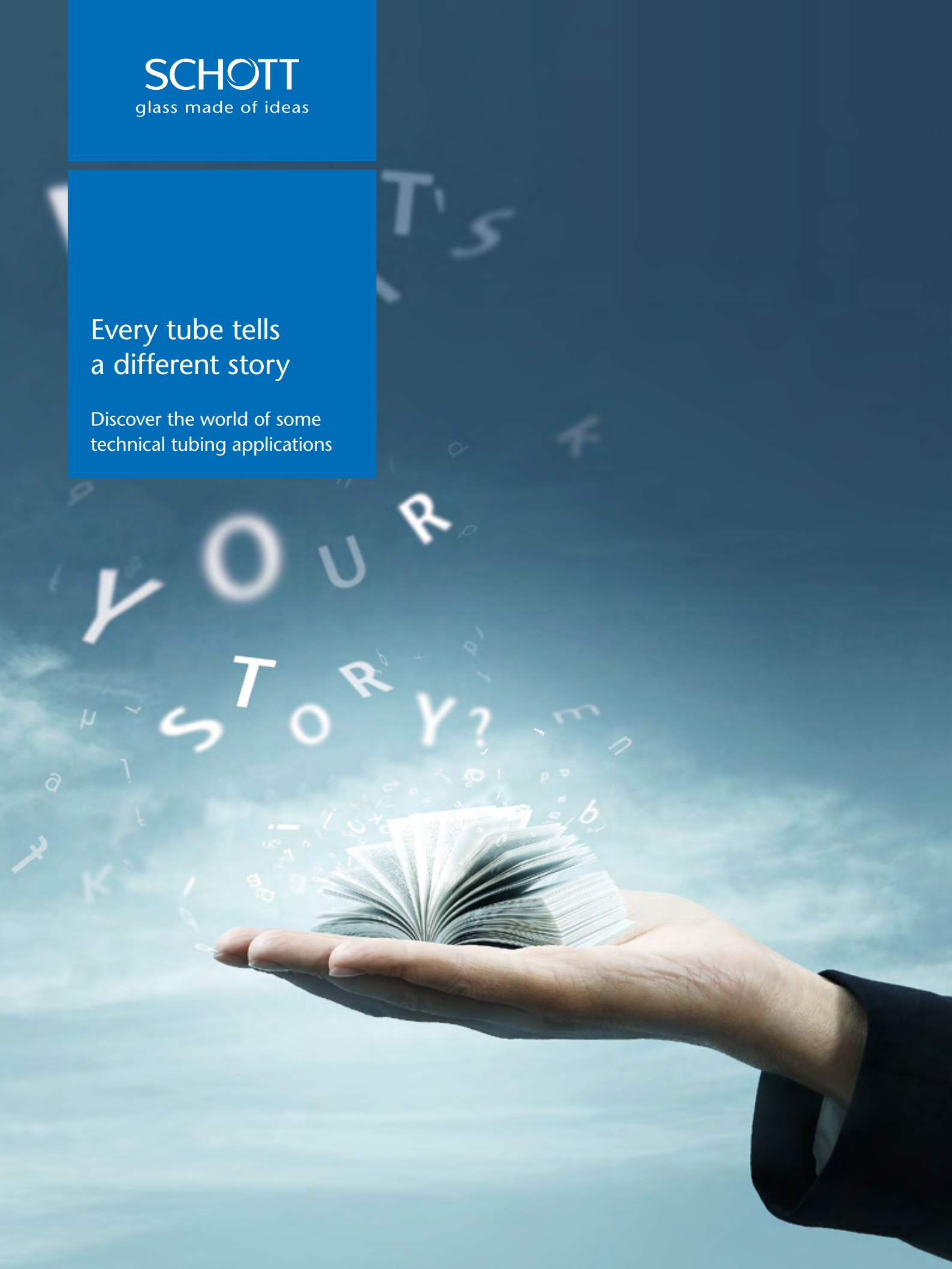


SCHOTT
glass made of ideas

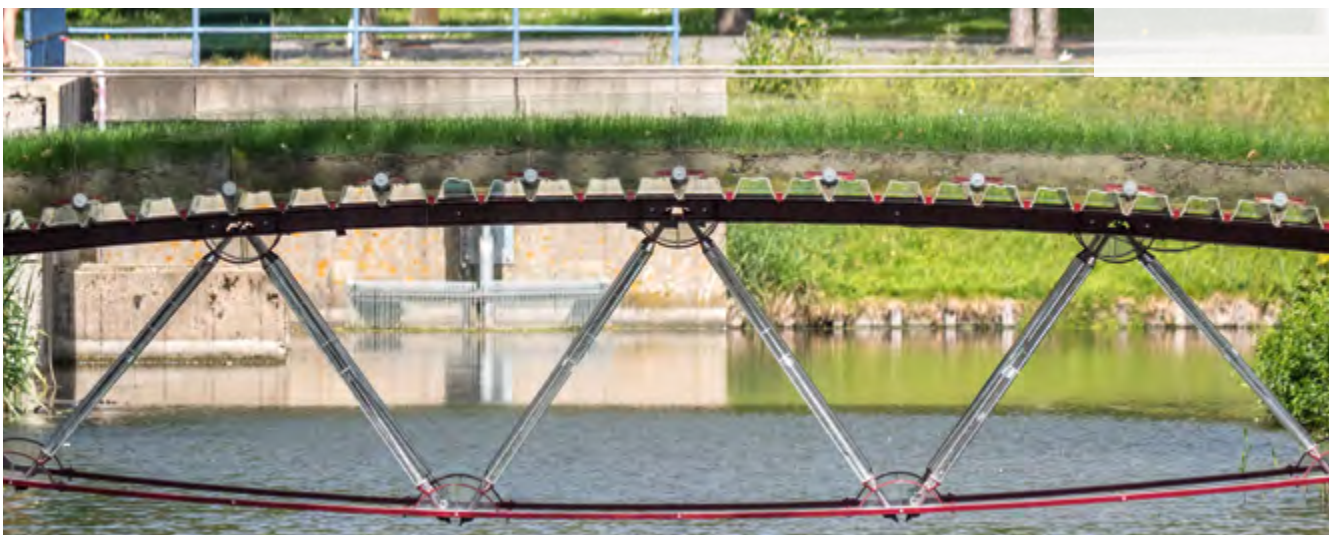
Every tube tells a different story

Discover the world of some
technical tubing applications



SCHOTT is a leading international technology group in the areas of specialty glass and glass-ceramics. With more than 130 years of outstanding development, materials and technology expertise we offer a broad portfolio of high-quality products and intelligent solutions that contribute to our customers' success.

With a production capacity of more than 140,000 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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Security at your fingertips

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.

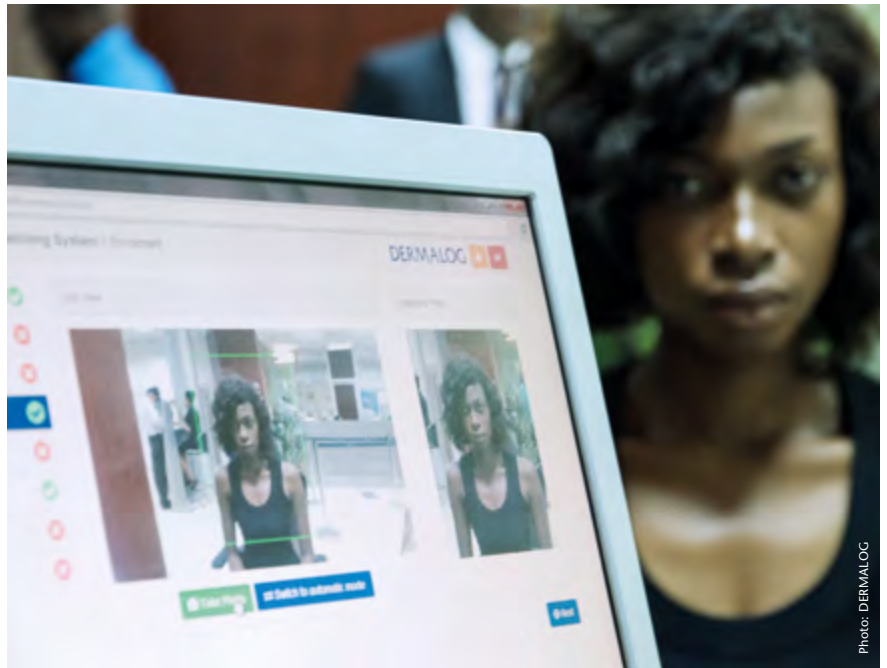
Biometric recognition grants access control to smartphones and PCs, and with electronic identity cards simplifies law enforcement, election registration and payments. Studies predict that passwords will be a thing of the past in a few years. Indian market and biometric analysts expect the biometric system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



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.

facturer and system integrator at the same time and see ourselves as leaders in innovation,” sums up DERMALOG Managing Director Günther Mull.

The company has now 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: “Once again, 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



Photo: iStock

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

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 in 2014.

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,

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.

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.

SCHOTT Product: **CONTURAX®**
schott.com/innovation

Pure energy

Austria has a photobioreactor with 43,000 glass tubes from SCHOTT.



Photos: Ecoduna



Dr. Silvia Fluch from ecoduna on the successful utilization of glass in photobioreactors.

Algae are pure bundles of energy; the green single-cell organisms can convert light into biomass five times more efficiently than terrestrial plants. They are cultivated in photobioreactors. Microalgae producer ecoduna is currently building in Lower Austria's Bruck, not far from Vienna, a one-hectare (2.5 acres) large manufacturing plant with 43,000 DURAN® glass tubes from SCHOTT. The vertical components are 5.5 meters tall, and laid end-to-end, would cover a distance of 230 kilometers (142 miles). "It yields a photoactive capacity of more than 800 cubic meters and it translates to an annual output of about 100 metric tons of dried biomass from various algae strands," notes

Dr. Silvia Fluch, chief operating officer at the biotech company. "The protein thrives particularly well behind glass and the tubing is easy to clean and has a long lifespan." The applications cover a broad spectrum of industries including medicine and agriculture.



Interview ecoduna



schott.com/ecoduna

SCHOTT Product: **DURAN® tubing**
Solutions 2/2017, Page 43

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.



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 inside of the plastic surface after many cleaning cycles

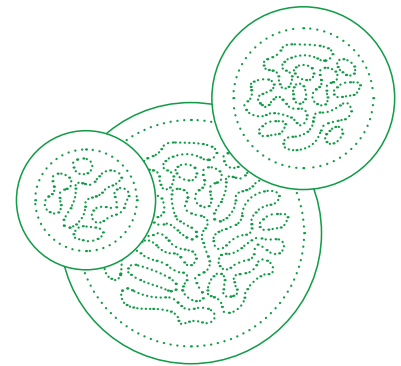
Photos: ecoduna



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.

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 Johann Mörwald, CEO of 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 ecoduna also refers to as "hanging gardens," also eliminate pumps. CO₂ and nutrients are introduced continuously at the bottom.

This is highly efficient and guarantees maximum purity. 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; 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.

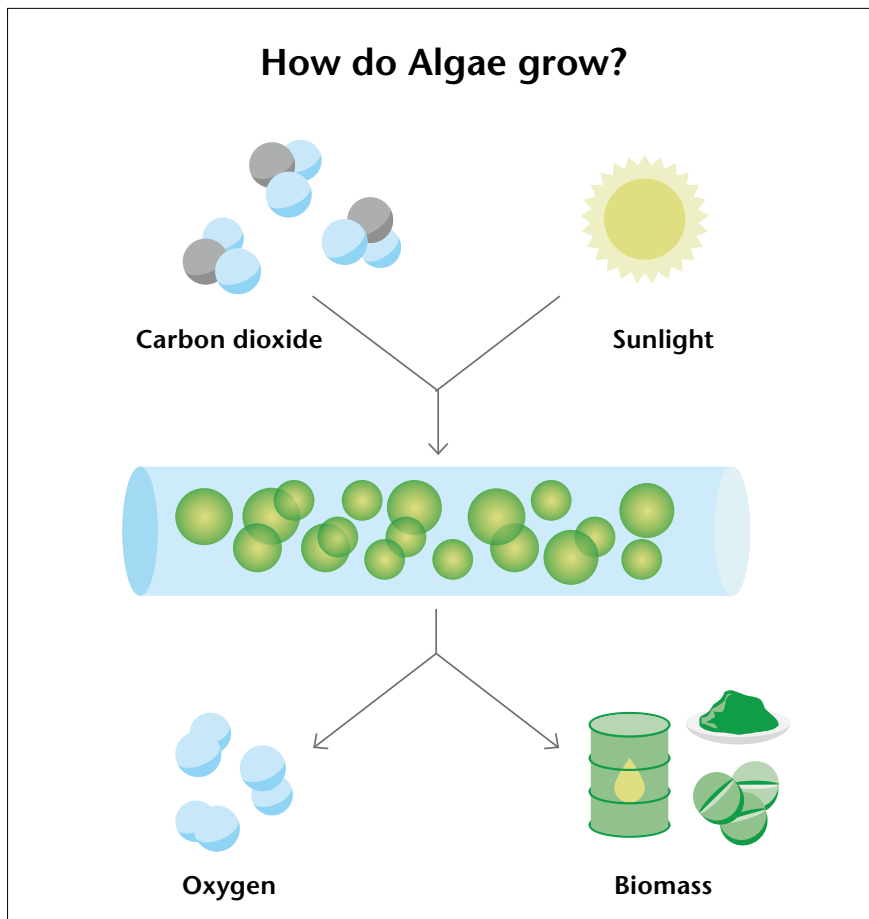


Higher output – lower costs

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 ecoduna in the future to find ways to improve system efficiencies, boost algae growth, and increase biomass yields.

“Using glass tubing in our ‘hanging gardens’ has proved to be a smart investment that lowers our operating expenses and practically eliminates replacement costs.” – Johann Mörwald, CEO of ecoduna



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.

As clear as Water

The US company Clearas has developed a biological, algae-based method by which water can be purified for reuse and, at the same time, valuable biomass as a byproduct can be obtained. Photobioreactors that contain glass tubes demonstrate their ability to perform in a test facility.



The view from space clearly shows why our earth is also called the “blue planet.” 29 percent of the earth’s surface is occupied by land, the greater share (71 %) by the oceans which contain more than 97 percent of the earth’s total water. More than 70 percent of the 2.5 percent fresh water is in frozen form. All living beings on earth, except for marine life, thus share the remaining 0.75 percent of the total water. With the world’s population increasing to currently nearly 7.3 billion and an estimated nine billion in 2050, the world’s water has to be shared among

more people. At the same time, in recent decades the proportion of water used for agriculture and for growing food has tripled to 70 percent of the world’s water supply. And industry requires water, amounting to about 22 percent. The remaining eight percent of the world’s water is used by households.

Global need for clean water

According to the UN’s 2015 World Water Report, water efficiency needs to be increased and contamination

of water reduced by adopting stricter regulations. “Vision for 2050: Water for a Sustainable World,” also points out that “waste water should be viewed as a resource that provides energy, nutrients and fresh water for reuse.” Clearas Water Recovery in Missoula, Montana, is a company that pursues this very goal with great commitment. With its patented “Advanced Biological Nutrient Recovery” (ABNR™) solution, the Clearas team has been offering innovative biological wastewater treatment technology for industrial, municipal and agricultural customers



Photo: Clearas

since 2011. Substances such as nitrogen and phosphorus in wastewater pose a particular challenge for these consumers. Other advantages for the user include the fact that the system is modular and if necessary can be connected to an existing water treatment infrastructure as a retrofit system.

“Our approach is to achieve sustainable, future-oriented resource recovery. Here, algae are not a pure product, but rather viewed as a process,” says Rick Johnson, Vice President of Clearas and responsible for market development.

The principle is that ABNR™ technology reliably gains back excess nutrients and other pollutants from industrial, municipal and agricultural wastewaters by using a special flow process involving algae and other existing biological organisms. During the first phase, to initiate the recovery of nutrients, contaminated waste water and carbon dioxide (CO₂) are mixed with a composition of algae and other existing biological organisms in a mixing vessel. In a second phase, the biodiverse mixture is forwarded for cleaning in a closed photobioreactor, which consists

of horizontally arranged glass tubes that lie on top of each other. The greenhouse structure and light sources provide for optimal biological activity and photosynthesis. “Around the clock, 24/7,” says Johnson.

The algae inside continuously break nitrogen down biodegradably in symbiosis with bacteria phosphates, carbon dioxide and unwanted pollutants. In this process, pollutants are absorbed by the algae and converted into biomass without generating any new pollutants. In a third



“Our approach is to achieve sustainable, future-oriented resource recovery. Here, algae are not a pure product, but rather viewed as a process.”

Rick Johnson, Vice President of Clearas

The Clearas technology recovers excess nutrients and other pollutants from industrial, municipal and agricultural waste streams. The treated water can be discharged into rivers and lakes or be reused in plant operations.

separation phase, modern micro-filtration separates the mixture into two streams: purified clear water which can be easily introduced into rivers, lakes and streams, or be reused in plant operations; and a recirculation or recycle stream. The latter leads algae and other microorganisms back into the mixing vessel, from where they undergo the same process again. Another advantage: excess algae can now be removed and used as valuable biomass. Johnson states, “Clearas is actively looking for applications for the biomass produced. One idea is to use it to produce special algae plastics, for example.”

Glass tubes in test mode

SCHOTT is an important partner to the algae industry with its products and comprehensive expertise with

photobioreactors (see solutions 1/14; p. 18). “Our glass tubes are also perfect for use in algae-based sewage treatment,” explains Dr. Niko Schultz, Product Manager for Photobioreactors at SCHOTT. This was demonstrated at a Clearas test facility inside a paper mill in Spokane, Washington. SCHOTT delivered 531 tubes and 381 bends made of high-quality DURAN® borosilicate glass and 675 couplings. “We are very pleased with the performance,” says Vice President Rick Johnson. “Glass is a material that ideally meets the high demands on our closed photobioreactors,” he notes. “Compared to plastic, glass offers many advantages,” expert Dr. Schultz explains. “Our special glass tubing is highly chemically resistant and durable, mechanically very strong, and also very resistant to pressure in combination with glass arcs and pipe connections.”

The balance sheet is rather impressive. By using the new method, phosphorus can be reduced by a factor of 10 and nitrogen by a factor of 3 compared with conventional technologies. The purified water is below the detection limits for harmful substances and can be safely discharged or used as recycled water. 45 million liters (12 million gallons) of wastewater were actually treated with the ABNR™ System in 2015. Clearas also has high goals for the future. “We challenge the current status, face up to new challenges and strive to exceed expectations,” explains CEO Jordan Lind. And perhaps this also includes developing the wastewater treatment technology via algae to such an extent that drinking water quality can be achieved.



Kevin McGraw, Operations Manager & Co-Founder, explains the patented Advanced Biological Nutrient Recovery (ABNR™) solution. Glass tubes from SCHOTT are also used successfully in this innovative algae-based wastewater treatment technology.

SCHOTT Product: **DURAN®**
Solutions 1/2016, Page 12–15

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.



CO₂ 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 (CO₂) 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 spe-

cialty product from the China-based company RECI. "We are focused on the production, research and development, and sale of CO₂ lasers. Today, we are the largest producer of CO₂ lasers in the world," says RECI's general manager, Lu Chundi. CO₂ lasers have particularly high efficiency and are regularly used in industry for cutting and welding. "RECI's CO₂ 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 Henry Chen, Sales Account Manager 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 Chen.

This is precisely why SCHOTT’s DURAN® tubes 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



Photo: SCHOTT/F. Fischer

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 Chen.

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 life-time,” summarizes Chundi. This and other developments in the laser industry paint a very promising picture of the future. SCHOTT’s Sales Account Manager, Henry Chen, 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 (above and right photo). They ensure a precise optical path and make it possible to meet the high quality demands the global market places on CO₂ lasers, explains Lu Chundi, General Manager of RECI (left).



SCHOTT Product: DURAN®
Solutions 1/2016, Page 41 – 43

Inventive Spirit with a Perfect Outlook

Innovative camera technology for online streaming of 360-degree panorama videos in real time is expected to become the new standard for all types of live transmissions. Its commercialization was first made possible by anti-reflective, coated DURAN® glass tubes.



Innovative 360-degree live streaming is already being put to use successfully for events, television programs, concerts and at trade exhibitions and sports events.

A party was held in the snow-covered Alps in the Allgäu region of Germany. More than 800 snowboarders, including Europe's elite, traveled to Nesselwang last January to attend the grand opening of Red Bull's new Street Snowpark. And even those who couldn't be there were able to enjoy the entire program as if they were right in the middle of it. Special mirror camera constructions on three stations provided more than twelve hours of full HD video recordings in a 360-degree panorama view.

What was special about this was that these transmissions were broadcast live and could be viewed online via streaming. Everyone who downloaded the special app was able to experience the happenings at the winter sports park through their iPhones or iPads and then using their index fingers was able to select the camera stations or control the direction of view.

A vision begins to come to life with this new development for Michael Kanna.

"Sometime in the future, we will wear virtual eyeglasses and experience the world from a 360-degree perspective," the Managing Director of Videostream 360 is convinced. The young team of the German company based in Leipzig has written a success story on the way to achieving this. It all began at the Leipzig College of Technology, Business and Culture (HTWK). In 2009, as part of his Master's thesis in Media Information Technology, one of the company's founders developed the principles for



The panorama mirror delivers circular, 360-degree moving images that are recorded by a camera and then equalized by using a patented procedure. The DURAN® glass that surrounds it protects the device from scratches, environmental influences and reflections.

a method of equalizing the circular 360-degree moving pictures that were obtained using specially shaped panorama mirrors. In the years that followed, this finally became Videostream 360 – a company and a patented technology on real-time transmission of 360-degree video streams. This technology had previously not been possible because it required costly multi-lens cameras, whose images then needed to be tediously converted into rectangular pictures. “The Patent Information Center in Leipzig informed us that a system like ours did not yet exist anywhere in the world,” Michael Kanna notes. Nevertheless, there were still obstacles to be overcome. The goblet-shaped concave mirror attachment together with an HD TV camera, for example, initially resulted in a very large, unattractive and rather error-prone construction. However,

the presentation of this bulky innovation at the Hanover Fair met with completely unexpected success. An excited trade fair visitor and former trainee at SCHOTT suggested miniaturizing the structure and protecting it in a special anti-reflective glass tube. “That was one of the keys to commercializing the product,” Michael Kanna emphasizes.

SCHOTT supplied DURAN® glass tubes in standard dimensions for this project. This stable borosilicate glass is highly resistant to heat, shifts in temperature and corrosion. It especially protects the camera lens and the extremely sensitive mirrors that supply the image information from scratches and environmental effects. An innovative ETCAR (Easy to Clean Anti Reflex) coating has been applied to the glass tubes to minimize annoying light reflections and soiling.

In combination with a professional digital action mini-camera, the new construction is now enjoying success for indoor and outdoor use – in the German scientific TV program “Galileo,” for example, and also at concerts, sports events and at trade exhibitions such as CeBIT 2015. The main appeal of this technology also lies in the fact that its interactive video player is easy to operate and can be embedded in websites and used as a mobile app. “We consider 360-degree live streaming to be the future standard for all types of live transmissions, but that isn’t all. We are also planning projects in the area of process monitoring and smart homes,” Michael Kanna concludes.

“Sometime in the future, we will wear virtual eyeglasses and experience the world from a 360-degree perspective”

Michael Kanna, Managing Director of Videostream 360



SCHOTT Product: **DURAN® tubing**
Solutions 1/2015, Page 17 – 19

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.



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 precise



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

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

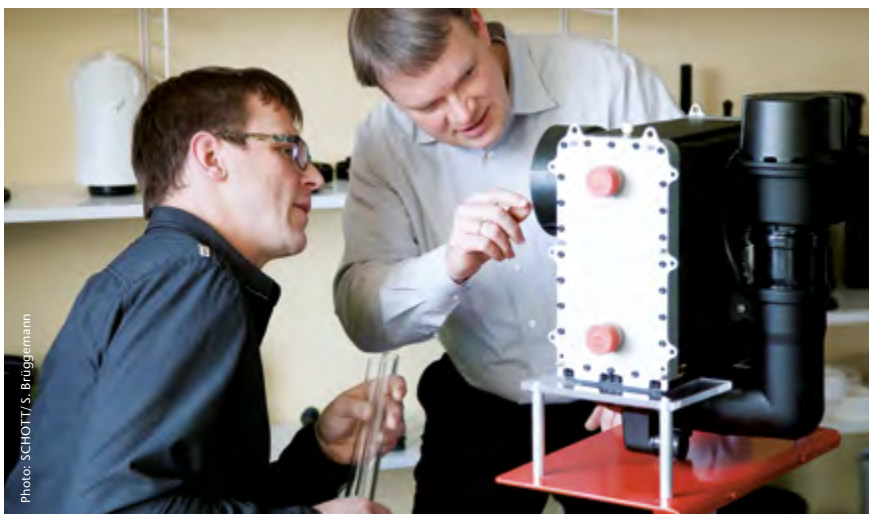
approval for use. A vacuum blower for active transport of flue gases to the outside makes this possible. This function allows for the heat exchanger to be connected to a boiler with a forced air burner for natural gas or fuel oil.

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 CO₂ 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.



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**
Solutions 1/2015, Page 39–41

Washing the air

The Bavarian company 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.



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.

But now, 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.

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.

Photo: SCHOTT/H.-J. Schulz



Photo: SCHOTT/H.-J. Schulz

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

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 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."

TRIPLAN LightClean® has so far only been tested in trial runs. In 2015, as Triplan celebrates its 25th anniversary, this is going to change. The first 60 devices are to be used in prefabricated houses that are being refurbished and in French wine cellars. "French winemakers and the restoration industry have already recognized the potential of TRIPLAN LightClean®," says Beck.

"French winemakers and the restoration industry have already recognized the potential of TRIPLAN LightClean®."

Andreas Beck, Managing Director of Triplan Umwelttechnik

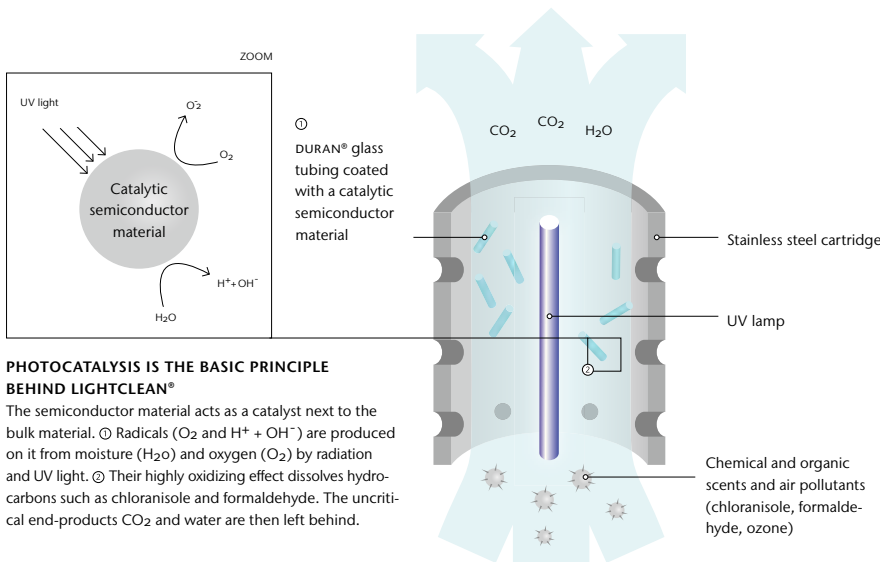


Photo: SCHOTT/H.-J. Schulz

Andreas Beck (right), Managing Director at Triplan, is already thinking of new uses for the innovative ventilation system.

But Beck also sees a future for his air-cleaning technology in other areas besides musty old buildings and corked wine: "Fresh, clean air would also be very beneficial to doctors' offices and shoe stores."

DIAGRAM OF HOW TRIPLAN LIGHTCLEAN® WORKS



PHOTOCATALYSIS IS THE BASIC PRINCIPLE BEHIND LIGHTCLEAN®
 The semiconductor material acts as a catalyst next to the bulk material. ⊕ Radicals (O₂ and H⁺ + OH⁻) are produced on it from moisture (H₂O) and oxygen (O₂) by radiation and UV light. ⊗ Their highly oxidizing effect dissolves hydrocarbons such as chloranisole and formaldehyde. The uncritical end-products CO₂ and water are then left behind.

Source: SCHOTT/Transquer

SCHOTT Product: DURAN® tubing
 Solutions 2/2014, Page 18 – 19

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.

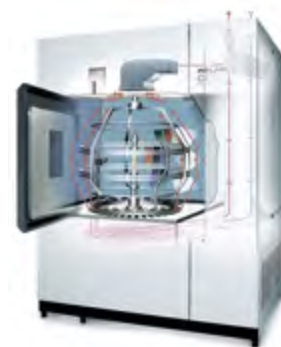
"All materials, not just human skin, are affected by sunlight," explains Rainer Eichholz, Lead Developer Glass, Melting and Drawing Technology for the SCHOTT Business Segment Tubing. Even varnishes, seat covers or synthetics age with constant exposure to sunlight. "In the past, an entire car was simply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

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.



Source: ATLAS Material testing technology



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.

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."

SCHOTT Product: [Specialty Glass](#)
Solutions 1/2013, Page 44 – 45

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 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 pre-filled 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.

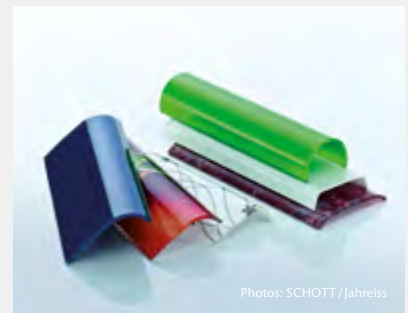
SCHOTT manufactures seamless CONTURAX® Pro profiled tubes in a wide variety of shapes, including triangular, rectangular, hexagonal, and lots of others, with the help of a patented continuous drawing process. This allows processors to avoid costly conversion processes. The tubes are

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.

"It's quite exciting and inspiring to enable new applications that meet such high requirements," says Jean Krystkowiak, Regional 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 Jean Krystkowiak from SCHOTT. "We are pleased to be able to contribute to this," he concludes.



Photos: SCHOTT / Jahress

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 3,950 mm and wall thicknesses of 1.2 mm (± 0.2 mm) to 5 mm (± 0.8 mm). Diameters range from 42 mm to 150 mm. The many different geometric shapes allow for countless uses, in lighting and interiors, for example.

SCHOTT Product: **CONTURAX® Pro**
Solutions 1/2012, Page 22 – 24

A Potent Gas: Ozone

It was a recording-breaking event when the new cellulose 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 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 system from Wedeco, 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 Jacaré 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 covering. "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 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



The ozone generators are installed in large-capacity containers.



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.

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 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 Ralf Fiekens and the Technical Director of Wedeco Environmental Technologies, Uwe Hofer. Hofer 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!"

Signaling the future

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.

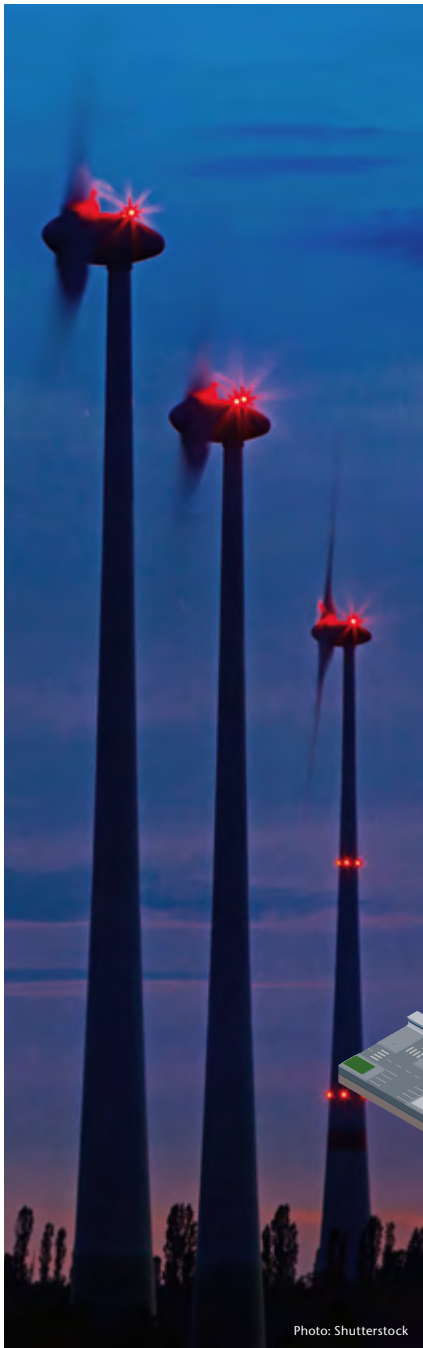


Photo: Shutterstock

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.”

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.”



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

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.”

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.



Photo: Obelux

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

More information
Weitere Infos



schott.com/duran



SCHOTT Product: **DURAN® tubing**
Solutions 1/2017, Page 40 – 41

Light in the Desert

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.



With ,Soluxio,' cylindrical solar cells have now been integrated into the light pole. The completely grid-independent street lights that are protected by a high-quality glass casing are extremely durable and maintenance-free – and therefore they are capable of withstanding extreme weather and environmental conditions.

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.



Sustainability plays an important role in these innovative solar street lights. Thanks to their special design, they lower electricity costs and deliver full performance. Furthermore, they are made of recyclable materials.

“When we heard about this innovative idea, our DURAN® glass tube made of borosilicate glass instantly came to mind,” says Klaas Roelfsema, Regional Sales Manager 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.

Interview

Lennert van den Berg, CEO of FlexSol Solutions

“Sustainability is an important aspect”



solutions: What inspired you to develop the modular solar streetlight?

Lennert van den Berg: I had been working on developing flexible solar cells for quite some time resulting in a cylindrical solar panel using these cells. The lab work took more than a year. However, you can't do a lot with just one solar cell. You always need to think about a product in which you can integrate the technology.

solutions: How did you get the idea for Soluxio?

Lennert van den Berg: The first product that we experimented with was a ceramic roof tile with integrated solar cells. In fact, we're still working on this product. Its launch is planned for the end of 2014. At the same time, we explored other ways of using curved solar cells – and finally came up with the idea of light poles. When we noticed the problems that autonomous light poles have with flat solar panels, we decided straight away to develop our own solar-powered streetlights. Now, we even have three patents for our solar panels. We will soon have a smaller version for sidewalks.

solutions: What else makes your products special?

Lennert van den Berg: Sustainability is an important aspect for our company. We try to develop, engineer and manufacture our products in a sustainable way, using sustainable and recyclable raw materials and components. We try to work according to the Cradle to Cradle philosophy.

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 CO₂ 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. A shipload of Soluxio streetlights will soon be installed in the Middle East – in Qatar and Abu Dhabi, 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. And that is just as it should be, since further Soluxio projects are also set for Dubai and Saudi Arabia in the coming months.

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.



Photos: FlexSol Solutions

SCHOTT Product: **DURAN® tubing**
Solutions 1/2014, Page 52–55

Seeing the Light in Case of Emergency

The Mont Blanc tunnel reopened for traffic on March 9, 2002 introducing new installations to provide greater safety. One feature is, for example, an escape tunnel with a lighting system constructed with SCHOTT glass.

Many people are apprehensive about driving through massive mountains. In fact, Norwegian psychologist Gunnar D. Jenssen determined that 20 percent of the men and 40 percent of the women in his country are afraid of tunnels. This figure is higher in countries where there are fewer tunnels, such as Denmark, where 50 percent of the population suffers from this phobia, according to Jenssen.

It is our fear of the unknown, coupled with the uneasy feeling of knowing there are thousands of tons of rock above, and the tunnel exit far ahead.

Obviously, this anxiety would be compounded if the tunnel were completely dark, and you could only see your own headlights. For this reason, engineers try to outfit tunnels with up to ten percent of the brightness of normal daylight, explains Axel Stockmar. He has been involved with tunnel lighting for 30 years and is now head of Light Consult International (LCI) in the Lower Saxon town of Celle, Germany, but the intensity of the light is only one aspect. It is also crucial how the light illuminates the tunnel. Will drivers be blinded? Engineers have to consider another factor: how does the light function in smoke caused, for



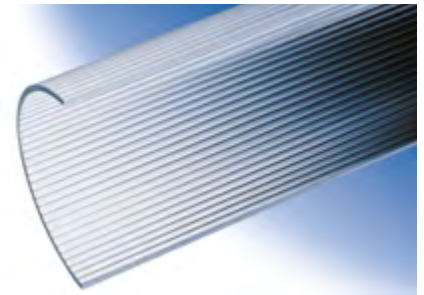
The Mont Blanc tunnel.

example, by accidents? Will it penetrate smoke, or is it absorbed?

After the recent devastating fires in various Alpine tunnels, the safety standards of many tunnels have been seriously disputed, and experts are already working on European guidelines. Meanwhile, national authorities have tightened their standards of safety measures.

Safety standards for tunnels

Take, for example, the Mont Blanc tunnel. With a length of 11.6 kilometers, it is currently the seventh longest mountain passage in the world. Before it reopened in March, a number of stipulations (that were not required for operation from the time of its opening in 1965 until the fire in 1999) now had to be fulfilled. These included additional escape and rescue routes. In this respect it was lucky that a tube running parallel to the tunnel already existed, although it had only been used as an access for maintenance work. This tube can be reached via



Comatelec produces its MY2 lamps with CONTURAX® semi-cylindrical glass covers from SCHOTT.

37 connecting corridors along the main tunnel and can now serve as a potential rescue route.

Hopefully, the tunnel will never have to be used as an evacuation route, but should the occasion arise, experts have to ensure that they can find their way. The 37 escape corridors to the emergency tunnel must therefore be well lit. The French company Comatelec was asked by the architects to design a lighting system for the Mont Blanc service and emergency tunnel. In fact, Comatelec has been responsible for the lighting systems in more than 85 percent of France's tunnels.

In their efforts to comply with the regulations, the lighting specialists remembered a project they worked on together with SCHOTT-Rohr Glas GmbH – now SCHOTT AG. Comatelec had chosen glass covers developed by SCHOTT glass for the lighting fittings they designed for the service tube of the Eurotunnel between England and France.

Restrictions regarding fire behavior

“Just as with the Eurotunnel, the lighting system in the Mont Blanc tunnel had to comply with all restrictions regarding fire behavior,” explains Philippe Gandon-Léger, Technical Director of Comatelec. For this reason, plastic was ruled out as an engineering material for the lamps. It had to be glass. Borosilicate glass from SCHOTT is particularly heat- and chemical-resistant and is therefore used to produce various laboratory glassware.

The optical properties of the glass tubing are also important. “The lamps should not cast a beam of light just anywhere in the tunnel,” stresses Gandon-Léger. “What we needed was an evenly distributed illumination of the evacuation routes so that people can find their way. There should not be any dark areas.” With the help of a specially devised profile – in the form of prismatic grooves on the inside of the semi-cylindrical glass protector – the light is optimally and evenly dispersed in all directions, and the light loss is kept to a minimum.

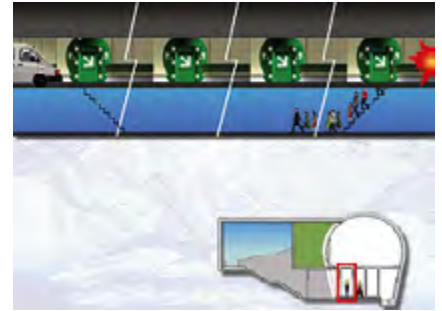
A product tailored to needs

“The remarkable thing about SCHOTT was not only the glass,” recalls Gandon-Léger. “The deciding factor for us was that SCHOTT was very flexible in accepting our exact wishes and was thus able to tailor its product according to our needs.”

In fact, a new product was developed specifically for the Eurotunnel lighting: CONTURAX® profile 038. Comatelec received some 7,700 semi-cylindrical glass covers for the Eurotunnel in the early 1990s. The French company has since become a regular customer. For the Mont Blanc tunnel alone, Comatelec has ordered more than 4,000 CONTURAX® profile 038 glass covers in different sizes for its “MY2” lamps, as Comatelec calls its lighting elements.

Philippe Gandon-Léger is not bothered by the fact that, in the ideal case, the many thousands of people who drive through the Mont Blanc tunnel every day will not see the “MY2” lamps that Comatelec took great effort to develop. “Although we all hope they will never have to play a crucial role, it is nevertheless our job to ensure that the lights work reliably in emergency situations.”

The installation of an additional tunnel for emergencies and the requirements in terms of its lighting are not the only features of the new safety concept. The tunnel test made by the German automobile club, ADAC, shows that the more stringent regulations have achieved their first success. When the German organization conducted an extensive safety check of 30 tunnels in Europe in spring 2002, the Mont Blanc tunnel ranked among the top three. And with a grade of “very good,” ADAC rated it number one of the Alpine tunnels tested.



The main tunnel can be exited through fireproof doors to 37 connecting corridors. Staircases lead to the emergency tunnel below, which is constantly supplied with fresh air.

SCHOTT Product: [CONTURAX® half shell](#)
SCHOTT Info 101

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.



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

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



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

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.

SCHOTT Product: **CONTURAX®**
SCHOTT Info 99

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.

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.

The tubing was supplied by SCHOTT Scientific Glass in Parkersburg, West Virginia.

This two-and-a-half ton masterpiece hangs in the new 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



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

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



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



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 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**
SCHOTT Info 94

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 Nijse, 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.

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, Business Development Director at SCHOTT Tubing.



Photos: Frank Graphitude, Aupiais

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.



The bridge strut is made of DURAN® glass tubing.



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

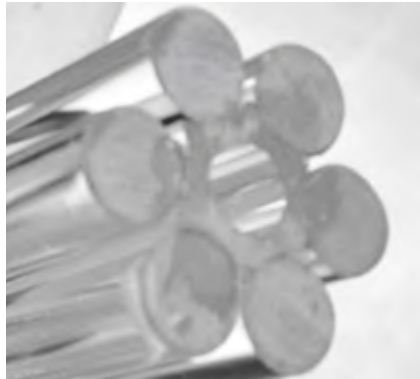
In an interview with Ate Snijder he discusses the construction of the glass trust bridge and the special processing of SCHOTT glass.

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.

What were your biggest challenges with the project?

We used a relatively new kind of material composition for bridge construction, first developed by Prof. Nijssse and technically conceptualized by Faidra Oikonomopoulou – glass rod bundles. We connected a star-shaped



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.

CONTURAX® glass tubes with six round DURAN® glass tubes. A transparent UV adhesive holds the tubes together. By making a bundle rather than 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?

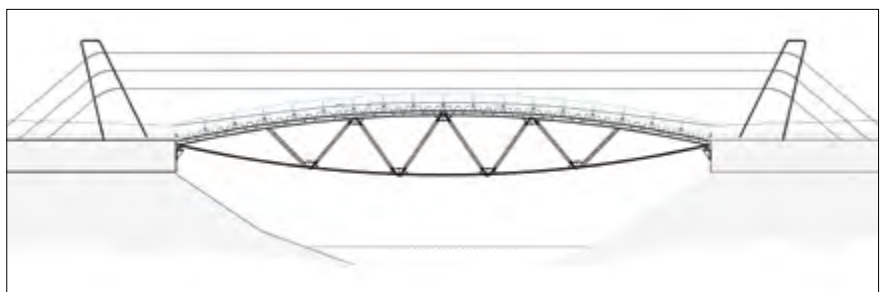
Bundles of glass are safe for use in structures because of their redundancy since they can take damage without failing completely. They are also very strong in compression, comparable to steel or concrete. By prestressing the bundle, which means applying a compressive force on the glass, we can make 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.

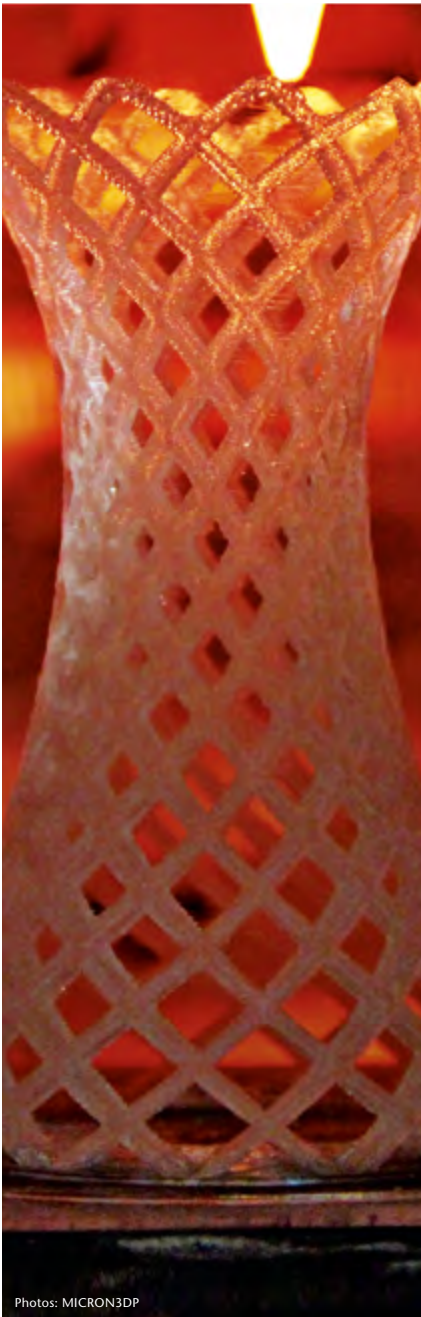
Special thanks to Zwatra Transport, DIMI, The Green Village, RHDHV, Hovenier van der Heijde.

SCHOTT Product: **DURAN®**
[schott.com/innovation](https://www.schott.com/innovation)



Printing in the third dimension

SCHOTT is providing “Ink”, high-grade DURAN® borosilicate glass, to the world’s first 3D glass printer from Israeli start-up MICRON3DP.



Photos: MICRON3DP

3D printers from MICRON3DP allow to produce components with complex geometries.

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 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



Arik Bracha, CEO of MICRON3DP, has over 25 years of mechanical engineering experience.

its closetsized high-tech machines, MICRON3DP uses AR-GLAS® and DURAN® borosilicate glass from SCHOTT. In addition to SCHOTT’s network, technology expert Dr. Stephan Behle 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 Dr. Behle. 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 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 Behle. The first work groups have already set long-term goals in the development of 3D printing

solutions for optical components such as gradient lenses (Missouri University of Science & Technology, Prof. Ed Kinzel). Until then, there is still a long road ahead to reach the final destination.



The innovative 3D glass printers from MICRON3DP use specialty glass from SCHOTT as "ink."

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.

More information
Weitere Infos



schott.com/3DPrinting



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.

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 back-street 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.



Photos: SCHOTT/A. Sell; Zuriga

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

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.”



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.



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**
Solutions 2/2014, Page 18 – 19

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
Solutions 1/2014, Page 30–31

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 the glasstec 2012 trade

show in Duesseldorf – was realized together with the company Octatube (NL).

SCHOTT Product: **CONTURAX® Pro**
Solutions 2/2012, Page 24–25

Infinite Light Loop

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

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



Photos: SCHOTT/M. Coughman

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.

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 Manager with SCHOTT UK.

SCHOTT Product: **DURAN® rods**
Solutions 1/2013, Page 22 – 23

Creating Something New Without Replacing what is Old

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.

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, sustain-able 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.

“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



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.



Photo: SCHOTT/H. Cock

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.

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®**
Solutions 2/2012, Page 44 – 45

Unconventional Glass – Tubing for Exquisite Effects

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

Ensclosed 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-Rohrglas – now 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.



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”.

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 W. Roelfsema, Business Manager for tubing for Northern and Western Europe at SCHOTT.

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.



Photos: SCHOTT/M. Couchman

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.

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**
Solutions 1/2011, Page 46 – 47

Tubing

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