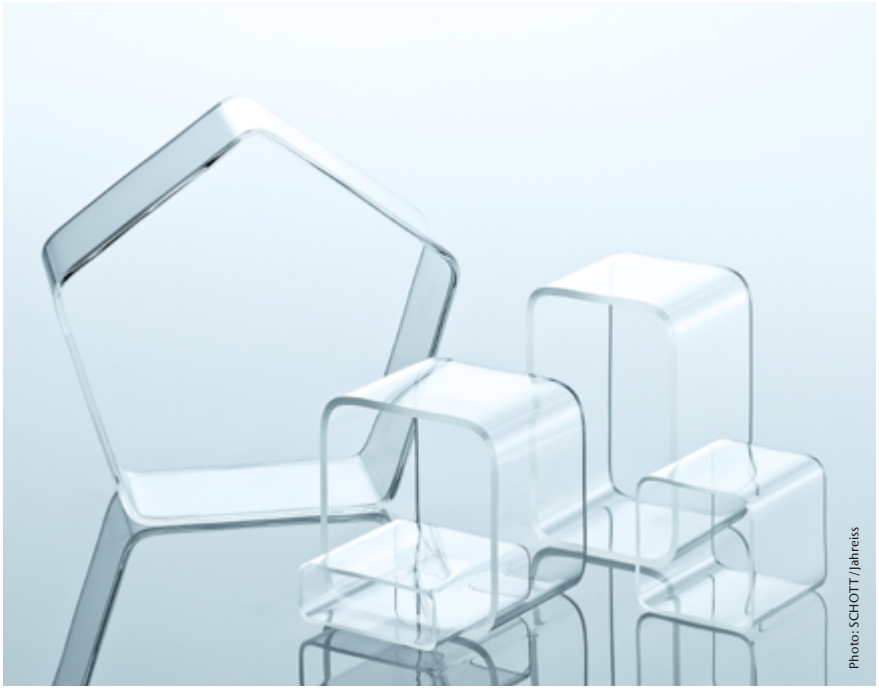


Photo: SCHOTT/Jahreiss

PATENTED PROCESS

SCHOTT uses a patented continuous drawing process to manufacture CONTURAX® Pro glass profile tubes. This allows them to be formed with high precision in large quantities. The glass tubes are available in lengths of up to 4,000 mm and wall thicknesses of 1.4 mm to 3.00 mm. Diameters range from 42 mm to 150 mm. The many different geometric shapes allow for countless uses, in lighting and interiors, for example.

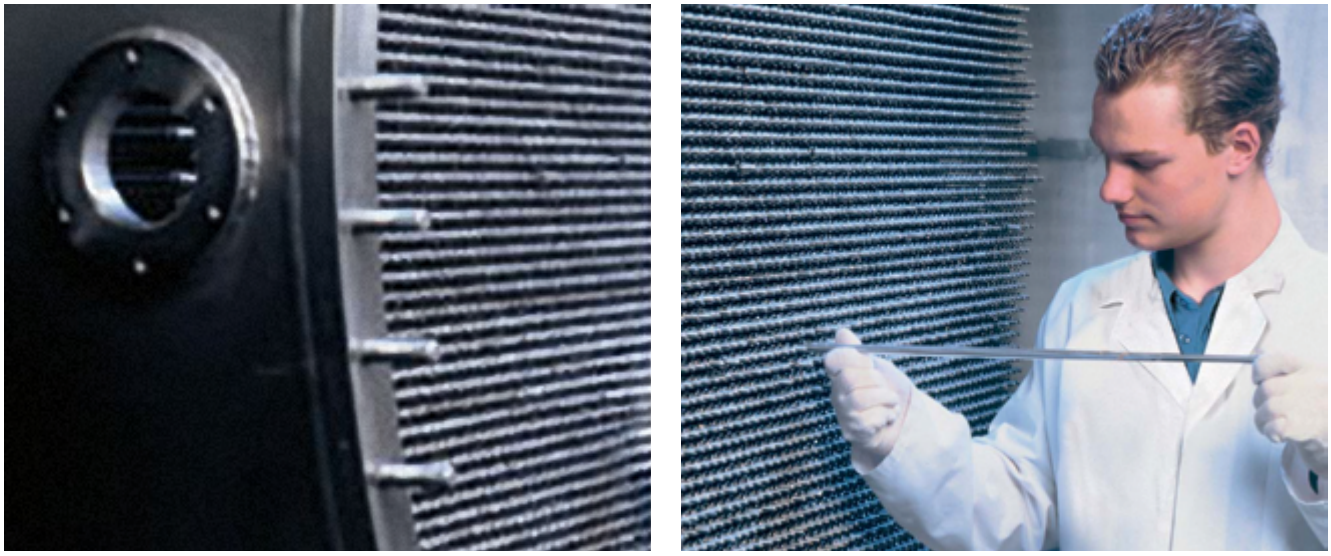
"It's quite exciting and inspiring to enable new applications that meet such high requirements," says Hermann Tietze, Sales Director EMEA for Technical Tubing at SCHOTT AG. "Normally, our glass needs to be as durable and strong as possible. With these ink cartridges, however, our tubes are expected to break quickly and evenly, without getting damaged during manufacturing or while they are being transported."

So far, this intelligent cash protection system from Oberthur has been introduced mainly in Western Europe. Now, the company is expecting expansion of its customer base to include other regions of the world. "Simply knowing that these glass ink containers make stolen bank notes unusable for criminals acts as a deterrent and could well prevent acts of violence," adds Hermann Tietze from SCHOTT. "We are pleased to be able to contribute to this," he concludes.

SCHOTT Product: CONTURAX® Pro

A Potent Gas: Ozone

It was a recording-breaking event when the new celllulose plant of Votorantim Celulose e Papel featuring the world's biggest ozone generator went on stream in Brazil. Produced by Wedeco Environmental Technologies, the generator boasts another superlative: it is equipped with an impressive 63,000 DURAN® glass tubes from SCHOTT.



Three separate generators each with some 21,000 DURAN® glass tubes – 10,324 at each end – were installed in the world's largest ozone production system at VCP in Brazil. The outer and inner diameters of the special glass tubing required for the construction of the electrodes have an extremely narrow range of permissible variation.

"My friends always suspect that I am doing something bad," claims Ralf Fiekens. The process engineer at Wedeco Environmental Technologies (now Xylem Water Solutions) in Herford is used to people's reaction when he tells them he builds ozone generators. Ozone? Everyone is aware of the problems with the ozone hole and ozone warnings. It irritates Fiekens that the gas that is the focal point of his work has such a bad reputation.

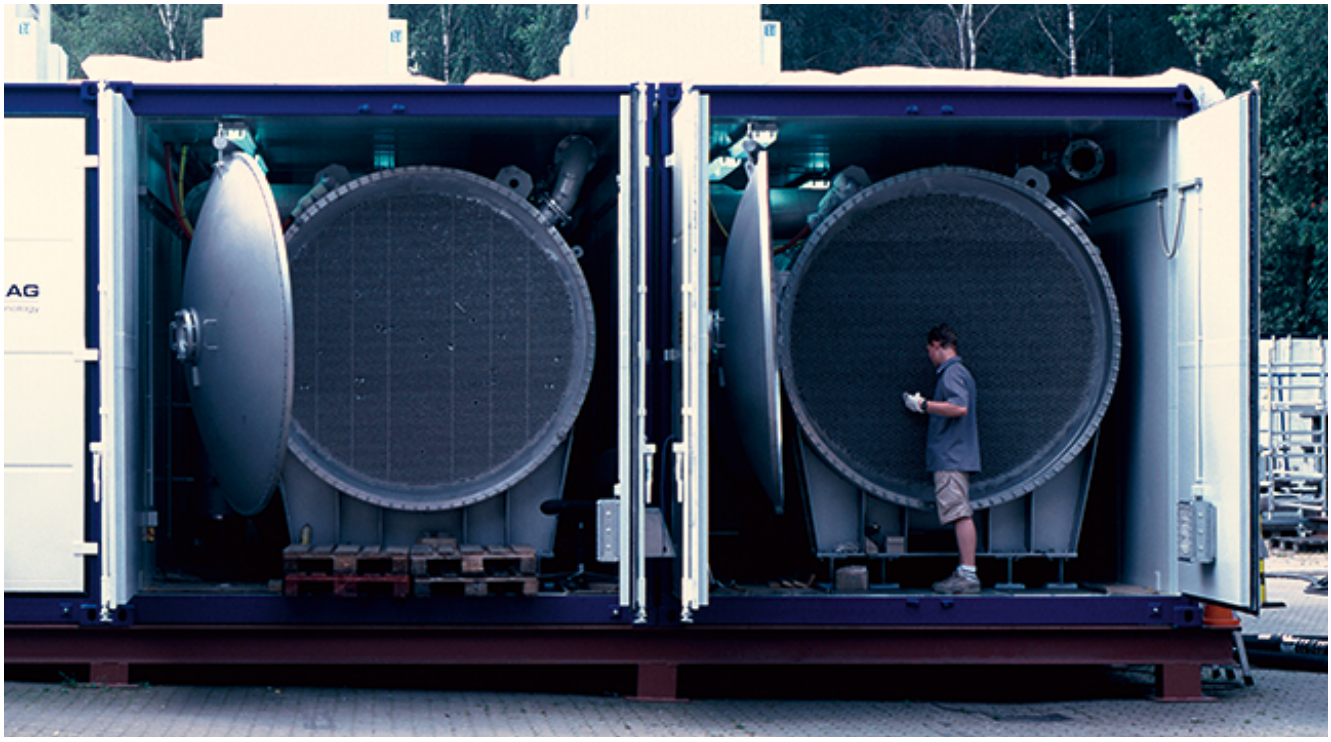
Mostly only experts know that ozone is a tried and tested disinfectant. After elementary fluorine, ozone is the strongest oxidant known to chemistry. The oxidation of organic substances is the important step in disinfecting water, and also in bleaching processes. This method was used for the first time in 1903 to disinfect the water system in Paris. For a long time the treatment of potable water was practically the only application of ozone – and even so, it was not widely used.

The range of applications has expanded in more recent years. Today, the three-atom variation of oxygen purifies highly polluted industrial effluent, and it is used to bleach, for example, cellulose, the raw material in paper production. If left unbleached, the paper would retain the color of lignin, a constituent of wood.

Always produced on site

For those who use ozone there is, however, one special feature. Unlike hydrogen or argon, ozone is not a gas that can be purchased in a bottle or a tank. Because of its instability, it cannot be stored and always has to be produced directly at the site of its application. This is the job of ozone generators.

The Brazilian paper and cellulose manufacturer, "Votorantim Celulose e Papel" (VCP), uses ozone to bleach its cellulose. VCP increased its production capacity at the end of October 2002 and started up a new factory. For this purpose, the Brazilian company had ordered an ozone



The ozone generators are installed in large-capacity containers.

system from Wedeco (now Xylem), which was delivered in the late summer of 2002. Their requirements exceeded the capabilities of a standard ozone system: the generator had to produce 510 kilograms of ozone per hour – nearly 20 percent more than the biggest unit used by the cellulose industry up to now anywhere in the world.

A silent discharge

The most efficient method to produce ozone on an industrial scale is silent electric discharge in oxygen. Manufacturing equipment for the production of ozone is Wedeco's daily business. But the unique feature of the order from Brazil was the size of the unit. While most of the units sold so far produce up to 13 kilograms of ozone per hour, the system designated for the city of Jacareí near São Paulo was to manufacture nearly 40 times that amount. One year of intensive project work was necessary to plan and construct the unit.

No matter how much ozone a unit is to produce per hour, the primary component for ozone production is always the same size: a borosilicate glass tube one and a half meters long with a diameter of 11.5 millimeters. An equally long metal rod runs through the interior. There is one chamber between this rod and the inner wall of the glass tube, and another between the outer wall of the glass tube and the stainless steel outer covering around the glass tube.

Air or pure oxygen is fed into these two chambers. At the same time a very high voltage is applied between the metal rod and the metal covering, thus creating a strong electric field similar to the one between two capacitor plates. When exposed to the electric field, some of the oxygen molecules in the input gas break down into two oxygen atoms. These single atoms attach themselves to free oxygen molecules and form ozone.

If pure oxygen is used, the ozone output is higher than with simple air, which usually has an oxygen content of only about 20 percent. However, pure oxygen as a starting material must first be produced or bought, whereas air is freely available.

Glass tubes prevent short circuits

The fact that such high voltage does not cause a short circuit is due to the glass tubing. Borosilicate glass is an effective insulator that prevents any charge transfer from the metal rod to the metal coveriing. “That is the reason why we use this glass for the construction of our electrodes,” says Ralf Fiekens about the DURAN® glass tubing that Wedeco/Xylem has been purchasing from SCHOTT for years.

2002 has been a particularly good year. The application of ozone has been booming, as the eight industrial-scale ozone systems in Wedeco’s order books prove. Some 63,000 glass tubes alone were required for the biggest generator produced so far, the one in Brazil. There are obvious reasons for this impressive number: the more ozone to be produced, the greater the number of electrodes arranged in parallel lines.

In the case of VCP, this means three separate generators, each with nearly 21,000 electrodes. In fact, SCHOTT concluded a separate agreement with Wedeco for special service in connection with this order. “For this project, it was extremely important that the outer and inner diameters of the glass tubes

A primary component of ozone generators are the glass tubes, each of which contains a metal rod. The glass tubes are enclosed by stainless steel sheaths. Ozone is produced from pure oxygen by applying electric voltage to the chambers between the metal rod and the metal sheathing.

were kept within a very narrow range of permissible variation,” stresses Ralf Fiekens. SCHOTT included the specially requested measurement of the inner diameter in the quality requirements for Wedeco’s order, thus ensuring that all 63,000 tubes sent to Herford had the requested specifications.

Adding value

It appears there may be more big orders for the manufacturers of ozone generators in the future. Despite this boom in recent years – and not to mention all the advantages and ecological benefits compared with chlorine – ozone still only plays a minor role. Thus the potential is enormous. But even that is not enough for Ralp Fiekens. Fiekens not only hopes to expand end-of-pipe applications, such as effluent treatment, potable water disinfection and cellulose bleaching. He also intends to penetrate the value-added chain with this potent gas and already has an example of how he plans to do it. “Tests with juice cartons have shown that the final polyethylene lamination of the aluminum coating is a better quality if you anodize the aluminum beforehand with ozone.”

Ozone therefore appears to be a promising substance for the future. And who knows, perhaps Ralf Fiekens’ friends will react differently some day. “What? You produce ozone? That’s great!”

SCHOTT Product: DURAN® tubing

Material with a double soul

When it comes to designing lamps, characteristics like visual comfort, performance, quality of light are essential. Ettore Cimini, CEO at Lumina Italia srl, speaks on their cooperations with SCHOTT and Foster + Partners and on the challenging and fascinating aspects of working with glass.

Mr. Cimini, what is your philosophy at LUMINA?

In Lumina, we love developing products that last over time and whose form and function reach an ideal synthesis. Lamps that are lightweight in structure and made with precision engineering. Nothing more, nothing less. Our know-how is at the service of design, which is why we've built trustworthy relationships with designers and architects of international renown.

Since when do you have the design cooperation with Foster + Partners, the famous architects and designers, and how did it start?

The English studio had known and used Daphine, our icon, in their projects for many years until they conceived Flo – with fluid and essential lines. They thought of us and contacted us. We met for the first time in 2009 and, after Flo creation (produced since 2010). We have shared many ideas and projects, some of which have become products that we have, in the following years, included in our catalogue.

A result of this cooperation are the products Eva and Eve. Is there a special story of these products that you can share with us?

Eva was born to be produced in a limited number of copies (40 pieces) for a Foster + Partners project in Hong Kong. However, as soon as we turned on the first prototype we immediately fell in love with it and decided to make it available to all our customers.

Which are the most important aspects for the construction of a lighting product?

The most important aspects are certainly those related to light: visual comfort, performance, quality of light. The second aspect is the durability of the product, which is a consequence of our design and production choices, the choice of noble materials is essential. This is why we are proud of using plastic only where it is strictly necessary, mainly as an electrical insulation.

What fascinates you as a designer about the material glass?

Glass is a material that man has been using for 5000 years. At the beginning, it was used only as a seal due to its extraordinary aesthetic properties. Thanks to the continuous evolution of fusion techniques and silicon mixtures, its use has expanded throughout history until today where the word "glass" is no longer enough to define its applications and fields of use. As a lighting designer, I consider glass an exceptional material for both its aesthetic aspect, and even more for its physical properties: glass allows you to refract or reflect light, you can diffuse it, you can filter it, you can concentrate it, and you can even fold. The fact that it is not easy to work with makes the challenge even more fascinating.

Ettore Cimini, CEO at Lumina

Ettore starts working on Lumina as a child, during the summer break, helping in the workshop and in production. After completing his technical studies, before enrolling at the University, he began working in the technical office as a mechanical designer. The untimely death of his father Tommaso Cimini, in August 1997, forced him to interrupt his studies and devote himself to the family business with his brother, Andrea. In 2007 Ettore decides to take over Lumina, acquiring the majority and focusing on the product.He still leads the company today with the same passion and enthusiasm.

Is the fragility of glass a challenging or more a beauty aspect for you?

I believe that glass has a double soul, an aesthetic and a functional one, which will always go hand in hand.

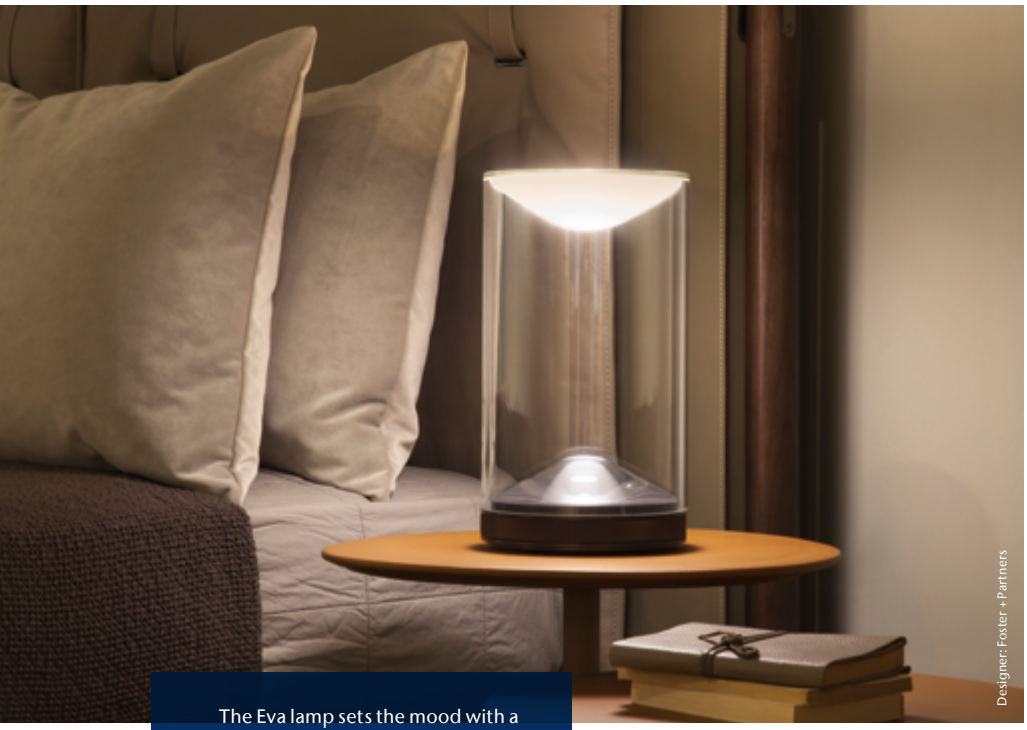
Why did you choose DURAN® glass tubing from SCHOTT for the construction of Eva & Eve lamps?

We choose for our customers the best materials and technologies available on the market. Eva was immediately born to be an exclusive product: we wanted the best glass tube for our customers and we chose SCHOTT.

What are the most important features of the glass for you?

Transparency and therefore its purity, its resistance in combination with its limits, precision in production and processing.

Eva & Eve: Two beauties in the world of lighting



The Eva lamp sets the mood with a welcoming glow of illumination

SCHOTT Product: DURAN® tubing

Handcrafted Light Design

When designing interiors, many elements contribute to the creation of unique atmospheres. Lighting in particular takes on a key role in this creative process. It underlines the architecture of the space and sets accents. At the same time, it attracts attention as an outstanding design piece. The London based design studio Cameron Design House uses organic and precisely engineered elements such as DURAN® glass tubing or rods for their sculptural chandeliers. Ian Cameron, Creative Director of Cameron Design House, about his ideas – and working with glass.

What is your philosophy at Cameron Design House?

Cameron Design House is a bespoke sculptural lighting company with workshops in St John's Wood where all of our designs are handcrafted. We specialize in designing and manufacturing statement chandeliers for iconic projects around the world.

How does a design process look like?

Every piece goes through a full design service with our Design Team before being handmade to order. We work closely with each client to customize design elements including the finish, sizing, and configuration to ensure it will work perfectly for the intended space. Once the design has been signed off, the piece is put into production in our North London workshops which typically takes around 10 to 12 weeks.

Which are the most important aspects when designing a light?

We always say how important it is to choose a piece that works best for space rather than the other way around. Always consider the architecture first, for example, highlight a dramatic high ceiling with a chandelier that has a long drop.

What are the design concepts of Haara and Rokua?

Cylindrical and linear, like the ancient coniferous forests of Rokua National Park in Finland, the Rokua luminaire evokes the same serene ambiance of this UNESCO site. The Rokua lanterns are made up of hand-drawn glass that conceals the lighting element while diffusing a warm tranquil glow. The solid brass structure of the Rokua, engineered from the hand-milling of brass plates, holds a sophisticated internal structure that supports the hand-drawn glass.

The branching frame of the Haara pendant has a delicate and finely engineered structure derived from close observation of nature. The cylindrical lanterns are assembled from hand-drawn glass and polished brass concealing the lighting element and creating a unique and beautiful lighting diffuser to be admired whether the light is on or off. As in nature, this piece can grow to suit any interior environment.

The bespoke options and design services are available for the Rokua and Haara.


Photo: Cameron Design House

About Cameron Design House

Cameron Design House is a bespoke sculptural lighting studio founded by Creative Director Ian Cameron in 2014. All of their pieces are handmade to order by a team of artisans in their St John's Wood workshops before being installed at iconic projects around the world. They focus on sustainability by using the best materials and manufacturing processes to create pieces that last for many lifetimes.

Inspired by nature: The chandelier Haara made with DURAN® glass tubing.

Why did you choose glass from SCHOTT?

Our aim is to create pieces that last for many lifetimes by using the best manufacturing processes and materials available. SCHOTT produces the best glass in the world therefore working with their experts was the only option!

What is your experience with the material glass?

Several of the most recent pieces from our collection such as the Kuulas, Helmi, Haara, and Rokua, feature glass elements within the design. It is one of our favorite materials to work with due to its versatile nature. I love being able to bend and mold the glass to create unique shapes.

Glass is and will remain fragile. Does this present you with new challenges for the design and especially the production of design pieces?

There are a few important factors to consider when working with glass such as refraction and weight as well as fragility. All of our pieces are handmade to order so it is crucial that we get every final detail correct.

The Rokua lanterns remind of the ancient coniferous forests of Rokua National Park in Finland.

SCHOTT Product: DURAN® rods

Light in the Desert

Photo: FlexSol Solutions

In 2014, the Dutch start-up company FlexSol Solutions has developed an innovative solution for bringing light into darkness: a modular streetlight with cylindrical solar panels. And the special glass supplied by SCHOTT makes this solution ideally suited for street life. The success story continues.

New York, London, Tokyo, Dubai – the streets are alive in these megacities, no matter what the time is. Artificial lighting turns night into day – and sends the electricity costs soaring. Some cities are already using solar streetlights as a way of saving energy. But so far, the solutions have not been ideal. ”Conventional solar panels are flat and do not look particularly attractive, and they are also not optimal for streetlights since dirt can accumulate and reduce their performance,” says Lennert van den Berg, CEO of the start-up FlexSol Solutions.

The Dutch entrepreneur and his team rose to the challenge and developed the lighting solution ”Soluxio.” What makes this product special is that its cylindrical solar panels are integrated into the light pole. But Van den Berg not only wanted to design a streetlight that meets aesthetic standards and fits into the cityscape. His aim was for the solar streetlights to also withstand extreme weather and environmental conditions. And since he needed to protect the sensitive solar cells with a high-quality glass casing, Van den Berg contacted SCHOTT.

”When we heard about this innovative idea, our DURAN® glass tube made of borosilicate glass instantly came to mind,” says Klaas Roelfsema, Regional Sales and Business Development Director for North Western Europe at SCHOTT Tubing. The Soluxio developers needed extremely thin glass that is barely reflective, long lasting and robust enough for use on the streets. ”We also wanted our product to be as light as possible,” says Van den Berg. The reason is Soluxio’s pole. It also consists of individual modules made of aluminum that are lightweight and designed to reduce loading. But therefore off-the-shelf glass was either too heavy or not strong enough. Roelfsema: ”DURAN® was able to meet all of these requirements. The glass has to have a diameter of 20 centimeters, but it is only three millimeters thick and can withstand the severest environmental conditions.” The special glass tubes also cope well with temperature changes. ”But the main point is that DURAN® prevents unwanted reflection and can easily be mounted thanks to its high dimensional accuracy,” says Roelfsema. Van den Berg is also happy.

”We are experimenting a lot with glass, and are also using DURAN® glass tubes in many other products we are currently developing.” But finding the right glass was only part of the challenge for the start-up FlexSol. ”The most difficult thing was financing,” van den Berg recalls. Only then could FlexSol really get started on cylindrical solar panels. With the support of partners and pole specialists Sapa Pole Products, the Dutch firm developed the Soluxio light pole in just two years. This was also made possible with the help of SCHOTT. Van den Berg thinks highly of the company. ”SCHOTT is one of the largest glass manufacturers in the world, so we were delighted at how flexible and willing its experts were in supporting our project.”

The hard work has certainly paid off. Both the product itself and Soluxio’s individual components are sustainable. The autonomous solar light pole does not merely help to reduce CO_2 emissions. ”All of the materials can be completely recycled,” van den Berg adds. Soluxio’s success has shown that van den Berg was right to focus on quality.

In the meantime, Soluxio brings light to roads all over the world: in the hills above Las Vegas and in the Arabian Desert, where dust and desert sand can create problems for the solar panels in the lights. But thanks to the robust glass surface, this is not an issue. “Our glass provides Soluxio with the perfect protection against abrasion and with optimal UV stability,” Roelfsema says.

Soluxio can also be found along the first $C0_2$-neutral federal highway in the Netherlands near The Hague. The street light generates its energy from solar modules. The highlight is the round shape of the vertical solar panels, which resist soiling and always deliver full power. Soluxio is completely independent of the power grid and doesn’t require any wiring. “The DURAN® glass tubing from SCHOTT is ideally suited for protecting the solar modules of the lantern,” explains Roelfsema. “We quickly realized the potential of Soluxio because it has everything a sustainable product needs”. The material hardly reflects, is lightweight, resistant and withstands all weather conditions.

Thanks to its modular design, it can be adapted to any location. Sometimes one solar module is enough; sometimes you need several. In addition, the intelligent lamp adapts its luminosity to its surroundings. Equipped with GPS trackers and a radio link to the Internet, it collects data that FlexSol uses for maintenance and further development. The Dutch are currently using connectivity to set up a comprehensive WLAN network on a Caribbean island with the help of lanterns.


Photo: FlexSol Solutions

Basically Soluxio stores the energy for its own needs, but can also be used as a power generator with several solar modules and cable connections. Equipped with sensors, it can record weather or traffic data that municipalities can use for urban planning. In addition, almost all of its components are recyclable.

FlexSol is growing steadily thanks to Soluxio, and SCHOTT is helping. “We always want to give new impulses to our customers,” says Klaas Roelfsema, who always supplies the young company with test samples in a timely manner. FlexSol repays the trust with strong customer loyalty and impulses for the developers at SCHOTT. They have long been working on innovations that could make Soluxio even more efficient and SCHOTT products even better.


Photo: FlexSol Solutions

SCHOTT Product: DURAN® tubing

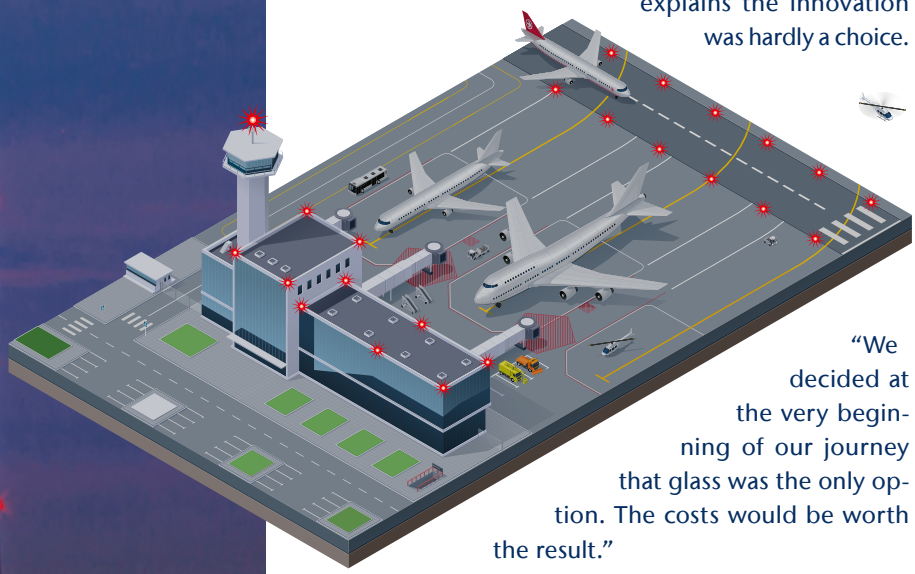
Signaling the future

Photo: Shutterstock

In an industry flooded with plastics, Finnish beacon light innovator Obelux sees a bright future with DURAN® glass tubes in its longlife LED devices. In the harshest environments, they help light the dark for aviation, wind and marine industries.

As one of the first companies in the world to focus solely on LED technology, Obelux has built a reputation for quality. It is one of the only major players in the industry to secure its luminous devices with glass rather than plastic, which is cheaper and lighter.

So why did they choose glass? Tapio Kallonen, Director of Sales and Marketing at the Helsinki-based company, explains the innovation was hardly a choice.



"We decided at the very beginning of our journey that glass was the only option. The costs would be worth the result."

Signal lights at windparks or airports have to work reliably for many years.

His customers have reason to agree. “Our products are on skyscrapers, wind turbines, bridges, even out at sea – these places are hard to reach, very hard to clean, and very hard to service with maintenance or repair.”

Aviation signal lights are designed to last upwards of 20 years, and must offer a consistency of performance that satisfies strict regulations from various industries and authorities. Devices with plastic covers absorb a fraction more light than glass, producing a slightly less luminous output. “It’s all about the optics,” says Kallonen. “We get more light through glass.”

Photo: Obelux

Obelux LED light sources are protected by DURAN® glass against extreme weather conditions.

DURAN® borosilicate glass meets these optical requirements as well as the protection of the LED lights perfectly. “Let’s imagine a typical example, like an offshore wind farm. You’ve got salt spray, cold wind, many other factors which affect a device. After two or three years in these conditions, a plastic cover is damaged on a completely different scale compared to one made from DURAN® borosilicate glass. By then, the plastic cover may no longer be compliant with industrial guidelines anymore. Yet after 10, 15, even 20 years, that glass beacon shines as brightly as on day one.”

As a pioneer of LED technology, Obelux has never used a traditional light source in one of its products. Despite the diverse regional regulations of the aviation industry, its commitment to sustainable quality has seen its products certified across the world, even in the highly domestic market of Japan.

“I couldn’t possibly overstate the importance of having an outstanding partner. Not only can I not imagine another glass producer that could make such specific glass tubes in such large dimensions, but whenever the irregular demands of the industries we serve force us into urgent action, SCHOTT is always there to meet our timeframe.”

As the demand for sustainability grows, Kallonen sees the advantages of DURAN® glass tubes leaving clients with the same realization Obelux reached long ago. For these two innovators of light and glass, the future is looking bright.

SCHOTT Product: DURAN® tubing

Special Effects with Lighting

In the Bundesrat Building in Berlin, lighting elements with CONTURAX® profile rods enhance stylish surroundings with pleasant lighting.

The building in Leipziger Strasse, Berlin, has had an eventful history. Built between 1899 and 1904 as the seat of the first chamber of the Prussian Landtag (parliament) in the style of a baroque nobleman's palace, its subsequent occupants included the East German Academy of Sciences. Since summer 2000 the former Prussian manor house has been the seat of the Bundesrat or upper house of the German parliament.

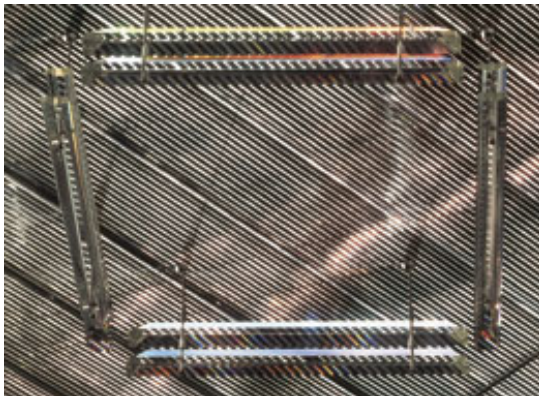
In September 1996 the Bundesrat decided to move its headquarters from Bonn to Berlin. In the four years leading up to the move, the building had to be adapted to suit the requirements of modern parliamentary work. The architects, Schweger & Partner from Hamburg, achieved this without any major changes to the basic structure of the historic building. One special challenge turned out to be the lighting system, which had to be harmonized with the historic architecture of the building.

DURAN® borosilicate glass is resistant to aging and able to withstand fluctuations in temperature of up to

500 °C.

Challenge for Light Engineers

In modern-day lighting engineering, glass and light are inseparably linked to one another. Special types of glass with specific properties are usually indispensable. When illuminating the various conference halls in the Bundesrat Building, lighting specialist Spectral thus opted for modern glass technology from SCHOTT. Prism-shaped CONTURAX® profile rods are part of the lighting elements providing the rooms with decorative illumination. The profile rods made from 3.3 borosilicate glass have long been highly successful in sophisticated lighting systems. CONTURAX® combines aesthetics and the excellent properties of DURAN® borosilicate glass. It is resistant to aging and able to withstand fluctuations in temperature of up to 500 °C. Glass lighting elements for the ceiling provide perfect integration of innovative lighting systems into historic architecture. In each meeting room 40 rectangular lighting elements offer uniform, virtually glare-free illumination. The specified distribution of light has been achieved by using reflector systems and optical elements. Light sources located on one side of the room project the light onto aluminized plastic components via reflectors placed at precisely calculated positions. Additional CONTURAX® crystal glass prisms provide the desired reflection and an amazing brilliance. The result is an attractive illumination system, impressive both visually and in terms of functionality.



In the Bundesrat Building a total of 40 lighting elements with glass profile rods provide stylish illumination.

Aesthetic and functional – conference hall with CONTURAX® crystal glass prisms.

SCHOTT Product: CONTURAX®

Floating Sculpture

Internationally renowned architects, designers and engineers have collaborated to create the world's largest light sculpture. It is made with DURAN® from SCHOTT.

The new DG Bank is located just a stone's throw from the Brandenburg Gate, one of Berlin's most famous landmarks.

A glass ceiling above the sculpture allows the glass objects to come to life in the natural light.

What do glass tubing and light sculptures have in common? For glass designer Nikolas Weinstein, quite a lot. Together with a highly talented project team, he used SCHOTT's DURAN® glass tubing to construct the largest light sculpture in the world.

This two-and-a-half ton masterpiece hangs in the corporate headquarters of Germany's DG Bank. Designed by world-renowned architect Frank O. Gehry, the building is located in a highly prestigious area of Berlin, just next to the Brandenburg Gate. "Pariser Platz 3" is both the name and address of the building.

The First of Its Kind

Unprecedented in its design, the DG Bank light sculpture covers a space of over 1,990 square feet. Nikolas Weinstein describes it as "an ephemeral and airborne gathering of 36 elements that soar through the central public atrium of the building, making it appear that the entire building is opening up to the sky."

The light sculpture's unique design was inspired by its location in relationship to the building's conference hall. The large interior atrium of "Pariser Platz 3" features a curved glass ceiling and a curved glass floor. The conference hall is located within a sculptural shell that rests on the glass floor in the center of the atrium. Clad in stainless steel on the exterior and wood on the interior, the hall appears to float in the space. As Weinstein explains, there is a direct "conversation" taking place between the opaque hall and the sweeping glass sculpture, which both captures and diffuses light.

The individual panels, ranging from four to ten feet in length, are suspended by approximately 600 fine aircraft cables. The elements rise as high as 26 feet and drop as low as twelve feet above the floor to engage the scale of the viewer. During daylight hours, it captures the natural light that flows through the atrium roof. At night, a lighting system filters through the various elements to illuminate the public space below.

The installation of the sculpture took two months. 600 steel cables allow the glass clouds to float in the atrium of the DG Bank. The suspension construction is designed to support 14 times the actual weight of the pieces.

The DURAN® borosilicate glass functions like safety glass, without being laminated or tempered. Its unique construction inhibits crack formation by arresting it locally.

The interior design of "Pariser Platz 3" is already capturing worldwide media attention. According to the Berliner Morgenpost International, this ambitious work of art is probably "unparalleled in the whole world".

SCHOTT Product: DURAN® tubing

Swinging with glass

Creative researchers at Delft University of Technology in the Netherlands have developed a glass swing using glass rods as the construction material. Ate Snijder, one of the developers of this extraordinary project, talks about the project background and its creation.

How did this unusual idea come about?

The glass swing idea was an attempt to bridge the disparity between glass art and architectural glass because little synergy exists between these two fields. Glass art can be sculptural, curvaceous and spectacular, whereas architectural glass tends to be structural, flat and can almost be invisible. Three engineers and educators with a passion for structural design, Prof. ir. Rob Nijsse, ir. Lennert van der Linden and myself often fantasize about and realize ways to do more with glass as a structural material. Our question is: Can the fields of architectural glass and glass art merge to create structures with the qualities of glass art, addressing form, light, playfulness, elegance and function? The swing says yes! With a small team of engineers and students, we have attempted to fully utilize the enormous aesthetic potential of glass while at the same time creating a strong, safe and functional object.

Who had the opportunity to have a go and enjoy the glass swing first?

The visitors of glasstec special show “glass technology live” in Duesseldorf were the first people to try. The trade show has a history of showing interesting and eye-catching glass objects with a playful character. The presented nine meter long glass slide in 2016 for example was such a fantastic piece; we liked the idea of following up on that. Our swing allowed the visitors to load the structure with their own weight. This gives them a more direct feel for the loadbearing capacity of the glass.

What was the scientific intention and how did you proceed?

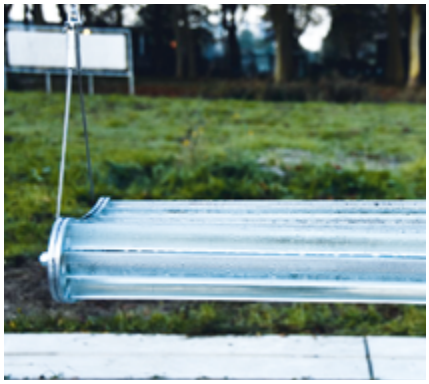
Our intent was to find an optimal but at the same time beautiful glass structure for the glass swing. To create both a stable and efficient as possible bearing frame of glass bundle bars my colleague Lennert van der Linden and I used computer aided parametric design techniques. We already knew the technology behind creating safe glass bundle bars, but the required structural nodes to connect the glass bundle bars had to be developed. We decided to use 3D printing to create the steel connecting detail. From the complete overview, each detail was drawn out in a computer program. This information was sent to the 3D printing company Ramlab in Rotterdam. In the workshop of Ramlab the steel connecting parts were 3D printed on steel spheres. At Delft, Kees Baardolf welded the connecting strips to these 3D printed nodes. He also welded the steel beam base frame that the glass swing was placed on.

Did your experiences with glass motivate you to use it again?

No doubt. Every project brings great satisfaction but also a gnawing regret about all the things that could have been done better in hindsight. A new project offers the opportunity to use the lessons learnt. This swing and the former glass bridge project will by no means be the last ones using glass rods.

Vita A.H. (Ate) Snijder

Ate Snijder graduated from the Architecture Master at the University of Delft, the Netherlands. In the graduation project, under mentorship of prof. ir. Rob Nijsse, he developed a series of shell structures with glass as the primary load bearing material. Currently, Ate Snijder works at chair of Structural Design and Mechanics within the faculty of Architecture. As a researcher he is part of the Glass Research Group where his focus is on the structural behaviour of glass load bearing components of bridges and buildings. Within the research group he specializes in FEM modeling of stress distribution in glass, detailing of glass connections and structural design with glass.



What was necessary from a material side to realize the swing? Did you get any external support?

SCHOTT was a fantastic partner for the swing. The material was provided cut to length and this was really helpful for the construction. In our publications, presentations and glass education we are happy to mention the collaboration we had in the construction phase of the swing. The quality of the glass has proven to be so high that we were able to weld on the nodes a few centimeters away from the glass, with hot bits of metal sometimes dropping on the glass without breaking it. In addition the 3D printing startup Ramlab have been great to collaborate with in the development and production of the connections.

Why is it so special to work with glass as a construction material?

The most challenging aspect is that you cannot hide anything. People can see right into the material and any bad detailing or damage is immediately visible. The trick is to keep the construction very clean and very simple. Secondly, there are big structural challenges: The structure must be safe, vandalism proof and stresses in the glass must be controlled carefully. Glass is not a very forgiving material in its use in construction. Fortunately, we have an enormous accumulated knowledge and experience here at the university on how to engineer glass structures.

Which idea do you think will come next from you and your students?

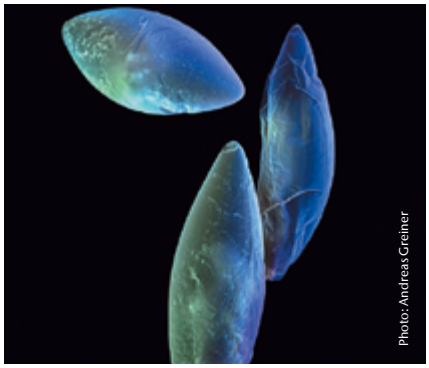
We have three solid ideas, which I hope we will incorporate in the coming glass courses for the architecture and civil engineering students. Of course, to be able to realize these we hope to continue and expand our relationship with SCHOTT for their contribution of the necessary materials. The three upcoming structures are spectacular and (I think) very advanced glass-engineering structures. The first is an arch bridge consisting of glass blocks, which are dry-assembled. The second is a space-frame structure with improved glass struts made from a combination of tubes and rods. The third is a grid shell from the same newly developed struts of tubes and rods.

SCHOTT Product: DURAN® tubing

Generating energy naturally

Visual artist Andreas Greiner's latest work is at the border of art and science: a spiral-shaped photobioreactor filled with luminescent deep-sea algae and built from SCHOTT glass tubes. Greiner literally illuminates natural energy production processes.

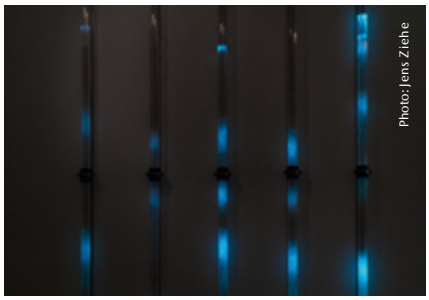
Already during his studies of art and medicine, Andreas Greiner was interested in the dichotomies of nature, technology and culture. It became apparent early on that these were also to set the course for his visual art – until today, as his most recent work shows.



Scanning electron microscope image of bioluminescent algae (Pyrocystis fusiformis). Andreas Greiner in collaboration with Stefan Diller, 2018

Greiner's work stages transformation processes of nature from which energy can be naturally generated. At the center of his room installation stands a spiral-shaped photobioreactor made of glass tubes. The installation becomes an experience in light of the bioluminescent deep-sea algae "Pyrocystis fusiformis" growing within it. Daylight interacts with the algae as it binds CO_2 and later releases the light energy by glowing in the dark. The process is facilitated by a mechanical pulse of rising air bubbles. The artist and scientist had spent years perfecting the cultivation of this particular algae strain. For his project to succeed, he needed a glass reactor that would let in only that light necessary for growth, but which would also not release any harmful substances into the water. Since DURAN® glass tubes have precisely these properties and are already used in industrial-scale algae cultivation, Greiner turned to SCHOTT.

Unlike industrial algae production for energy, his work on the cultivation of "Pyrocystis fusiformis" is symbolic, seeking to bring natural phenomena and living processes into the discourse on the relationship and interaction of humans and the environment through sculptural experience. Algae have long played a role in his artistic examination of this topic. Besides a series of portraits, he has also presented a musical composition with deep-sea algae and developed a test reactor for bioluminescent algae cultivation.



Installation view with SCHOTT Tubing and bioluminescent algae (Pyrocystis fusiformis).

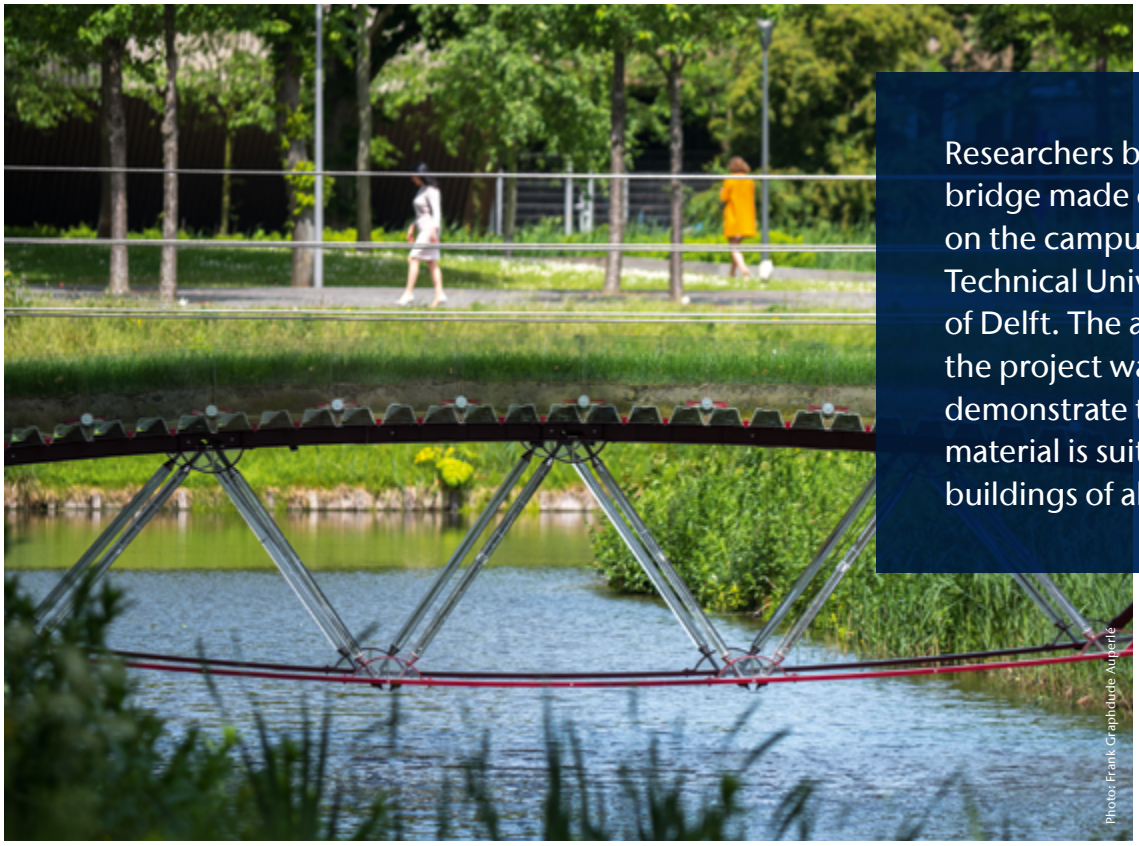
Andreas Greiner

Andreas Greiner – a master student of Olafur Eliasson

Andreas Greiner is a graduate of the Institut für Raumexperimente at the Berlin University of the Arts and a master student of Professor Olafur Eliasson, who teaches there. Following studies in medicine and sculpture, his focus is now on time-based, living and digital sculptures. His work often addresses possible extensions of classical parameters in sculpture. He concentrates on the increasing dissolution of classical dichotomies of nature, technology and culture and the associated anthropogenic interventions in nature and evolution.

SCHOTT Product: DURAN® tubing

Technology meets aesthetics



Researchers built a bridge made of glass on the campus of the Technical University of Delft. The aim of the project was to demonstrate that the material is suitable for buildings of all kinds.

Glass is extremely strong and very durable as it neither corrodes, rusts nor rots. It's also sustainable and completely recyclable. So why not put it to the ultimate test and build a bridge out of glass? Researchers who worked with Prof. Rob Nijsse, Ate Snijder, Joris Smits, Telesilla Bristogianni, Faidra Oikonomopoulou, Kees Baardolf, Christian Louter and Dr. Fred Veer asked themselves exactly that when they initiated the project at TU Delft. Together with colleagues and students, they developed the design and construction of the glass bridge. Glass tubes from SCHOTT were used as the building material.

The bridge strut is made of DURAN® glass tubing.

Using glass as an outdoor building material places steep demands on it: "DURAN® borosilicate glass has high thermal shock resistance and stability. That's exactly what an ambitious project like building a glass bridge needs," says Klaas Roelfsema, Regional Sales and Business Development Director for North Western Europe at SCHOTT Tubing.

The 14-meter-long glass bridge, which can be seen and crossed on campus, proves two things: first stability and secondly, the material's special aesthetic value. It fittingly forms the gateway to

the “Green Village,” a test site on the university grounds that houses prototypes of sustainable innovations. Employees and students of the university as well as visitors can experience new technologies in action. Once all vulnerabilities are resolved, the prototypes are rebuilt at another location.

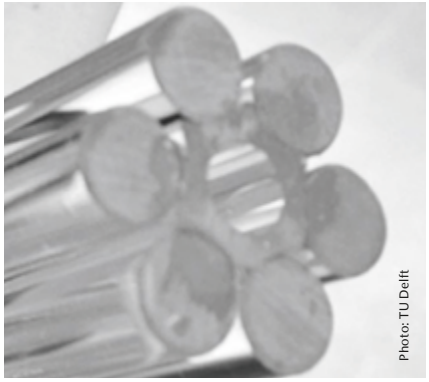
Even though the present glass bridge stands alone, it builds the trust for the next project – an arched bridge fully made of glass. The magical ice bridge from the movie Thor (2011) provides the inspiration. Its transparency and form gave the researchers the idea of experimenting with glass. The material’s transparency would create a unique aesthetic.

Technology of tomorrow

In an interview with Ate Snijder he discusses the construction of the glass trust bridge and the special processing of SCHOTT glass.

Why did you choose glass as a building material?

Originally, we thought of a steel structure. But that’s nothing new. We wanted the bridge to have a certain aesthetic. Glass has several advantages. It’s a very strong, durable and resilient material. It’s made of sand and can be recycled, which makes it sustainable, a complement for the “Green Village.” A glass bridge also means virtually no maintenance because it neither rusts, corrodes nor rots. On top of that, glass is affordable. Calculations and digital simulations finally showed that implementing our idea was actually possible. The fact that using glass as a construction material is still relatively new and hardly researched was one more reason for us as scientists to use the material.



Bundle made of star-shaped CONTURAX® glass tubes and six round DURAN® glass tubes.

Ate Snijder thinks that bundles of glass are safe for use in structures.

What were your biggest challenges with the project?

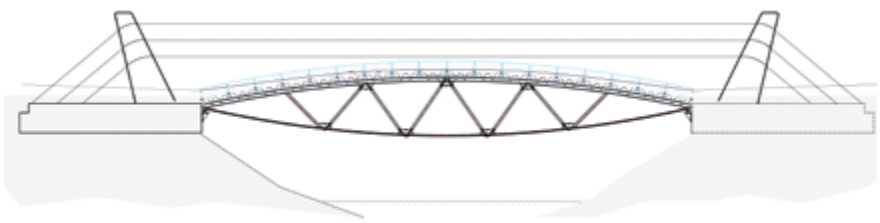
We used a relatively new kind of material composition for bridge construction, first developed by Prof. Nijsse and technically conceptualized by Faidra Oikonomopoulou – glass rod bundles. We connected a star-shaped CONTURAX® glass tubes with six round DURAN® glass tubes. A transparent UV adhesive holds the tubes together. By making a bundle rather that a single glass rod, we create redundancy. If one, or even two or three rods in the bundle fail, the bundle as a whole still retains some load bearing capacity.

What are you taking away from the project?

Bundles of glass are safe for use in structures because of their redundancy since they can take damage without failing completely. They are also very strong in compression, comparable to steel or concrete. By prestressing the bundle, which means applying a compressive force on the glass, we can make sure that the glass bundle is always under compression, even if loaded by a tension force. But the bundles' most important quality is their incredible aesthetics. To further optimize the glass bundles, we will test different configurations with and without glue.

SCHOTT has proven to be a great supplier throughout the project. We're more than satisfied with the quality of the glass tubes and the service. We hope to keep our relationship open and work together in the future because we already have some exciting projects in mind. For instance, we want to expand the current glass bridge into an arched bridge. Students are also working with the glass bundles on a truss structure.

Special thanks to Zwatra Transport, DIMI, The Green Village, RHDHV, Hovenier van der Heijde.



SCHOTT Product: DURAN® tubing CONTURAX®

Printing in the third dimension

3D printers from MICRON3DP (now Micron E.M.E.) allow to produce components with complex geometries.

SCHOTT is providing “Ink”, high-grade DURAN® borosilicate glass, to the world’s first 3D glass printer from Israeli start-up Micron E.M.E.

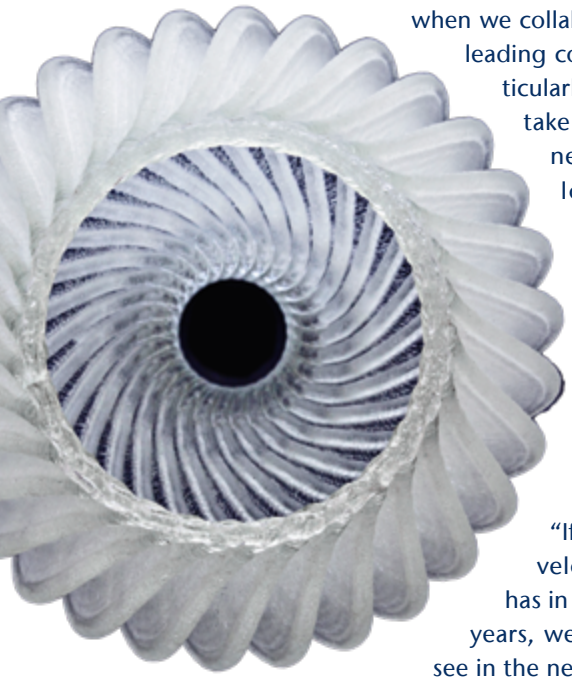
Arik Bracha, CEO of Micron E.M.E., has over 25 years of mechanical engineering experience.

2016: Arik Bracha holds a glass workpiece in his hand and meticulously examines it from all angles. Not only is he quite proud of the object‘s complex geometry, but also of the machine that produced it: the world’s first 3D glass printer. The Israeli start-up Micron E.M.E. (former MICRON3DP) is recognized as one of the pioneers of high-resolution glass 3D printing and has already achieved with its 3D printing technology, which is based on a FDM process at extremely high temperatures, “the first successful results,” according to company founder Bracha.

The entire global market for 3D printing, which is currently valued at USD 10 billion, is indeed very promising; the material portion alone, such as the “Ink” for printing, accounts for 10 to 30 percent of the market. Whereas plastics, metals and ceramics have established themselves in the market, glass and the respective printing machines are still very much at the early stages of the game. At the moment, it is used only as filler material in plastic 3D printing or as an additive in prosthetics applications.

As print material for more demanding applications, where typical glass properties such as optical quality can be increasingly played off, glass powder, pastes, rods or tubing are optimal. Bracha explains that 3D printers for glass face a special challenge since the material must be melted and made printable at temperatures of over 1000 degrees Celsius. As “ink” for its closetsized high-tech machines, Micron E.M.E. (former MICRON3DP) uses AR-GLAS® and DURAN® borosilicate glass from SCHOTT. In addition to SCHOTT’s network, technology expert Bernd Hoppe is there to provide material and process know-how to the start-up. With its extensive capabilities in glass technology and the diversity of materials it can provide, SCHOTT is well positioned to offer customized materials and approaches for additive manufacturing processes.

USD 10,000,000,000 is the current market value for 3D printing.



"In this way, future 3D printing applications will include the internationally respected 'SCHOTT quality' in their development," explains Mr. Hoppe. Adds Bracha: "We firmly believe that when we collaborate with globally leading companies – and particularly SCHOTT – we can take our process to the next level." And how long before that happens? The company head estimates that by the end of the year MICRON3DP (now Micron E.M.E.) will install first Beta testing 3D printers.

"If the technology develops as rapidly as it has in the last two or three years, we will most certainly see in the near future the realization of technologically demanding 3D glass applications in hollow glass and laboratory glass as well as optics," notes Hoppe. The first work groups have already set long-term goals in the development of 3D printing solutions for optical components such as gradient lenses (University of Notre Dame, Indiana; former Missouri University of Science & Technology, Prof. Ed Kinzel). Until then, there is still a long road ahead to reach the final destination.

An innovative glass printer

Third dimension printing

whether it involves plastics, metals, ceramics, glass, or even cell tissues – is considered the key technology of the 21st Century. However, it utilizes an array of manufacturing techniques and processes which are designed to fulfill an assortment of functional principles. What all of the processes have in common, though, is that they can create 3D objects where the materials are reinforced and applied in thin layers. Technically speaking, this is known as "additive manufacturing", which is in contrast to "subtractive manufacturing" where materials are cut away using milling machines. Already 33 years ago, the American inventor Chuck Hall submitted his 3D process for a patent.

SCHOTT Product: DURAN® tubing and AR-GLAS®

Simply good coffee

The Swiss espresso machine ZURIGA express is elegant and easy to operate. Invented by Moritz Güttinger, it has been built with glass from SCHOTT.

Makes simply good espresso: ZURIGA express invented by Moritz Güttinger (below).

The story begins with a disgruntled coffee lover: It annoyed Moritz Güttinger that his expensive Italian espresso machine was unable to consistently conjure up a delicious hot drink. The environmental engineer took apart the appliance, thought about it and then learned a great deal about the technical art of preparing espresso. Thus was born, after much fiddling in his backstreet studio in Zurich, a truly special product: a striking, affordable appliance for the home which made simply good espresso every time. Finished? Not yet. The financing for its development came from a crowd-sourcing initiative. To ensure that the coffee tasted like it does at an Italian bar, the system had to be something entirely new and it has been registered for a patent. It uses a filter holder so it does not contribute to the mountains of waste created from pods and capsules. The technical components come from a number of sources which Güttinger himself put together.

The water container was developed by the Swiss glass blowing workshop GlasForm (Gossau, Switzerland) together with SCHOTT Switzerland – the material used is CONTURAX® Pro profile tubing. ZURIGA express is not only supposed to be less expensive than other machines, but it also should be quicker. In two minutes the espresso should be steaming. Adds Moritz Güttinger: “We found that to make good coffee, we needed to return to keeping it simple.”

SCHOTT Product: CONTURAX® Pro

The People's Smile

A new art installation in Groningen was completed in February 2014: "Universalis" consists of over 2,000 DURAN® borosilicate tubes.

People arriving in the northern Dutch city of Groningen are now greeted by a big smile. It is composed of approximately 2,000 colored glass tubes that form the relief of a giant face. The artwork is called "Groninger Universalis" and was completed in the city's new municipal building of Social Affairs and Welfare at the beginning of 2014. Universalis is visible to anyone. And at night it becomes brightly illuminated and remains an eye-catcher even then.

The project's goal is to give a face to all the different people the municipality's administration is working for: "The old-fashioned concept of having a number for every citizen is outdated," explains artist Lambert Kamps, who created the piece together with his colleague, Tjeerd Veenhoven. To start off the project, the duo spent a day in downtown Groningen taking pictures of the city's inhabitants. 100 portraits were then combined to generate the face of the average Groninger – the "Groninger Universalis." "We deliberately chose many different types of people to achieve a universal result," says Veenhoven. Afterwards the picture was divided into dots, and then each dot had to be "translated" into a glass cylinder with a unique color.

"We picked glass because it is a nice material, it's easy to clean and it has a nice surface," says Kamps. For each dot, the artists painted a glass tube of DURAN® borosilicate glass. They used seven different shades of warm gray paint and coated the tubes on the inside. The process wasn't an easy task: "We had to come up with a way to circulate the air inside the tubes so the special two-component paint could properly bond to the glass," explains Kamps. Another tricky part of the project was producing the tubes in the first place. They had to have a consistently round bottom without contaminations. This was the responsibility of the laboratory glass specialists at LGS B.V. On the basis of the requested length of the tubes, LGS's manager Klaas Jan Nijboer advised to use borosilicate glass 3.3: "99 percent of our borosilicate glass comes from SCHOTT. We are very pleased with the high quality and with the excellent services of SCHOTT Benelux."

After the first few samples had arrived, the artists were convinced. In their workshop in Ubbena, LGS' expert glass blowers carefully customized the DURAN® tubes to suit the artists' needs. "Each tube had to be carefully pulled and shaped in order to produce the smooth and beautifully rounded bottom," explains Nijboer. Having been matched to a pixel of the original picture, the painted nine to 47 centimeter long tubes were then inserted fixed to a backlit support wall. Now, the four by five meter relief not only greets, but also shines a light onto every visitor of Groningen and the city's new municipal building.

Photos: SCHOTT / F. van der Veen

The artwork complements the design of the train station opposite the municipal building: people stopping at the train station can look straight through and onto the smiling face.

SCHOTT Product: DURAN® tubing

Touching magic made of glass, light and sound

40 touch-sensitive glass columns at the Dubai Mall, one of the world's largest shopping centers, invite visitors to a concert for the senses. The artistic interactive installation Aviary from the architecture firm Höweler + Yoon from Boston produces unique light and sound compositions when it is touched or wiped. These 2.5- to 4-meter high objects made of borosilicate glass from SCHOTT were all equipped with a sensitive foil and a light core.

SCHOTT Product: DURAN® tubing

Photo: Höweler + Yoon

Glass tubes with edges

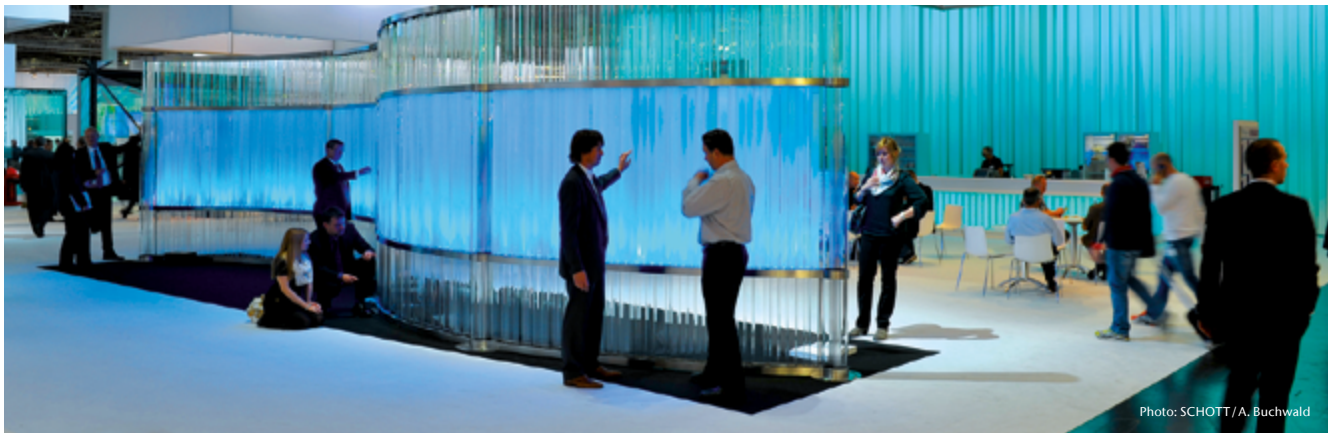


Photo: SCHOTT / A. Buchwald

SCHOTT's expertise and years of experience in special glass made it possible to successfully develop a new type of non-round glass tube: CONTURAX® Pro. This profiled tubing offers high transparency and thermal shock resistance as well as hard, smooth surfaces for vast scratch protection. Furthermore, it enables precise processing through its geometrical accuracy. Due to their variety of shapes, CONTURAX® Pro glass tubes are ideally suited for an extensive range of applications in the field of architecture, art and design. The 12 meter glass wall – shown at a former glasstec trade show in Duesseldorf – was realized together with the company Octatube.

SCHOTT Product: CONTURAX® Pro

Infinite Light Loop

Photos: SCHOTT / M. Couchman

Artist Tim Morgan's latest sculpture captures light with DURAN® glass rods in London's City of Westminster.

The plastic Aurora consists of two belts of rolled steel that have been painted a vibrant yellow. The space between the steel belts is filled with thousands of cut glass rods.

A stroll through London's West End leads past famous and historic highlights: Picadilly Circus, Oxford Street and Soho are just some of the numerous attractions. Since 2010, the borough of Westminster has been host to an open-air art gallery. Launched in the build up to the 2012 Summer Olympics and the Queen's Diamond Jubilee, the "City of Sculpture Exhibition" features dozens of contemporary sculptures on display in Westminster's squares and parks. The pieces are exchanged regularly and the project's popularity has led city planners to extend it indefinitely. One of the newest additions to this public gallery is Tim Morgan's "Aurora." As SCHOTT has provided glass for his sculptures in the past, Morgan approached the company in search of support: "I've always had a good relationship with SCHOTT and their products are of the highest quality."

Aurora is the largest single piece sculpture Morgan has built to date. It stands an impressive three meters high and weighs slightly less than a ton. Aurora exemplifies the elegant engineering complexity that is a feature of Morgan's work. It is made from two belts of rolled, welded and painted mild steel. Its tense, wound form is balanced by its bright and playful, vibrant yellow paint. Where the belts delaminate the space is filled with thousands of cut glass rods – their combined length spans a distance of over twenty soccer fields. The glass rods capture ambient light from the sun, buildings, and traffic, and focus it into bright eye-catching slivers. In this way, the sculpture's appearance is particularly dependent on its environment and changes as the day passes.

The circular form of the sculpture subtly displays its engineering. It also suggests common cultural symbols; those of the Greek infinity icon or the originally Egyptian motif of a serpent eating its own tail. In addition, the work pulls off a slight optical illusion: the single belt appears to be two to many viewers. "Placed in the semi-natural environment of Cavendish Square, the simple steel and glass form of the sculpture contrasts with the fractal complexity of nature," says Morgan. DURAN® is the same glass used in a wide range of lighting and laboratory applications. "Its special optical qualities and durability also made it ideal for this artistic outdoor project," says Klaas Roelfsema, Regional Sales and Business Development Director for North Western Europe at SCHOTT Tubing.

SCHOTT Product: DURAN® rods

Creating Something New Without Replacing what is Old

Photo: SCHOTT / H. Cock

The Dutch artist Giny Vos used tree trunks, glass tubes and LEDs to create "The Window of Your Eyes," a dramatic symbiosis of natural materials and modern, sustainable technology.

Giny Vos, shown here attending the inauguration of "The Window of Your Eyes," has been realizing installations involving light in public areas since 1985. Her studio is located in Amsterdam.

Her artworks cannot be found "hiding" in galleries or museums, but rather integrated into public areas where everyone can see and experience them. Her works attract the viewer's attention, make environmental aspects more visible and create a different impression of them in both literary and figurative terms. Her works also reflect her fascination with science and technology. Light on the move, whether by video, computer, neon or LED displays, represents an important means of expression and design in the oeuvre of the renowned Dutch artist Giny Vos (52). For the installation and light artist born in Rotterdam, however, the main focus isn't on the physical existence of her light works, but rather the processes they initiate. Her installations tell their own stories. They not only physically exist, but also actively communicate with their environment and extend the local experience. "The work allows the current situation to appear in a new light and creates something new without forcing what is already there to disappear," Giny Vos explains.

On the other hand, her latest work "The Window of Your Eyes" on the provincial government's grounds in the Dutch city of Assen demonstrates how real existing surroundings can have an impact on the artistic experience. Giny Vos allowed herself to be inspired by the countryside she found here with its impressive, historic oak avenue and deepened natural atrium that was probably used to hold assemblies and parliamentary sessions back in the Middle Ages.

The installation in the middle of the park-like area was realized with the help of tree trunks, glass tubing and LEDs – a perfect symbiosis of natural elements and modern, sustainable technology. 200 tree trunks four meters in length form a grid inside which dynamic light effects enchant the viewer. The light flows in every direction, shines, goes out again, flashes, takes on different colors and shapes that range from bright to soft-glowing. The 11 centimeter thick trunks are positioned 85 centimeters apart to enable the viewer to walk between them without difficulty. The trunks are joined together in the middle at different heights by transparent DURATAN® glass tubes from SCHOTT that are 80 to 120 centimeters in length.

Giny Vos's artworks use tree trunks, glass tubing and LEDs to create a mysteriously beautiful place permeated by light. Borosilicate glass tubing exhibits a high degree of impact resistance, withstands temperature changes, resists scratches and offers light-fastness. In other words, it is perfectly suited for outdoor use.

"We found the perfect solution for this project with thermally toughened DURATAN®. When it came to the dimensions of the tubes, we chose an outside diameter of 110 millimeters, a wall thickness of 7 millimeters, and a length of between 1,000 and 1,500 millimeters," explains Hanneke Velders from SCHOTT Benelux. More than 2,300 LEDs have been attached to the special glass tubes, of which three multicolor lights each form a light point.

This offers the audience a play with light that appears to be almost mystical both from a distance or right in the middle – an opportunity to reflect and contemplate. "In my fantasy, I wanted 'The Window of Your Eyes' to be a place to meet, a home, a mysteriously beautiful place permeated by light," Vos notes. The feedback clearly shows that her fantasy has become a reality. A reality that might well shine well beyond the borders of the capital city of the Dutch province of Drenthe, at least this is what the people responsible are hoping.

SCHOTT Product: DURATAN®

Unconventional Glass – Tubing for Exquisite Effects

Photo: SCHOTT / M. Couchman

The architects of Foster + Partners used glass tubing from SCHOTT in a London office complex.

Fascinating style element: Structured CONTURAX® brand glass was used as a large-surface solution for the first time ever in the London-based office complex "Walbrook".

Ensconced in a wavy looking grid of highly reflective cast-aluminum brises soleil, the office complex located in the middle of London sparkles in the sun. The curved façade elements offers protection from its rays by being lined up next to each other. They grow in density with increasing height and shimmer more intensively at the higher levels.

The international architectural firm Foster + Partners built the "Walbrook" office complex in London's financial district from 2005 until 2010. The sculptural building features some 40,000 square meters of office and commercial space. Retailers and restaurants will later occupy the 70-meter long front of the complex that faces Cannon Street. Those who enter the building are immediately greeted by a white illuminated wall made of glass tubes that is 70 meters in length. It separates the two parts of the foyer from each other and extends all the way up to the ceiling behind the reception area. Thanks to its wavy structure, the wall appears to be almost fluent.

The glass tubes from SCHOTT AG that Foster+Partners used are perfectly suited for design and architectural applications. For the first time ever, the structured CONTURAX® brand glass was used in a large-scale application for this office complex. Two 3.3-meter high panes consisting of glass tubes that are lined up next to each other were installed in layers to form the 6.6-meter high wall. Hardly an everyday situation, despite its fascination, and the glass experts faced several difficulties. After all, the structured surface of the borosilicate glass is limited in terms of its maximum wall thickness, thus posing a real challenge for an architectural application of this dimension. "For safety reasons, we were faced with having to find a way to reduce the risk of breakage of the glass panes that are only three millimeters thick," explains Klaas Roelfsema, Regional Sales

The white illuminated wall of glass tubing 70 meters in length separates the two sections of the foyer from each other and reaches all the way up to the 6.6 meter high ceiling.

and Business Development Director for North Western Europe at SCHOTT Tubing.

The team at SCHOTT finally came up with the idea of reinforcing the glass with a second glass tube that had a thicker wall. To do so, the installation personnel placed a pane of unstructured DURAN® brand glass tubing in a thickness of 9 millimeters in front of the wall of CONTURAX® tubing. Both special-purpose glasses were mounted on multiple sides and halogen lighting was integrated to illuminate the tubes from the bottom. “We created a huge wall of light by combining the many glass tubes.

The architects were quite impressed by the glow of the extremely even lighting effect throughout the entire height of the tubing wall and also the special glass that was used,” Roelfsema explains. The impressive wall has become part of a very impressive and energy-efficient lighting strategy.

The elevators made entirely of glass also add to the play of light and reflection in the foyer which the building is known for both inside and outdoors, thus allowing Foster + Partners to pick up on another motif in both the façade and the interior design. The wavelike structure that adorns the shell of the office complex can be found once again in the structured wall made of glass tubes in the foyer.

SCHOTT Product: CONTURAX® / DURAN® tubing

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