WACKER WORLD WIDE MAGAZINE

WWW 02 20

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WACKER

ARTWORK MADE OF SILICONE

Lena Policzka and her spatially encompassing installation for Murnau City Hall

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Dear Reader,

When the last issue of our company magazine was published in May this year, most of the world was in the middle of a lockdown to contain the outbreak of the coronavirus pandemic. That was half a year ago and in this short time, the world has learned a lot about the virus – how its spread can be curtailed, how to treat patients. And also, how to deal with the consequences of the toughest global recession since the Second World War.

Now that we have gained over six months' experience with the coronavirus and how it affects us, it is evident that compared with companies in other sectors, WACKER has held its own fairly well in this crisis. Both our production plants and administrative departments have responded to this entirely new situation with great flexibility.

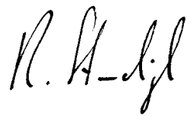
Following a very weak second quarter in the wake of the pandemic, which affected our incoming orders considerably, demand has spiked in the third quarter. Our plants are producing at high capacity.

However, not only WACKER's performance over the next few months will hinge on whether the global rise in infections once again leads to severe restrictions. Managing the economic fallout of COVID-19 is a major issue for countries and businesses alike.

Especially in times like these, it's important not to lose sight of the main challenges facing companies today: they must drive and implement innovation, act sustainably and keep costs under control.

In this issue of our company magazine, I am delighted to present to you some innovative applications of our silicone and polymer products that address the above three topics going forward. A model project in Guinea, West Africa, demonstrates how using polymers combined with cement as a soil stabilizer can dramatically increase the service life of a road. The same applies to silicone rubbers when they are used to coat the nylon fabric of hot-air balloon envelopes. Or to silicone-based anti-graffiti coatings which, thanks to a newly developed primer, can now also protect smooth, non-mineral surfaces from vandalism.

This is how we extend the service life of products, reduce raw-material demand and decrease the number of renovation cycles. These topics are set to gain traction in the future, true to the spirit of sustainable and cost-conscious management.



Dr. Rudolf Staudigl
President & CEO of Wacker Chemie AG

Dr. Rudolf Staudigl
President and CEO of Wacker Chemie AG

"This is how we extend the service life of products, reduce raw-material demand and decrease the number of renovation cycles."

30

VACCINES

TRAINING FOR THE IMMUNE SYSTEM

The coronavirus has shown how important vaccines are for keeping the body's defenses in shape to combat dangerous infections. Wacker Biotech has been making vaccines on behalf of pharmaceutical companies and research institutes for some 20 years now. The company's portfolio extends from conventional live and killed vaccines to protein-based active ingredients, and polysaccharide and glycoconjugate vaccines.

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WWW 2.20 ▸ GLOBAL ▸ **WACKER WORLDWIDE**

WACKER WORLDWIDE

WACKER has production sites, application technology centers, subsidiaries and sales offices on every continent. Here is a selection of news and interesting topics from the Group's four business divisions.

1 MIDELT

Morocco is continuing its efforts to exit energy production based on fossil fuels. The plan is for more than 50% of energy to be generated from renewable sources by 2030, thanks to measures including a new solar power station in the southern foothills of the Middle Atlas. Once this power station – a hybrid of photovoltaic and solar thermal power plants – is fully operational, its output will be around 400 megawatts, making it the second largest solar power plant in the world after Ouarzazate, which is also in Morocco. Because it is highly resistant to heat and extremely durable, silicone fluid from WACKER is used as a key heat-transfer medium in solar thermal power plants. It achieves the kind of efficiency rates in solar thermal power plants that wouldn't be possible using conventional heat-transfer oils.

2 MUNICH

"Capital" financial magazine, in tandem with "Ausbildung.de" talent platform and Territory Embrace's HR marketing experts, voted WACKER one of the best vocational training companies in Germany for the fourth year in a row. Of the 666 companies rated, 171 – including WACKER – gained a top score of five stars in the vocational training category. A further 324 companies were awarded four stars. What's more, WACKER received a four-star rating in the Dual Study Program category. The Group currently employs some 600 apprentices throughout Germany, with 480 based at Burghausen and 80 at Nünchritz, together with 39 enrolled in a dual study program.

3 BURGHAUSEN

WACKER has been placing company bicycles at the disposal of its Burghausen site employees since 1948. Of the more than 8,000 employees there, some 5,000 use these bicycles to get around the plant premises. The site has its own cycle workshop, where two employees are in charge of obtaining, organizing and repairing the bikes. Around 3,000 repairs are made every year. A special inspection badge is issued whenever a company bicycle is serviced, which happens regularly, every two years.

5 MELBOURNE

Wacker Chemicals Australia Pty. Ltd. celebrated its 40th anniversary this August. It was founded as a joint venture between WACKER and Hoechst Australia in 1980. The Group's activities down under actually date back to the 1970s, when a specialist silicone distributor was sent there, initially working for Hoechst Australia Ltd. WACKER Australia operates a sales office, technical center and several warehouses. It also provides customers based in the region with the WACKER Group's entire product and service portfolio.

4 XI'AN

Various Chinese manufacturers of solar-grade silicon wafers have transferred their production from China's eastern provinces to western and northern regions in recent years in order to take advantage of the comparatively inexpensive electricity supply there. That is why WACKER POLYSILICON recently started operating a new hub in Xi'an, central China. Covering an area of 30,000 m^2, this hub features a bonded warehouse and a railroad container center. It is connected to the nearby highway and is just 1.5 kilometers away from the port of Xi'an. Its geographical proximity to a number of key customers allows WACKER POLYSILICON to meet requests faster. For instance, using the China-Europe Railway Express Center reduces the lead time from Burghausen to this new hub by about 50% compared with the maritime route.

GROUP UPDATE

The Nanjing site manufactures VINNAPAS® dispersions and dispersible polymer powders as binders for construction applications and for coatings and adhesives.

MANUFACTURING CAPACITY FOR POLYMER PRODUCTS DOUBLED IN NANJING

Group invests US$100 million in the world's largest plants for VAE products

WACKER is expanding its Chinese polymer activities by investing around US$100 million in building two new production facilities at its Nanjing site. The expansion involves construction of a reactor for vinyl acetate-ethylene copolymer (VAE) dispersions, and a spray dryer for VAE dispersible polymer powders. Construction is set to start as soon as the local authorities have issued the necessary permits. The new facilities, which, once completed, will be the largest of their kind in the world, are expected to go on stream in the second half of 2022.

WACKER's Nanjing expansion will more than double its production capacity there, enabling it to meet growing customer demand for its high-quality binders, particularly from China's buoyant construction industry. "China is the largest building market in the world, accounting for 20 percent of all construction investment. Our capacity expansion in Nanjing strengthens our position as the global leader for vinyl acetate-ethylene dispersions and polymer powders," said Dr. Rudolf Staudigl, President and CEO of Wacker Chemie AG, explaining the reasons for the investment.

"Our binders not only enhance the properties of building materials, but also make construction activities more resource-efficient," added Paul Lindblad, President of WACKER Greater China. "Ongoing urbanization and the need to renovate existing residential buildings continue to drive the development of environmentally-friendly dry-mix building materials in China. Nanjing's expanded capacities will enable us to securely meet future market growth in the region."

Dispersions and dispersible polymer powders from WACKER are used in such sectors as construction, paints, coatings and adhesives – for example, for formulating high-quality tile adhesives, energy-saving external thermal insulation composite systems, and low-odor low-emission interior paints. They also find application in paper coating and in carpets and textiles.

At its fully integrated production site in the Nanjing Jiangbei New Material High-Tech Park, WACKER manufactures not only VAE dispersions and dispersible polymer powders, but also polyvinyl acetate solid resins, used for example as binders and/or additives in adhesives, soundproofing film or low-profile additives

WWW 2.20 ▸ NEWS ▸ **UPDATES**

WACKER is investing in new cleanroom structures at its biotech site in Amsterdam.

WACKER EXPANDS BIOLOGICS PRODUCTION

The Amsterdam biotech site gains a new fermentation line and optimized cleanroom

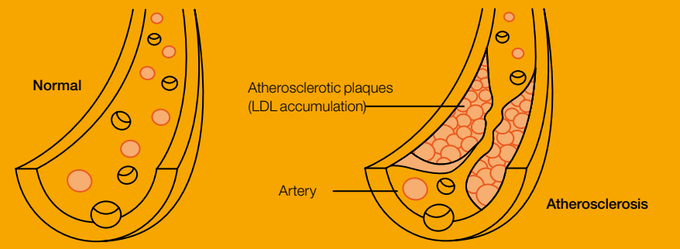
WACKER, the Munich-based chemicals Group, is investing in its production facilities for biologics, LMPs (live microbial products) and vaccines at its Amsterdam site. Projects include the construction of a new fermentation line with a volume of 1,500 liters as well as the setting up of new cleanroom structures in the 270-liter fermentation line. The investment price is a mid-double-digit million-euro amount.

"By investing in new plants and production equipment, we are continuing to upgrade the Amsterdam site two years after WACKER took it over, and are making our company fit for the future," explains Dr. Jörg Lindemann, managing director of Wacker Biotech B.V., a WACKER subsidiary.

The construction of a new fermentation line with a volume of 1,500 liters is planned, which, after a transition period, will eventually supersede the existing 1,500-liter line. At the same time, new, improved cleanroom structures within the 270-liter production line are to be created. The existing cleanrooms are to be gutted, completely renovated and successively refitted with state-of-the-art equipment. Among other improvements, new utility supplies are planned, such as water for injection. These measures will contribute to preparing the plant to produce new classes of actives, such as pDNA and mRNA-based vaccines. These nucleic acid-based actives classes are currently playing a role, for example, in the search for a vaccine against the new SARS CoV-2 coronavirus.

"The new structures, new equipment and new fermentation line will also enable us to reliably meet our customers' demand in the next years. We will strengthen our position as one of the leading contract manufacturers in the field of microbial production of biologics," adds Dr. Guido Seidel, head of the Biopharmaceuticals business line and managing director of Wacker Biotech GmbH.

As a CDMO (contract development and manufacturing organization), Wacker Biotech combines the Group's biopharmaceutical activities. WACKER took over the site in Amsterdam, the Netherlands, in 2018, thereby doubling the company's biologics capacity. The portfolio was expanded with the production of vaccines (including polysaccharides) and live microbial products. The site has two fermentation lines, currently with capacities of 1,500 and 270 liters respectively. These lines manufacture microbial-derived biopharmaceuticals, not only for clinical testing, but also for the commercial market. Further manufacturing potential is offered by single-use fermenters with a capacity of 250 liters, together with the ancillary equipment. The site's service offering is rounded out with a fill-and-finish facility for filling and lyophilization, which enables the complete manufacture of pharmaceuticals from the active agent to the filled product.



"Bad" LDL
deposits cholesterol in the bloodstream

"Good" HDL
regulates LDL deposition and promotes excretion

High LDL (low density lipoprotein) levels are one main factor for the occurrence of coronary heart disease and arteriosclerosis.

HTESSENCE® ANTIOXIDANT PROMOTES HEART HEALTH

Two studies prove positive effect of hydroxytyrosol

The results of two studies show that WACKER's hydroxytyrosol HTEssence® has a positive effect on heart health. A recent human clinical study demonstrates that HTEssence® is able to reduce LDL (low density lipoprotein) cholesterol levels. Reducing LDL has been found to support heart health. This confirms the positive effects of HTEssence® that had been demonstrated in an earlier study. Regarded as a highly effective antioxidant found in olives, hydroxytyrosol may have positive effects on blood pressure, joints and the immune and cardiovascular systems. WACKER produces this nature-identical substance in a patented process that ensures high purity and a precisely defined content.

In an initial randomized, double-blind, placebo-controlled study published in 2018, 29 healthy volunteers consumed 30 mg of hydroxytyrosol per day for a total of four weeks (Siefer et al., 2018, Journal of Nutritional Medicine and Diet Care). In a recent, similarly devised study, 92 healthy volunteers were prescribed 30 mg of hydroxytyrosol a day (Knaub et al., 2020, Journal of Nutrition & Food Sciences). This more recent study lasted longer, running for twelve weeks.

The results of the earlier study had shown a significant reduction of LDL cholesterol in the blood plasma by 9.4 mg/dL (-8%) with HTEssence®. This positive effect has now been confirmed. The results of the second, lengthier study likewise demonstrate a reduction of LDL cholesterol in the blood plasma, this time by 8.5 mg/dL. High LDL levels are one main factor for the occurrence of coronary heart disease and arteriosclerosis (see diagram). The US NCEP (National Cholesterol Education Program) estimates that each 1-percent reduction in LDL cholesterol can reduce the risk of heart disease by approximately 1 percent.

Available both as an odorless, water-soluble powder and in liquid form, WACKER's hydroxytyrosol is suitable for use in functional foods and dietary supplements, such as tablets, capsules, energy bars and beverages.

A look inside WACKER's new competence center for silicone-based thermal interface materials in Shanghai.

COMPETENCE CENTER FOR THERMALLY CONDUCTIVE SILICONES OPENED IN SHANGHAI

Industry needs more and more heat-dissipating materials for electric cars and all kinds of IT devices

WACKER officially opened a global competence center for thermal interface materials in Shanghai. Located in the Caohejing High-Tech Park, this new lab facility is dedicated to studying and developing innovative, thermally conductive silicones and silicone-based solutions for electric cars and a growing number of consumer electronics and telecommunications applications.

With an annual growth rate of more than 6 percent, thermal interface materials have been among the most rapidly expanding material segments for the last ten years. Due to their wide-spread use in all kinds of IT devices, as well as in the batteries and power electronics of electric cars, the demand for silicone-based thermal interface materials will continue to rise over the next few years, particularly as energy densities are growing exponentially and greater importance will be attached to the thermal management of electronic components.

When in use, electronic devices and batteries generate a great deal of heat that impacts their functionality and service life and can lead to serious faults. Efficient thermal management is therefore growing increasingly essential in many applications, such as consumer electronics and electric vehicles. "To cool the components more effectively, industry is increasingly turning to heat-dissipating materials," explains Christian Gimber, head of Engineering Silicones at the WACKER SILICONES business division. "Our thermally conductive silicones not only can be processed efficiently, but also take account of the stringent safety and reliability demands imposed by the electronics and automotive industries."

The new competence center for thermal interface materials (TIM) is located at the Group's China HQ in the Caohejing High-Tech Park in Shanghai. The new center provides other WACKER laboratories and technical centers around the world (such as in Germany and South Korea) with support in developing new formulations.

Thanks to their unique properties, silicones are often used in thermal management applications. Silicone-based thermal interface materials are not only electrically insulating, but also extremely resistant to heat, chemicals and UV radiation. Examples of products supplied by WACKER for the TIM market include gap fillers, encapsulants, adhesives, sealants, and various kinds of lubricating grease and foam.

SILICONES FOR SANITARY PAPER AND HOUSEHOLD PRODUCTS TO BE SOLD UNDER THE NAME LIOSIL®

High-quality silicone additives are being jointly marketed under a new trademark

WACKER recently started to market its high-quality silicone additives for the household and personal care industry under a new trademark. Silicone fluids and emulsions for textile and surface care products and for enhancing sanitary paper will be marketed under the name LIOSIL® going forward. These silicones improve the performance of the end product and offer important additional effects that protect treated surfaces and materials, while also making them more attractive and enhancing their sensory properties. Additives produced using a climate-friendly mass balance method that conserves resources will be labeled with the equally new LIOSIL® eco logo. This means that WACKER will immediately begin using its biomethanol-based production method in household-care applications as well. Fossil constituents are fully compensated by plant-based, i.e. climate-neutral, raw materials (see also the article on the next page).

The LIOSIL® brand encompasses three product lines: LIOSIL® FC, LIOSIL® HC and LIOSIL® TS. The FC in LIOSIL® FC stands for fabric care. These kinds of silicones make tissues soft, absorbent and supple, simplify the job of ironing, keep laundry from wrinkling and extend fabric life. Surface care products will fall under the brand name LIOSIL® HC, where HC stands for home care. Finished products containing additives like these protect and nourish flooring, impregnate textiles and leather, and let furnishings shine like new. LIOSIL® TS (tissue solutions) will be the brand name for tissue lotions. These products are silicone formulations that noticeably improve the properties of sanitary paper, even when used in very small amounts.

Silicone fluids and emulsions can be used to give textiles a water-repellent impregnation. WACKER will be marketing these products under the LIOSIL® brand name.

Sealing up a joint: a version of WACKER's silicone sealing compounds is now being made without fossil raw materials.

SILICONE SEALANTS ARE NOW AMONG THE PRODUCTS BEING MADE ON THE BASIS OF BIOMETHANOL

TÜV Nord inspection body certifies production based on the mass balance method

WACKER has achieved another milestone in the use of renewable raw materials for silicone production. After having certified biomethanol-based silicone fluids and emulsions, technology service provider TÜV Nord recently used the REDcert² standard as a basis for giving a green light to resource-efficient silicone sealant manufacturing. The WACKER method involves determining the mass fraction of raw materials and auxiliaries derived from fossil-based resources and offsetting this with methanol produced from biomass. This makes WACKER the first chemical company to produce the organic components of its sealants exclusively on the basis of plant-based materials instead of raw materials derived from petrochemicals. Silicone sealants are important materials in construction and installation projects, and are primarily used for the bonding and sealing of joints.

Silicone sealants consist primarily of plasticizers, fillers and additives, as well as a silicone polymer that cures at room temperature to form a rubber-like elastomer. Alongside silicon, which is obtained by reducing quartz sand with carbon, an important raw material used for manufacturing the polymer is methanol. The compound is first converted to methyl chloride, which is then reacted with elemental silicon in what is known as the Müller-Rochow process to produce a mixture of various methylchlorosilanes. These, in turn, serve as starting products for silicone production. WACKER uses methanol derived both from fossil raw materials and from biomass, but the source makes no difference in chemical terms – the molecule is always identical with respect to its structure and properties.

The mass balance method takes advantage of that. If methanol from both plant- and fossil-based sources is used within an integrated production system, the portion of raw materials derived from biomass can be determined and explicitly allocated to individual sales products. The approach is comparable to the green electricity certification system used in Germany. WACKER already uses this method for manufacturing biomethanol-based silicone products for the textile, paper and consumer goods industries.

TÜV Nord has now extended its certification to include the production of WACKER's silicone sealants. In this case, certification met the requirements of the new REDcert² standard. This standard covers not only all of the organic raw materials for silicone manufacturing – it also encompasses all of the other organic components of the formulation. This serves as verification that WACKER's silicone sealing compounds are 100 percent free of fossil raw materials. To qualify, purchased raw materials must have been sustainably manufactured from biomass, and all of the required starting materials must be obtained from certified sustainable sources as well. The volumes of raw materials needed for product manufacturing undergo regular audits as part of an annual recertification process.

"Successful certification of our mass balance method makes us the first company to offer ready-to-use sealing compounds based on non-fossil raw materials," explains Dr. Robert Gnann, president of the WACKER SILICONES business division. "That's good news for our customers, who can likewise declare that the biomethanol-based sealants they purchase from us preserve natural resources and contain no fossil raw materials."

CHANGE LAB!

BUILDING FOR GREATER SUSTAINABILITY

WACKER supports the Karlsruhe Institute of Technology in building up an innovation platform

The Munich-based WACKER Group is supporting a project by the Karlsruhe Institute of Technology (KIT) to build up an innovation platform for sustainable construction. The project being funded, known as "ChangeLab! WACKER / KIT Innovation Platform for Pioneering Sustainable Construction," is aimed both at KIT students and at architects, engineers and construction experts seeking to learn about and discuss new ideas and conceptual approaches in the fields of materials development and sustainable construction. Public lectures, symposia and ideas competitions are planned. All activities on the platform will be posted publicly on the https://changelab.exchange/ website. WACKER is also providing funding for a digital overhaul of the institute's materials library. The project is scheduled to last three years.

The goal of the innovation platform is to forge stronger ties between researchers and actors at the various stages of the construction-sector supply chain, such as architects, construction firms and manufacturers of building materials. The focus will be on the innovative potential offered by renewable building materials and their structural design principles in the construction sector.

"Even in times of the coronavirus, sustainability remains a top priority for us," says Peter Summo, president of the WACKER POLYMERS business division. "We are deliberately laying down a marker for the development of sustainable technologies in the construction sector. This is a matter of strategic importance to us." WACKER has long espoused sustainable product solutions. WACKER POLYMERS, a world-leading producer of binders based on vinyl acetate-ethylene copolymers, uses biobased acetic acid sourced from the timber industry to manufacture binders for interior wall paints.

The other project partner involved in the innovation platform is the Professorship of Sustainable Construction at the Institute for Building Design and Technology within the KIT's Department of Architecture. An expert group there, led by Prof. Dirk E. Hebel, has been studying sustainable materials resources and closed-loop construction principles since 2017. "Climate change and the issue of how to manage ever-diminishing resources in the future need to inform our daily thinking, action and construction in our field of study," says Hebel. In his view, it is therefore important to develop new materials and structural design principles that will add to the range of possibilities available to architects and construction engineers and to keep pressing ahead with the closed-loop approach, e.g. through the use of biotic building materials.

Mjøstårnet in Brumunddal, Norway, is currently the world's tallest timber building.

WACKER MAKES ADVANCES IN SILICONE CROSSLINKING WITHOUT PRECIOUS METALS

Royal Society of Chemistry honors trailblazing collaboration between WACKER and the Institute of Silicon Chemistry at the Technical University of Munich

A special honor has been bestowed upon researchers from the Munich-based WACKER Group and from the WACKER Institute for Silicon Chemistry at the Technical University of Munich. Their pioneering work on eliminating the need for precious metals in crosslinking silicone rubber was published by the Royal Society of Chemistry (RSC) in a special volume entitled “2020 Green Chemistry.” The RSC editorial board is using this edition as a way of honoring outstanding contributions to the development of sustainable concepts for the chemical industry. Headquartered in London, the Society is one of the oldest and most prestigious professional associations for chemists. The organization’s publications, for instance, have been advancing scientific work for over 175 years.

The term silicone describes synthetic polymers consisting of an inorganic silicon-oxygen backbone modified with organic groups. Silicone polymers represent a variety of product groups: fluids and resins used as additives or processing aids, as well as the highly elastic silicones that play valuable roles in applications such as medical devices, automobile electronics and displays.

Before use, silicone is in the form of silicone rubber, which is converted to a rubber-elastic state through chemical crosslinking. One of the more important methods used for this in industry is addition-curing, as this crosslinking process does not release any byproducts and results in particularly high-quality silicone elastomers. The process does have one disadvantage, however: the catalysts required for crosslinking contain precious metals such as platinum, which make the manufacturing process relatively expensive. These metals also remain in the silicone permanently.

A team of researchers led by Professor Bernhard Rieger, who holds the WACKER Chair of Macromolecular Chemistry at the Technical University of Munich, and Dr. Richard Weidner, who oversees organosilicon research at the “Consortium für elektrochemische Industrie” – the central R&D division of the WACKER Group – has now found a promising approach to resolving this issue. For the first time, these scientists successfully cured silicone rubber without the use of precious-metal catalysts. Rather than working with otherwise standard crosslinkers, the team instead used silicone modules containing silirane units.

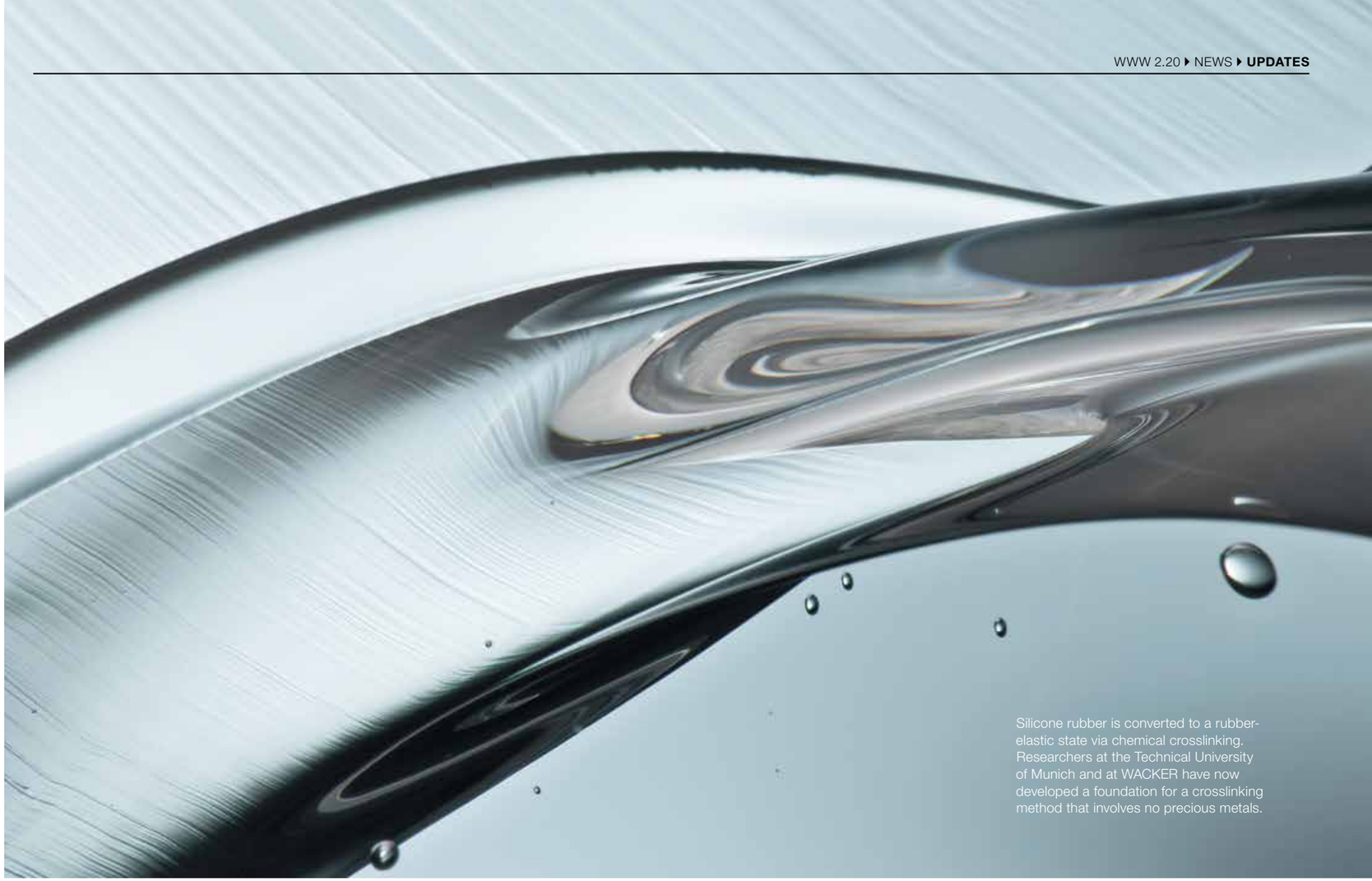
Siliranes are three-membered rings with a high degree of ring strain, which makes them reactive. The rings consist of one silicon atom and two carbon atoms, and, upon opening, can either react directly with suitable functional groups – without releasing any byproducts – or generate what are known as silylenes through a process of thermal and/or photochemical activation. These highly reactive divalent compounds – the subject of considerable discussion in the scientific community – can, in turn, react with any functional groups or synthetic building blocks typically used in the production of silicone rubber. Depending on the type of activation process and the choice of starting compounds, this method opens up a variety of pathways for curing silicones with silirane-containing crosslinkers.

And this is precisely what researchers at the WACKER Institute were able to demonstrate in the lab. Through experiments with select silicone formulations, the team successfully showed that the method can be used for crosslinking silicone rubber. The final properties are determined exclusively by the selection of starting products and their mixing ratio. The silicone elastomers produced in this way are characterized by their exceptional purity, containing neither volatile substances nor traces of precious metals. “That’s especially true for elastomers, which are crosslinked via a ring-opening reaction. Silicones like these are particularly suitable for medical applications or as encapsulants for the electronics industry,” says Rieger.

What makes this a trailblazing paper is that, for the first time, it shows a way of making such highly reactive silicon compounds theoretically useful for an industrial application. Researchers have to overcome a few more hurdles, however, to demonstrate practical viability for industrial use. “But we can already clearly see the advantages of the method,” Rieger notes. “Given the global growth in demand for precious metals, which are only available in limited quantities, alternative concepts like the use of siliranes to crosslink silicone without precious metals could play an important role in protecting important resources.”

Located on the Garching research campus near Munich, the WACKER Institute of Silicon Chemistry was founded jointly in 2006 by the Technical University of Munich and by Wacker Chemie AG. Since that time, 54 researchers at the institute have gained their doctorate. Eleven scientists are currently studying the fundamental chemistry of industrially relevant organosilicon compounds as part of their doctoral research.

The article of B. Rieger et.al. (“Application of multifunctional silylenes and siliranes as universal crosslinkers for metal-free curing of silicones”) was published in Green Chemistry, 2020, 4489–4497. A patent application for this technology has been submitted.



Silicone rubber is converted to a rubber-elastic state via chemical crosslinking. Researchers at the Technical University of Munich and at WACKER have now developed a foundation for a crosslinking method that involves no precious metals.

WACKER CONFERS INNOVATION AWARD FOR OPTICAL BONDING MATERIALS

WACKER has honored Korean employees SeungA Lee and JungEun Lee with the Alexander Wacker Innovation Award for the development of new silicone resins for optical bonding applications. Additionally, and for the first time, WACKER presented this award in the Lifetime Achievement category – for outstanding performance during a person's career. It went to Amit Paul of Wacker Metroark Chemicals, WACKER's Kolkata-based joint venture, which makes silicone specialties for the Indian market and for international customers in the consumer goods industry. On account of the coronavirus pandemic, both awards, each worth €10,000, were presented at an online event in early September.

SeungA Lee and JungEun Lee work at the Center of Electronics Excellence, a Group research institute in Seoul. They developed customized solutions based on novel UV-crosslinkable silicone gels for the burgeoning market for high-quality non-reflective displays. In a process called optical bonding, silicone gels bond the thin cover glass with the electronic layers beneath. The display is made anti-reflective by filling this gap with gel and, thus, forcing out the air.

Silicone gels differ from other systems based on organic materials due to their stability and resistance to environmental influences, even after many years of service. As a result, they are widely used in sophisticated applications, such as large instrument-panel displays, restaurant-menu touchscreens, multi-functional sports watches and, above all, in the automotive industry. In every vehicle class, car makers are increasingly turning to ever-larger displays that are bonded with silicone gel. Such displays are indispensable for handling state-of-the-art connectivity systems. Furthermore, they open new design opportunities for car interiors, such as curved dashboard displays.

As in the past, a key reason for the notable success of WACKER's new product line is that customers receive products tailored to their individual needs. "The prize winners from our South Korean Application Technology department developed UV-crosslinkable silicone resins in close collaboration with a number of electronic-sector customers and, based on their specifications, tailored solutions precisely for various applications," said Christian Hartel, member of Wacker Chemie AG's Executive Board. "Their work has enabled WACKER to become a leading silicone manufacturer in the highly attractive optical-bonding market."

In total, 30 teams applied for the 2020 Alexander Wacker Innovation Award – a new record. The finalists included Amit Paul from Wacker Metroark Chemicals in Kolkata. His team successfully developed water-free silane oligomer-surfactant mixtures for treating cement compounds. This additive renders the cement hydrophobic during grinding, which achieves energy savings of up to 50 percent. Moreover, hydrophobic cement gives concrete and mortar compounds water-repellent properties.

This and other developments achieved during his 35 years of service (first at Metroark and later – since 1999 – at the Wacker Metroark Chemicals joint venture) are the reasons why Amit Paul has been honored with the Alexander Wacker Innovation Award in the Lifetime Achievement category.

"Throughout his career at WACKER, Amit Paul has excelled with his dedication and truly remarkable pioneering spirit," noted board member Christian Hartel in his speech honoring the award winner. "He always had our customers' needs and their business firmly in view and developed customized solutions for them which were crowned with success in a short time. He has made a valuable contribution toward driving forward WACKER's silicone business."

Korean researchers used UV-crosslinkable silicone gels to develop innovative solutions for non-reflective displays

JungEun Lee (left) and SeungA Lee (right) from Wacker Chemicals Korea received the Alexander Wacker Innovation Award for the development of novel silicone resins for optical bonding applications.

WWW 2.20 ▸ NEWS ▸ **UPDATES**

Amit Paul, head of research at Wacker Metroark Chemicals in India, with his Lifetime Achievement award – the very first time WACKER has presented it.

"I'M LEARNING SOMETHING NEW HERE EVERY DAY"

20 patents in 20 years: Amit Paul, head of research at Wacker Metroark, is the first person to win WACKER's Lifetime Achievement Award

When Amit Paul joined Kolkata-based Metroark Ltd. in 1985, this manufacturer of silicones was still a relatively small company with just three dozen employees. Metroark procured its raw materials – silanes – from WACKER and used them mainly to manufacture silicone fluid emulsions for the Indian textile industry. "After graduating in chemistry, I joined Metroark as the head of R&D and application technology. In those days, of course, we were still quite a modest setup. Even though we didn't do absolutely everything, we each had quite a few responsibilities."

In 1999, WACKER entered a partnership with this Indian family-run business, which had been founded in 1947. The new company was called Wacker Metroark Chemicals (WMC). Today, it is one of the two largest producers of silicones on the Indian subcontinent. Now that WACKER was involved, Amit Paul became production manager for the first five years of WMC's existence, although he hadn't bid farewell to R&D completely during that time. "R&D has always been my passion," says the 59-year-old chemist, and he officially became WMC's Head of R&D once more in 2004.

Amit Paul soon grasped how to capitalize on the technical and sales opportunities that opened up for Metroark now that an international company like WACKER was on board. For instance, he enhanced silicone fluid emulsions – not WMC's only source of business, but still its main focus – for major international customers from the consumer goods sector. In this way, he tapped into a global market worth an amount in the high double-digit millions of euros for both WACKER and WMC. In honor of his achievements, he was presented with Unilever's Best Innovation Award for Hair Care in 2008 and with L'Oréal's Most Innovative Technology Award in 2015. In addition, he worked on behalf of customers from all the other business units at WACKER SILICONES – thus underscoring his tremendous versatility.

Amit Paul has filed 20 patents on behalf of his employer during the last 20 years alone. Examples of projects of which he has been particularly proud over recent years include SILFOAM® SD 9019, known as a delayed defoamer and used to control foam in detergents. "This defoamer lowers by some 50 percent the amount of water needed to wash laundry by hand, which is still a common practice in developing countries," he explains. "As a result, we are making a real and long-lasting contribution to saving water – particularly in countries where water is truly scarce."

Amit Paul's achievements include the development of a silicone fluid emulsion of especially low particle size. It is used worldwide by an international consumer-goods manufacturer in its premium hair-care brand to ideally combine suppleness, shine and combability. He also made a significant contribution toward the introduction of hydrosilylation technology at the Kolkata site, where a plant for manufacturing functional silicone fluids went on stream in 2018 – the first of its kind on the Indian subcontinent. These specialties are used as high-performance additives in diverse applications, such as in cosmetic and varnish formulations and in crop protection.

What he appreciates about WACKER is its mixture of down-to-earthness and cosmopolitan outlook, not to mention the wealth of expertise in silicones that his colleagues in Germany, China, the USA and South Korea possess. "Even during this final phase of my career, I'm still learning something new every day," he says.

Although Amit Paul reached the Indian retirement age of 60 on November 15, WACKER and WMC won't be losing out on his patents and developments. What's more, he still intends to continue to place his expertise at the Group's disposal.

PROTECTIVE SHIELD FOR Street Art

Time was when antigraffiti coatings based on SILRES® BS 710 could only be used on open-pored surfaces, such as concrete. But thanks to a newly developed primer, it is now possible to treat smooth, non-mineral surfaces as well. This means that graffiti of artistic merit can be protected from being painted over.

Graffiti spray in action: The highly pigmented acrylic paints and nitrocellulose lacquers are difficult to remove from walls.

An unwritten rule of street art is that over-painting someone else's graffiti is taboo. Genuine graffiti artists would never stoop to such "crossing out." But not everyone sticks to the rules. "This disrespectful behavior also ruins those pieces of graffiti which have artistic merit," says Marianne Kreuzpointner, marketing manager for Construction Chemicals at WACKER SILICONES, who has recently been struck by the frequency with which such works of art are now appearing. Consider the case of three transformer housings belonging to the Strotög utility company in Töging am Inn, not far from the WACKER site in Burghausen. "About two years ago, we took a decision to have these housings decorated by professional graffiti artists from Potsdam," says Andreas Vogl, technical director at Strotög. "But unfortunately there will always be vandals who feel they have to leave their own mark on things." So, the phone call he received from Marianne Kreuzpointner at WACKER about an effective protective system came at just the right time. The three transformer housings were then given a protective coat of paint in April 2020.

A new product had to be developed to protect graffiti masterpieces

Dr. Hartmut Ackermann
Head of Applications Technology, Construction Chemicals, WACKER SILICONES

REMOVAL WITHOUT DAMAGE

The expert at WACKER specializes in permanent facade coatings from which graffiti can be washed off more easily and with less environmental impact. Removing the aggressive graffiti paint costs substantial sums of money and cleaning up spray attacks can damage the surfaces of defaced facades.

Consequently, there is great demand for technologies that can provide lasting protection for buildings. Alfred Martius, a technical service engineer at Rubersteinwerk GmbH in Saxony, is all too familiar with the issue. “As a company specializing in chemical dampproofing and in the management, repair and restoration of cultural resources, we have been working with WACKER for many years and we enjoy very close ties to their team,” he says.

In late 2016, the experts at Rubersteinwerk began using silicones from WACKER, especially SILRES® BS 710, for their antigraffiti coatings. This one-component silicone rubber cures at room temperature and in atmospheric moisture to yield a silicone elastomer that provides long-lasting protection for surfaces. SILRES® BS 710 is the active ingredient contained in the antigraffiti product made by Rubersteinwerk. “We combine it with other ingredients to produce a sales formulation. After all, the coating needs to be easy to use. This entails getting the consistency right so that painters can produce perfect results whether they use a brush, a roller or an airless spray device,” explains Martius.

The task of protecting graffiti masterpieces required a further development step to ensure that SILRES® BS 710 would adhere to smooth surfaces.

“First of all, we tested how effective the product was on facades, i.e. on absorbent mineral surfaces such as concrete, natural stone and tile surfaces, and then approved it for use,” says Dr. Hartmut Ackermann, head of WACKER’s applications laboratory for construction chemicals in Burghausen. The rationale for testing these substrates was that tags and paints adhere to the surface, become anchored in the pores close to the surface of the masonry and are hard to remove. But it soon became clear to him and Kreuzpointner, his colleague from marketing, that non-mineral or smooth surfaces, such as metals, plastics, wood, glass and coated surfaces, would have to be included as well. Not forgetting facades that have already been given a graffiti “makeover.” “The SILRES® BS 710-based antigraffiti coating wouldn’t be able to adhere very well or for very long to the graffiti on the transformer housings in Töging,” says Dr. Ackermann. The solution

Graffiti from Banksy, the world’s most famous street artist, who prefers to work with stencils. They are among the works of art that can be protected using SILRES® BS 710.

was to develop a bonding agent that enables SILRES® BS 710 to adhere steadfastly to the graffiti to be protected.

PRIMER OPTIMIZES ADHESION

Dr. Ackermann and his team of chemists killed two birds with one stone by developing a primer from a combination of silanes and silicone resins. This was used by the technical team at Rubersteinwerk to increase the adhesion of SILRES® BS 710 on painted surfaces. "The product is very thin and provides very high coverage – it only takes 50 milliliters per square meter. The colorless primer dries in half an hour and the antigraffiti coating can then be applied," explains Martius from Rubersteinwerk. The prime-coating agent from WACKER optimizes the adhesion to other organic systems – namely, spray paints. At the same time, it improves the adhesion of the subsequent protective coating.

"Porous substrates need around 250 milliliters of the antigraffiti product per square meter. For smooth substrates, 150 milliliters is enough," he adds. The protective coating is tack-free after about four hours and is left to cure for a day to form a permanent film of silicone that provides lasting protection against attacks with spray paint.

"To show that the graffiti works of art on the transformer housings in Töging were fully protected and that they can be cleaned quickly and easily, I even slipped into the role of official sprayer," says Kreuzpointner with a wry smile. To which Vogl from the Strotög utility company adds: "It really is impressive to see how easy it is to clean the treated facade by simply hosing it down with water. We know only too well how difficult it used to be to remove spray paints."

The reason that graffiti, posters and the like adhere so poorly to the silicone film is that the silicone has a particularly low surface tension. However, the sprays and tags have a high surface tension and so fail to form a coherent spray pattern.

01 Before applying the protective coating, painters remove grass and contaminants that might impede the paint's adhesion.

02 The primer is very thin and thus provides high coverage. 50 milliliters per square meter is sufficient.

03 The primer dries within half an hour and the antigraffiti coating can then be applied.

04 The primer improves adhesion to other organic systems, namely the spray paints used to create the mural, and also optimizes the adhesion of the subsequent protective coating of silanes and silicone resins.

Simple to clean with a jet of water >

05 The proof of the pudding is in the eating: graffiti on the mural is simply removed with water and a sponge. The silicone film can easily withstand more than 20 cleaning cycles.

But the roughly 100-micrometer-thick antigraffiti coating has further advantages to offer: the silicones crosslink amongst themselves to yield a durable, yet elastic film that can accommodate movement by as much as 30 percent. This effectively bridges cracks and surface irregularities and preserves the painted substrate from damage. And all the while, the film acts as a breathable barrier. Atmospheric moisture is able to pass through the masonry, which therefore does not serve as a breeding ground for microbes. What is more, the prophylactic treatment is long-lasting: the silicone film easily withstands more than 20 cleaning cycles. And it defies heat and UV light without turning yellow. “The coating we applied to the facades four years ago is still intact. And should the protective skin get damaged at some point, it is very easy to repair,” explains Kreuzpointner, adding that she hopes the graffiti on the transformer housings in Töging will enjoy a long life without coming to any harm. ■

THREE SYSTEMS FOR PREVENTING GRAFFITI

Coatings can be temporary, permanent or semi-permanent.

TEMPORARY

Temporary systems are made of waxes, biopolymers or acrylates. The protective film is invisible and can be used on listed buildings. A further advantage is that the systems are breathable. This means that moisture can evaporate from the building fabric. However, by their nature, such films do not provide lasting protection, as they have to be removed and completely replaced every time they are cleaned. Even in the absence of graffiti attacks, these coatings will only last a few years.

SEMI-PERMANENT

In semi-permanent systems, only one component of the film is lost during cleaning. The substrate has to be treated again every time graffiti is removed and at intervals of three to five years. The advantage of semi-permanent coatings is that they are barely visible and are permeable to water vapor. These products often consist of blends of organic waxes, silanes and siloxanes.

4 ever!

PERMANENT

The major advantage of permanent anti-graffiti systems is that they remain intact when the graffiti is removed and can last many years without losing their ability to protect the surface. The downside, however, is that these products usually affect the appearance of the substrate. In addition, many products seal the surface and thus prevent the natural passage of moisture. The protective film detaches in some places as a result, potentially causing blisters to form or the paint to flake off. Moisture damage to the building fabric is also possible. Because the new WACKER product consists of water-vapor permeable silicones, this undesirable side-effect does not occur.

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TRAINING THE IMMUNE SYSTEM

The coronavirus has shown how important vaccines are for keeping the body’s defenses in shape to combat dangerous infections. The experts at Wacker Biotech have 20 years of experience producing vaccines based on microbial systems.

They're on your skin, in your digestive tract, in the air and on the sea floor: we're surrounded by billions of bacteria and viruses. They live on us and in us. Invisible to the naked eye, most of these tiny organisms are harmless, and some of them are even critical to our survival. Some, however, make us sick, potentially triggering severe, even life-threatening illnesses.

Vaccines offer protection from an array of infectious diseases, such as polio, typhoid fever, cholera, hepatitis A and B, HPV and smallpox, which, thanks to a global immunization campaign, was eradicated in 1980. Nevertheless, new pathogens and variations of known pathogens arise again and again. The list is long. And it brings home one important lesson: vaccines are, along with the development of antibiotics, the cornerstones of modern medicine. The World Health Organization (WHO) estimates that vaccines save two to three million lives each year and prevent countless people from falling ill.

THE IMMUNE SYSTEM FORMS MEMORY CELLS

Vaccines do this by playing a trick on the body, leading it to believe it has been infected with a pathogen. The trick works by selectively exposing the body to either all or part of a killed or weakened organism. Not enough to cause disease, but enough to alert the immune system, which reacts by forming antibodies to fight the virus or disease-causing bacterium – an immune response, in other words. This is also when memory cells are formed, allowing the body to remember the pathogen, even once the acute danger has passed. If the individual is infected again at a later point in time, the immune system will be prepared for it.

Researchers are now working round-the-clock on a vaccine for the SARS-CoV-2 virus, which can trigger the respiratory illness COVID-19. The disease was first detected in December 2019 in Wuhan, a city home to millions of people in the Hubei province of China. In January 2020, the illness developed into an epidemic in China, ultimately spreading around the world to become a pandemic. Because the SARS-CoV-2 coronavirus had been unknown up to that point, it is often referred to as the "novel" coronavirus. According to the World Health Organization, 100 projects aimed at the development of a vaccine are currently underway (as of May 2020).

NOT ALL VACCINES ARE CREATED EQUAL

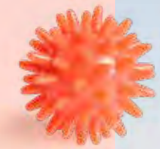
As part of that effort, pharmaceutical companies all over the world are working on very different kinds of vaccines. "Not all vaccines are created equal," explains Dr. Philippe Cronet, who leads the development of biotechnological production processes at Wacker Biotech – an area of responsibility that includes vaccine manufacturing. Pharmaceutical companies and research institutes have been contracting Wacker Biotech to produce vaccines for 20 years. The company's portfolio extends from conventional live and killed vaccines to protein-based active ingredients, and polysaccharide and glycoconjugate vaccines. The field is large, and development is ongoing.

"One option is to use the pathogen itself in the vaccine – in either a weakened or inactive form," he says. The organisms in live vaccines are capable of reproducing, but they can no longer cause illness, and the resulting live vaccines are referred to as attenuated, i.e., weakened.

"We develop production processes and produce vaccines for our pharmaceutical industry customers, but we don't do the corresponding concept development or marketing ourselves."

Dr. Phillipe Cronet, Director of Global Bioprocess Development, Wacker Biotech

HOW VIRUSES AND BACTERIA TRIGGER INFECTIOUS DISEASES



VIRUSES

are invisible to the naked eye and can only be seen with an electron microscope. Many look like tadpoles with tails, others are rod-shaped or resemble spheres. Their inner workings are relatively simple. Unlike bacteria, they have no metabolic processes of their own and consist of nothing but their genetic material. Strictly speaking, viruses are not even living things. And yet they can be hazardous to humans – the very simplicity of these tiny organisms is what makes them so dangerous. Viruses possess neither cytoplasma nor ribosomes, they cannot copy their genetic material, and they cannot make their own shells. This is why they replicate by attacking foreign cells and injecting their genetic material into them. Once inside the host cell, the virus reprograms the cell's own genetic information, forcing the host to produce virus particles from that point onward. Those particles, in turn, attack new cells. Once set in motion, this process destroys cells in the body. Diseases caused by viruses include the flu, herpes, AIDS, hepatitis, and the respiratory illness COVID-19.

BACTERIA

are many times larger than viruses: 0.1 to 700 micrometers. And, unlike viruses, they are living things – self-sufficient, single-celled organisms. They have their own genetic material, their own metabolism and they reproduce through cell division. Most bacteria pose no threat to human beings, and some are extremely useful, such as those that support digestion in the human intestinal tract. Only about 1 percent cause disease. When these bacteria enter the human body, they produce toxic metabolites that result in an infection. Familiar examples of these bacteria are those in the genus *Salmonella*, which cause food poisoning. Tuberculosis and whooping cough are caused by bacteria as well. Species of bacteria that are actually harmless and that live in or on the human body can also trigger an infection as soon as the immune system is weakened. One example here is pneumococcus, which can cause meningitis. While pneumococcal bacteria can be present in the noses and throats of many people without producing disease, dangerous inflammations can develop when they come into contact with older people, children or other immunocompromised individuals.

Our pharmaceutical proteins are delivered to customers in ready-to-use packaging.

Many of these vaccines – those that prevent childhood diseases such as mumps, measles and rubella – confer life-long immunity. Inactivated vaccines on the other hand, which are also referred to as killed vaccines, contain either a dead pathogen or part of an inactive virus to which the immune system responds. The protective immunity provided by killed vaccines generally only lasts for a few years, after which it will need to be stimulated once again.

A NEW DIRECTION IN THE 1990S

Most of today's vaccines are inactivated varieties developed from only select molecules of a pathogen. The use of genetic engineering to produce them has become increasingly common since the 1990s. These kinds of vaccines contain individual, characteristic proteins of a pathogen intended to produce an immune response within the body. For these to work, boosters known as adjuvants often need to be added. The same applies to what are known as polysaccharide vaccines, which use polysaccharides taken from the shell of a bacterium or virus to prompt an immune response. In order to amplify the effect, scientists in the 1990s also developed conjugated polysaccharide vaccines (conjugate vaccines), in which polysaccharides were bound to proteins. "These conjugates trigger a stronger immune response and provide longer-lasting protection than the antigen alone," Cronet explains.

PROMISING NEW CLASS OF VACCINES

Vaccines based on nucleic acids – the DNA or messenger RNA (mRNA) of a virus – represent a relatively new class of drugs offering a highly sophisticated immunization strategy. The vaccine contains only the blueprint of the DNA or mRNA of the virus, which the body uses as a basis for producing antigens. The immune system recognizes these antigens as foreign and fights them off – a trial run for a real infection in which the immune system never comes into contact with the pathogen itself.

"Vaccines based on nucleic acids are a very promising alternative to conventional vaccines," Cronet observes. "They offer a number of advantages. The most significant of which is their minimalist structure, which reduces development and production time. The only thing you have to produce is genetic material, after all. You don't have to culture the pathogen itself. And that eliminates a very time-consuming step." Up to now, however, no nucleic-acid-based vaccines have been approved for use in humans – all of the candidate actives are still in the development phase. Some products have already been approved, however, in another relatively new class of vaccines: viral vectors. Here the vaccine is based on a harmless virus that has been genetically engineered to contain characteristic, but harmless components of the dangerous pathogen. A vaccine based on a viral vector has recently been approved for Ebola.

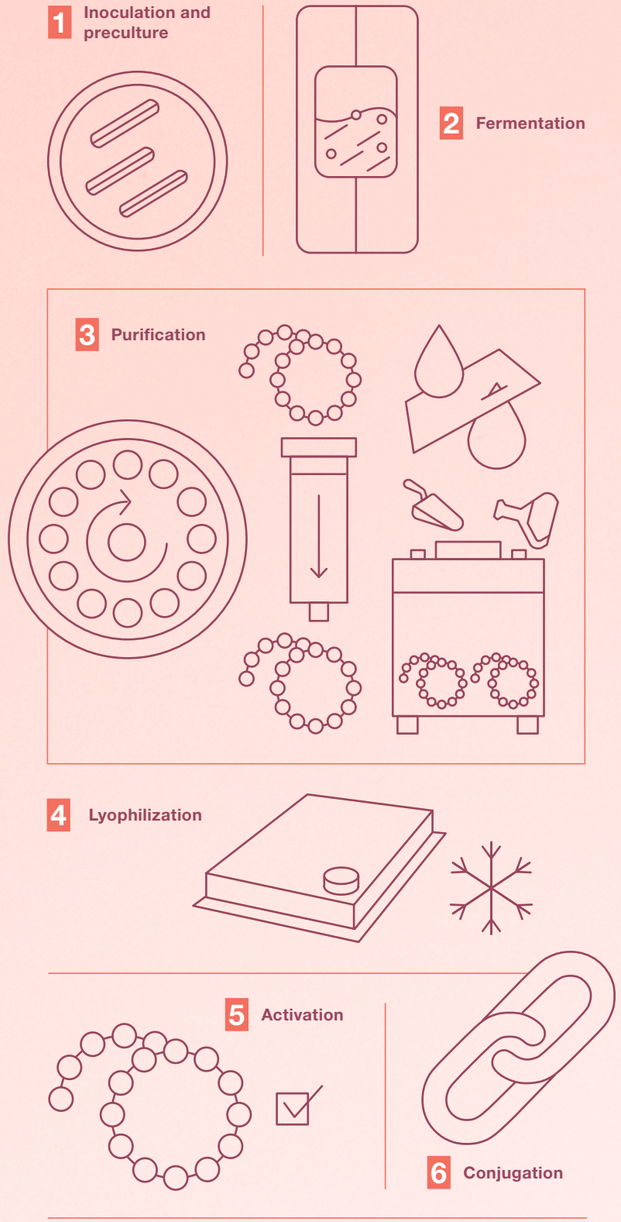
QUICKER RESPONSE TO NOVEL VIRUSES

Several research institutes are also looking to this new class of vaccines to combat the SARS-CoV-2 virus. According to the journal *Nature*, 20 projects throughout the world are currently underway with the aim of bringing an RNA- or DNA-based vaccine for the novel coronavirus to the market. Twenty-five projects for developing viral vectors have been launched as well (as of April 2020). Current efforts to combat the coronavirus pandemic could pave the way for these new classes of vaccine.

ABOUT WACKER BIOTECH

Wacker Biotech GmbH and Wacker Biotech B.V. are full-service contract manufacturers of therapeutic proteins, LMPs and vaccines based on microbial systems The company's portfolio extends from strain/process development to analytical testing to GMP production for clinical and commercial applications. Wacker Biotech maintains three GMP-compliant, FDA- and EMA-certified production plants in Amsterdam and at its sites in Jena and Halle in Germany. Wacker Biotech GmbH and Wacker Biotech B.V. are wholly owned subsidiaries of the Munich-based WACKER Group.

PRODUCING A CONJUGATED POLYSACCHARIDE VACCINE



Before the large-scale production of a vaccine can begin, the first step is to develop the production process in the lab.

"The rapid spread of severe infections like SARS, Ebola, and now the SARS-CoV-2 virus once again underscores the need for developing new vaccine technologies so that we can respond to novel viruses more quickly and effectively," says Cronet. Wacker Biotech will also be looking into research on nucleic-acid-based vaccines.

WACKER BIOTECH'S ROLE AS A CDMO

As a CDMO (contract and development manufacturing organization), Wacker Biotech works behind the scenes. "We develop production processes and produce vaccines for our pharmaceutical industry customers, but we don't do the corresponding concept development or marketing ourselves," Cronet explains. What Wacker Biotech experts do contribute are over 20 years of experience developing and producing living microorganisms, proteins and polysaccharides. These active substances are then used both in (pre)clinical studies and in commercial products.

Wacker Biotech produces vaccines at three sites: one each in Jena and Halle, Germany (Wacker Biotech GmbH), and one in Amsterdam (Wacker Biotech B.V.). Wacker Biotech GmbH and Wacker Biotech B.V. are both wholly owned subsidiaries of Wacker Chemie AG.

"The concept behind a vaccine is simple," Cronet observes. "Developing and manufacturing one is anything but simple." It can take ten to twelve years on average to move from the research phase to approval. In the case of a vaccine for SARS-CoV-2, however, scientists are hoping that an accelerated process could bring us to that goal within 12 to 18 months. The only reason this could work is because most vaccine candidates draw upon highly efficient development and clinical testing platforms that were devised for other pathogens. Researchers have already re-engineered existing vaccines by swapping out their genetic sequences so that they will respond to SARS-CoV-2.

From preclinical to clinical development, from vaccine manufacturing to market delivery: Wacker Biotech supports its customers the entire way. An individual production process is developed for each vaccine (candidate) and adapted to the stage of development that a given vaccine has reached. "Depending on the vaccine, that takes ten to fifteen months," says Cronet. Once the process is in place, millions of doses of vaccine can be produced within one to two weeks.

BROAD VACCINE PORTFOLIO

Wacker Biotech has already manufactured vaccines for a wide range of infectious diseases, such as cholera, meningitis A and C, and *Haemophilus influenzae* type B (Hib). "At this point we've provided over 650 vaccine batches for clinical and commercial applications," Cronet notes. Whereas vaccine manufacturing at Jena and Halle focuses on protein-based agents produced through the use of the bacterium *Escherichia coli*, the Amsterdam site makes attenuated live vaccines, polysaccharide vaccines and conjugate vaccines, too. This involves the use of an array of additional microorganisms, such as

650

That is the number of vaccine batches that Wacker Biotech has already made, both for clinical and commercial applications.

> "All of our facilities meet the highest standards of quality and have been approved by European and US authorities."
>
> **Dr. Phillipe Cronet,** Director of Global Bioprocess Development, Wacker Biotech

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Wacker Biotech uses stainless steel tanks, called fermenters, to apply biotechnology methods that induce bacteria, in this case modified strains of *E. coli*, to produce the desired pharmaceutical proteins. The strict quality control to which these pharmaceutical active ingredients are subject extends to the filling process.

Corynebacterium diphtheriae, *Salmonella typhi* or *Vibrio cholerae*.

Production in this case proceeds in multiple steps, and these vary depending on the type of vaccine. The first step takes place in the laboratory, where what are known as precultures are prepared of the vaccine candidate that the customer has provided. This is followed by scaling up production in single-use reactors or in stainless steel tanks called fermenters. Here the bacteria produce the target active substance – in the case of a conjugate vaccine, they build the desired polysaccharides (see illustration). The polysaccarides next undergo multiple purification steps and lyophilization, after which they are chemically activated and, in the final step, bound to the carrier protein to form the finished conjugate vaccine.

Wacker Biotech sites carry out this process in facilities meeting biosafety levels of 1 (Halle and Jena) and 2 (Amsterdam), on an ascending scale of 1 to 4. They produce vaccines in stainless steel tanks with capacities ranging from 270 to 1,500 liters, as well as in a 250-L single-use reactor. So, production volumes can be adapted as needed – small quantities of vaccine for clinical trials, larger amounts for supplying the market later on. In Amsterdam, active substances can also be dispensed into as many as 20,000 vials per batch following production. Freeze-drying (lyophilization) at the end of the production process is an option as well. "All of our facilities meet the highest standards of quality. They've been approved by the US Food and Drug Administration (FDA) and by the European Medicines Agency (EMA), which means we can supply the global market," says Cronet. Wacker Biotech ships its vaccines all over world.

THE VACCINE MARKET IS CONSTANTLY GROWING

Capacity utilization rates at all three Wacker Biotech sites are currently good, in part because the vaccine market is constantly growing – and not just because of the search for a SARS-CoV-2 vaccine. Scientists are continually discovering new pathogens, including many for which no vaccine currently exists. Also, because some pathogens possess the ability to adapt to their environments, there is a constant need for new vaccines to combat mutated organisms – this is why new flu vaccines are developed every year. Put in terms of actual numbers, the vaccine market is growing at an average rate of 7 percent a year. Studies have indicated that this is not likely to change in the coming years. Keeping pathogens in check remains a never-ending task – and that goes for Wacker Biotech too. ■

A PERFECT TAKE ON MILK FOAM

Foamed milk is as intrinsic to cappuccino as bubbles are to champagne. Vegans, who favor plant-based milk substitutes, can now also enjoy a full-bodied, creamy foam. This is made possible by cyclodextrins based on plant starch.

Not all milk foam is the same. In many large cities, you can now find barista academies, where café owners, or even just ordinary individuals, can learn how to make aromatic coffee along with the perfect milky topping. Large coffee and fast-food chains in turn have their own training facilities and laboratories in order to impart the necessary expertise as regards cappuccino, latte macchiato, etc. to their employees and to work on optimum formulations. The milk should be no hotter than 65 to 68 degrees Celsius and the steam nozzle should always sit one to two centimeters below the milk's surface – these are just two of a whole set of rules that a good barista should follow.

Not only the sweet, creamy taste is important, so is the appearance of the topping – our eyes evidently savor a latte macchiato or cappuccino, too. That's why more and more cafés and espresso bars are making an effort to decorate these coffee specialties with milk-foam images for their customers. Professional baristas even compete in this so-called "latte art" at international contests.

But what about soy, almond or oat milk? Many consumers now prefer these plant-based alternatives to cow's milk, either because they wish to reduce their consumption of animal products partly (if they are flexitarian) or completely (if vegan), or because they are lactose-intolerant or are allergic to cow's milk protein.

Although plant-based milk alternatives can be foamed, experienced baristas know that it is more difficult to produce great latte art with them. "Here, the foam's stability and durability are the deciding factors," emphasizes Dr. Ulrike Fischer-Nägele, head of the WACKER BIOSOLUTIONS food laboratory in Burghausen.

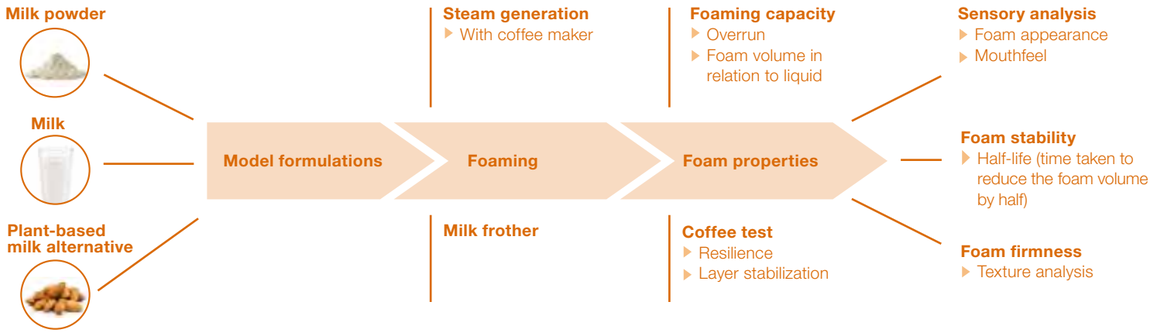
In cyclodextrins – cyclic sugar molecules based on plant starch – WACKER BIOSOLUTIONS offers an ingredient that promotes exactly these properties. "We used various model formulations to examine the influence of alpha-cyclodextrin on foam properties such as volume, stability and texture," she reports . The model formulations that the expert is referring to used different plant-based milk alternatives and milk powder alongside cow's milk as starting materials for the foam.

All of these milk alternatives are gaining in popularity: market studies confirm that the demand for soy and almond milk is rising by around 10 percent per year in the US alone. Additionally, powder-form, milk-based specialty products are used to make alternative toppings to fresh milk that are particularly long-life and easy-to-combine in finished system products.

REVERSIBLY ENCAPSULATED

Tests at WACKER's food laboratory in Burghausen are producing impressive figures that confirm the positive effect of cyclodextrins. WACKER markets these cyclic sugar molecules, which are able to reversibly encapsulate other molecules (see box on page 33), under its CAVAMAX® brand. The addition of 1.4 percent CAVAMAX® W6 to a milk-powder product of medium fat content almost doubles the volume of the resultant milk foam, for instance.

TESTED MODEL FORMULATIONS FOR FOAMING PROCESSES AND FOAM PROPERTIES



Tested Model Formulations, Foaming Processes and Foam Properties
Milk powder: dairy and non-dairy milk toppings in powder form with varying fat content; milk: ultra-high temperature (UHT) milk with varying fat content; plant-based milk substitute: (in this case almond milk with 2.5% almond content). The foam was created either by injection of steam with a coffee maker or by using a milk frother. Different properties of the resulting foam were subsequently analyzed.

WWW 2.20 ▸ INNOVATIONS ▸ **CYCLODEXTRINS**

"The foam lasts considerably longer – the coffee looks good in the cup for much longer."

Dr. Ulrike Fischer-Nägele, food laboratory head, WACKER BIOSOLUTIONS

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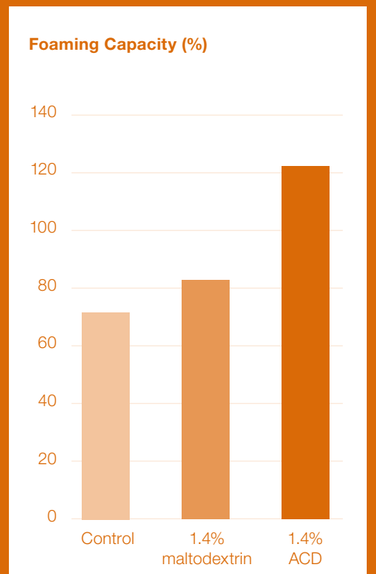
CYCLODEXTRINS

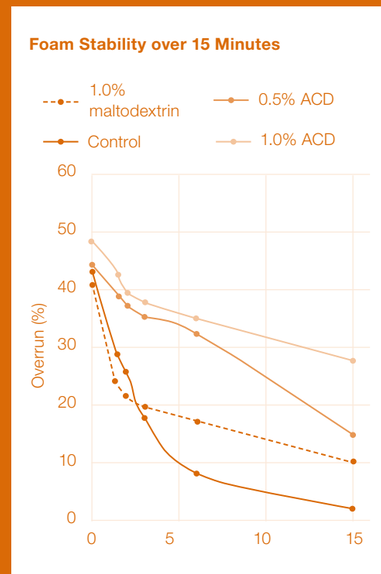
Cyclodextrins are oligosaccharides that WACKER BIOSOLUTIONS manufactures by enzymatic degradation of plant starch. The raw-material base is corn. Cyclodextrins are characterized by their cyclic three-dimensional structure with a hydrophobic cavity. This cavity can trap lipophilic molecules as "guests" – provided they have the right size and shape. The hydrophilic outer surface in turn ensures compatibility with aqueous systems. This special structure exhibited by cyclodextrins opens up a wide range of applications in medicines, food, food supplements and technical applications. As functional additives, they can be used for stabilizing sensitive substances, for controlled release of bioactives, masking unwanted aromas, rheology control or for improving solubility and bioavailability.

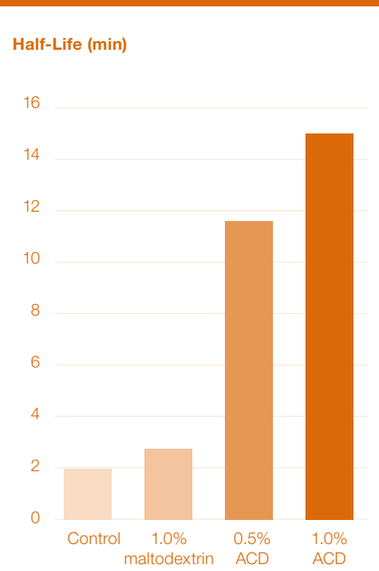
The size of the ring determines the type of cyclodextrin involved: α-cyclodextrin with six, β-cyclodextrin with seven and γ-cyclodextrin with eight glucose units. WACKER is the only company in the world to manufacture all three naturally occurring cyclodextrins. They are marketed under the following trade names: CAVAMAX® W6 (α-cyclodextrin), W7 (β-cyclodextrin) and W8 (γ-cyclodextrin).

FOAM VOLUME



FOAM STABILITY AND DURABILITY





Foam volume of different barista formulations: the addition of 1.4% alpha-cyclodextrin (ACD) almost doubles foaming. The same amount of an inert, linear oligosaccharide (maltodextrin) was used as a direct comparison and control for the foam volume. Maltodextrin gave rise only to a slight increase in overrun, due to the increase in dry matter.

Addition of alpha-cyclodextrin to the barista topping not only improves the foaming capacity – the stabilizing effect of CAVAMAX® W6 also retards foam-reducing reactions (Ostwald ripening, dehydration, coalescence and drainage) and thus has a positive influence on foam stability in these toppings.

Foam stability with alpha-cyclodextrin: the center diagram depicts the increase in foam stability for the model using dairy and non-dairy milk powder, reconstituted from four grams of powder in 100 grams of water. The addition of alpha-cyclodextrin increases foam stability even at low dosages and extends the foam half-life (time taken for the foam volume to shrink by half) from 3 to 15 minutes.

Barista products are part of a luxury lifestyle. This means that consumers attach great importance not only to the topping's volume and stability, but also to its overall appearance. The foam should look nicely creamy and uniform.

The diagram on the right depicts the positive effect of 1% alpha-cyclodextrin in an almond-milk foam. Consumers correlate this uniform, creamy pore structure with a full-bodied drink and enhanced mouthfeel. Plant-based barista toppings, in particular, often require a bit of help in this regard.

Visit our website for more information:

A look inside the food lab in Burghausen: technicians use this test setup to measure foaming capacity.

CAVAMAX® W6 is bioengineered from plant starch in a patented process. This alpha-cyclodextrin looks just like other sugars. Its molecules consist of six glucose (dextrose) units, linked together in a ring. WACKER BIOSOLUTIONS uses starch to manufacture the product in an enzymatic process.

FOAM REMAINS STABLE FOR LONGER

On top of the positive influence on foam volume and stability, alpha-cyclodextrin has other desirable effects: the half-life, as experts refer to the time taken for the foam volume to reduce by half, can be increased considerably with the addition of CAVAMAX® W6 – from 3 to 15 minutes. "This provides consumers with a longer period during which the coffee-based beverage can be served with an attractive topping," explains Dr. Fischer-Nägele. "The coffee looks good in the cup for considerably longer."

Her colleague Yvonne Haslauer describes a further benefit of the vegan additive: "A foam created with the addition of CAVAMAX® W6 looks more uniform and creamier than the corresponding pure milk foam – an effect that immediately catches the consumer's eye."

WACKER BIOSOLUTIONS food specialists have an explanation for the foam-enhancing effect: alpha-cyclodextrin's cyclic molecules possess a hydrophilic (water-attracting) exterior and a lipophilic, i.e. fat-loving, cavity in their interior. "In this lipophilic cavity, fat-soluble milk constituents such as triglycerides can form certain complexes, or inclusion compounds. They thus control the convergence of the liquid phase, stabilizing the foam structure," says Haslauer. Here, the liquid phase is the milk, which is converted into a dispersion (gas/liquid = foam) by the foaming process. "These stabilized barista toppings can be savored both on coffee-based drinks and tea drinks such as chai latte as a tasty lifestyle add-on," she explains.

PROFESSIONAL TASTERS

Aside from the improved foam stability, there is a taste effect when plant-based cow's milk alternatives are foamed with the addition of alpha-cyclodextrin. This sensory aspect is analyzed by means of the triangle test. This test involves 18 men and women standing in a line along a table in a room with neutral lighting; their places are separated from each other by a small, non-transparent panel. They each receive three glasses containing a milky liquid. The professional tasters must find out which of their three glasses differs from the others.

The glasses contain either pure almond milk or almond milk with 1 percent alpha-cyclodextrin. In this triangle test, a method described in an ISO standard, 12 out of the 18 tasters from an independent institute succeeded in correctly identifying the divergent sample in each case. The tasters described the pure almond milk as watery, nutty, bitter and lacking in body. The term "astringent" was also used, describing a puckering feeling in the mouth. By comparison, they found the almond milk with CAVAMAX® W6 on average to be more full-bodied and creamy and less bitter.

WWW 2.20 ▸ APPLICATIONS ▸ **SILICONE RUBBER**

AN UNBEATABLE COMBINATION

Creating works of art takes more than just creativity. Artists also have to find the right materials to make their ideas a reality. Thanks to two different silicones from WACKER, Lena Policzka was able to do just that for her art installation entitled “System: Circuit” at City Hall in Murnau, Germany.

The tubing was extruded from silicone rubber and filled with a silicone gel to which a pigment had also been added.

Her installation “System: Circuit” has been hanging in the council chamber of Murnau City Hall since early September, and that has special meaning for artist Lena Policzka. Not just because she lives right around the corner in the village of Unterammergau, but because Murnau, a town of 12,000 people in Upper Bavaria, has left a major mark on art history – despite its small size. Painters Gabriele Münter and Wassily Kandinsky, who lived together as a couple for many years, worked there, as did other members of *Der Blaue Reiter*, or The Blue Rider, a movement prior to WWI that served as critical inspiration for Expressionism.

“It’s important to know exactly what properties the customer needs. That’s the only way to pick the ideal silicone, so that we can then optimize the blend with the right additives.”

Richard Heider, director of Application Technology, Silikon-Technik Siltec GmbH & Co. KG

Lena Policzka puts the final touches on her art installation. Born in 1987, the artist studied at the Akademie der bildenden Künste (academy of fine arts) in Munich.

To this day, the citizens of Murnau feel a strong affinity for the fine arts, and so in 2019 they called for proposals for a redesign of the council chamber at City Hall – a competition that Policzka won. The 33-year-old artist did not limit herself to just decorating the walls, but instead devised a complete concept for the space.

“I felt strongly about using more than just individual chamber walls as my canvas – I wanted to tie in the whole space,” says Policzka, who creates installations and sculptures. Her idea was to create a diagram representing a living discussion – one that, in a metaphorical sense, tells a story about what goes on in the chamber. “I see the municipal council as a river delta fed by citizens’ concerns. I also liked the image of a mental switchboard – a communication network with neurons and synapses. Neural pathways take information and direct it to nerve cells where it’s bundled and analyzed, and ultimately used for making decisions,” she says.

The work also needed to incorporate aspects of the landscape, which, in Murnau, is dominated by the waters of Lake Staffelsee, the moorlands and mountain chains – a panorama that the town’s painters made famous as “The Blue Land.”

To make all of that a reality, the artist quickly realized that the best way for her to express her idea was to translate it into a tapestry of tubes and connectors filled with flowing colors. Her work contains several hundred of these nodes and brackets and roughly a kilometer of tubing.

A LOOP AROUND THE ROOM

The network runs along the walls of the entire chamber, encompassing its full perimeter. The

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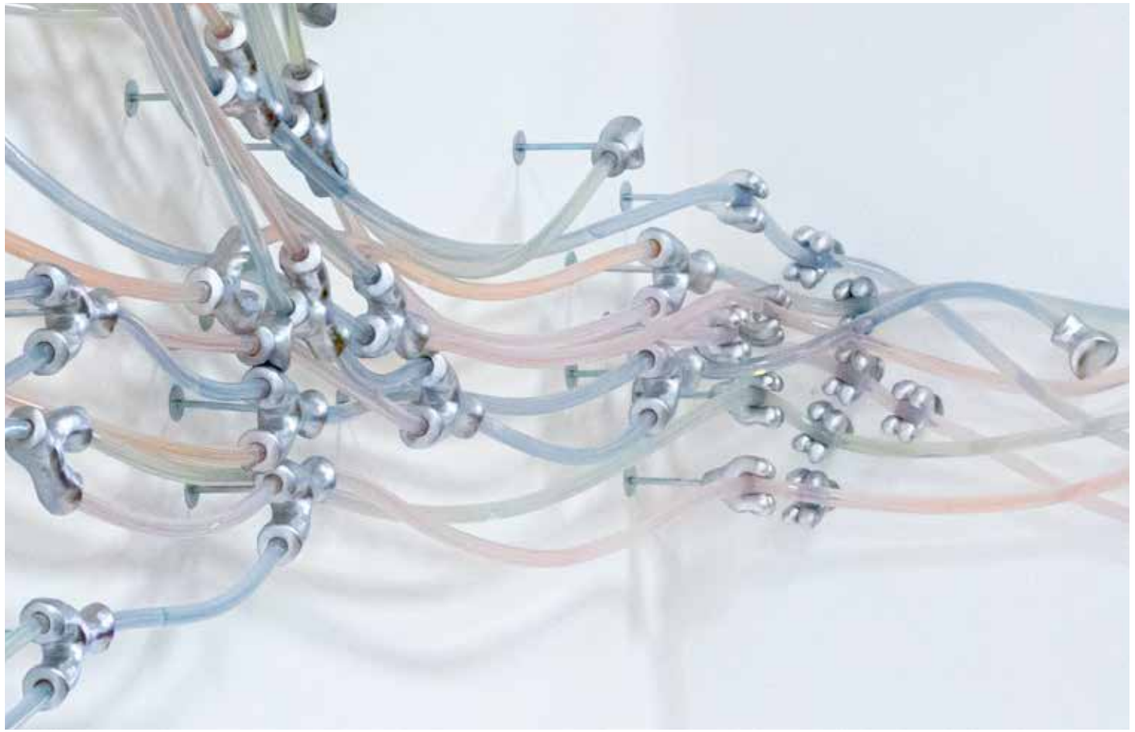


Policzka used roughly one kilometer of silicone tubing and several hundred nodes in her installation.

> "The abstract network flows in organic contours that can be reminiscent of a lot of things: sometimes a mountain chain, sometimes the cheerful play of water when you set the surface in motion, sometimes a huge neural network."
>
> **Lena Policzka**, artist

entrance to the chamber serves as both the beginning and the end of this loop – the point, in other words, where citizens' concerns enter the discussion and where decisions exit. But what materials would work for the installation? How do you make the most effective use of colors and shapes? What is actually doable? And how? "What I especially wanted was to give the impression of water flowing in the tubes. But at the same time, I also wanted to incorporate the colors of the landscape," Policzka points out.

GEL, NOT LIQUID

Filling the tubes with real liquid was not an option, however: "Pigments break down in liquids. In the end, a restorer friend of mine suggested working with silicone gels," she explains. Policzka turned to SILGEL® 612, a pourable, addition-curing, two-part RTV silicone rubber compound from WACKER. The major advantage of this silicone is that it – along with the pigments it contains – cures to form a crystal-clear material as soon as the starting materials have been mixed. Silicone is also UV resistant, which keeps it from aging or yellowing. For the artist, the tiny, entrapped air bubbles that manufacturers do their very best to prevent in industrial applications were perfect, creating the illusion of flowing water.

While it did not take long to see that silicone gel was the ideal material, the search for suitable tubing turned out to be more difficult. "It needs to be stable over a long period of time, after all – and that's not the case with PVC, which gets brittle after a while. The manufacturer could only guarantee a service life of five years, which wasn't long enough," she explains. A lengthy

The extrusion process makes it possible to produce bulk materials in a wide range of geometries and material qualities.

Modern extrusion equipment meets many different customer demands with considerable precision.

SILTEC

Founded in the late 1970s in Weiler, Germany, Silikon-Technik Siltec (www.siltec.de) and its roughly 200 employees produce silicone components for the medical technology, pharmaceuticals, food, automotive, road construction, aviation, aerospace and other specialized industries.

The company, which manufactures both molded and extruded parts, has its own compounding facilities and operates injection molding, extrusion, compression molding and transfer molding processes. In addition to standard products, its extrusion processes are also suitable for producing complex geometries, as well as coextruded and fabric-reinforced products.

Siltec technicians ensure dimensional accuracy through continuous automatic monitoring and through regular manual inspections.

search took her once again to WACKER – or, more precisely, to Dr. Christian Anger, who directs an applications technology lab for WACKER SILICONES in Burghausen.

"It's pretty unusual for someone to ask us to pick the right silicones for an art project," the chemist recalls. "But it was also a welcome departure from our routine work," he adds with a laugh. Anger normally works with silicones used in extrusion processes to make tubing for food-technology or medical applications such as urinary catheters or wound drainage systems.

UNIQUE REQUIREMENTS

He suggested Policzka try ELASTOSIL® R plus 4305 for her installation in the Murnau city council chamber. "Given what she needed, it didn't take long to decide which material to use," he says. "The tubes needed to be stable for a long time, highly transparent, colorless and odorless." Because the company is happy to support artists, WACKER also donated the silicone rubber.

Once the right material had been found, however, another company had to be involved to turn the silicone into tubing. "We provided support there too. To put it in our industry jargon, we more or less helped set up a supply chain for that part of the project," Anger explains with a grin. "There aren't that many companies out there that have the flexibility to respond to customer requests like that and can take on such small projects."

WACKER experts therefore turned to Silikon-Technik Siltec (www.siltec.de), a silicone compounder from the Allgäu region of Bavaria, bringing the company on board in February 2020. The two companies are connected through decades of partnership and collaboration. "We're not just a WACKER customer – we're regularly involved in development projects and are constantly talking with them in order to offer the best solutions we can," says Richard Heider, director of Application Technology at Siltec. "We also manufacture highly customer-specific products – and what Lena Policzka needed certainly fit that profile."

The experts at Siltec created their own formulation for the tubes, using WACKER silicone as the base material. "That's why it's important to know exactly what properties the customer needs," he added. "It's the only way to pick the ideal silicone so that we can then optimize the blend with the right additives."

The completed art installation in the council chamber of Murnau city hall is a metaphorical expression of the flow of information and lively dialogue that a democracy needs.

"We also manufacture highly customer-specific products – and what Lena Policzka needed certainly fit that profile."

Richard Heider, director of Application Technology at Siltec

The same goes for the extruder parameters – pressure, temperature, speed, processing window – which have to be set just right for the subsequent extrusion step, because these will determine the ultimate product properties. "The biggest challenge for us was to take the desired artistic qualities and translate them into quantitative, technical parameters," he recalls.

EXCEPTIONALLY TRANSPARENT MATERIAL

Another important consideration: the various colors of the silicone gels needed to be as true as possible, which required exceptionally transparent tubing with no inclusions that would get in the way. "A really smooth surface was important to me too – so not one that's a little sticky, like silicone surfaces often are," says Policzka.

That was something else the Siltec experts could do: a special surface treatment makes the tubing feel smooth, to the point of attracting almost no dust. "It was incredibly exciting to work with WACKER and Siltec and express my artistic and aesthetic vision in technical terms. I'm extremely grateful for the wonderful advice that I got from both companies," she adds.

"System: Circuit" has been in place at the Murnau city council chamber since September 9, 2020, where it serves as a visual representation of what goes on there: ideas and discussions move through the room, compromises are made, new suggestions are put forward or are rejected – until a consensus decision finally exits. A work of art, in other words, that basically expresses the soul of the space. □

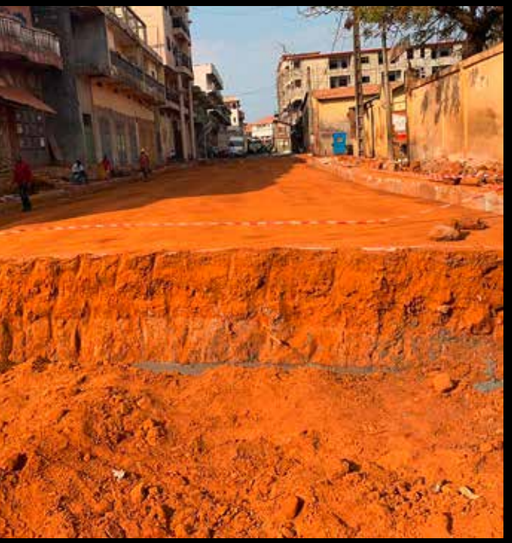
WWW 2.20 ▸ SOLUTIONS ▸ **ROAD CONSTRUCTION**

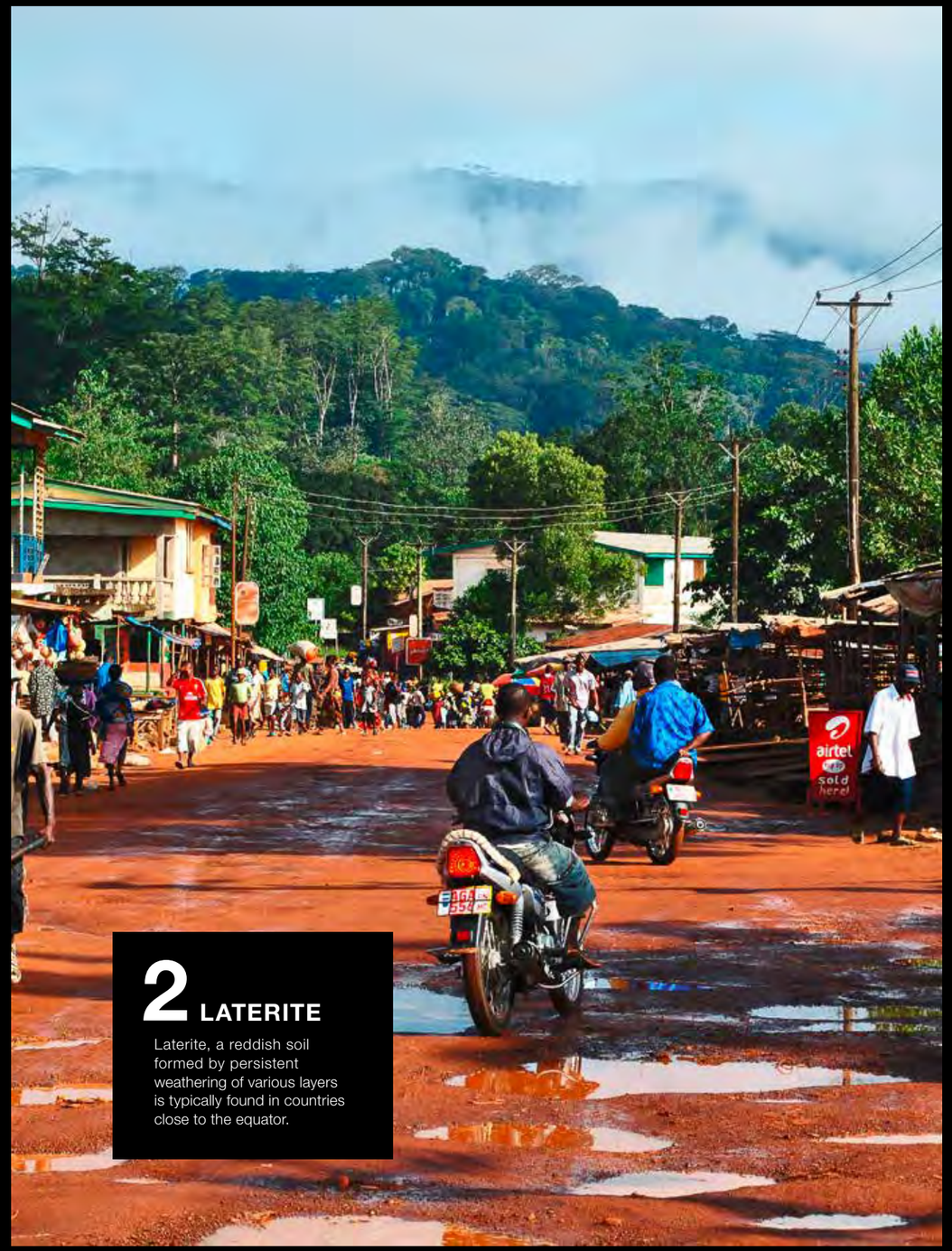
SOLID, BUT FLEXIBLE

Laterite is a reddish soil that is widely encountered in tropical regions and is popular for building roads. The load-bearing capacity, resistance and service life of such roads can be greatly increased by simultaneously incorporating cement and a polymeric dispersion into the soil. A trio of companies from Germany, New Zealand and West Africa has just demonstrated this in a joint project conducted in Guinea.

1 THE ORIGINAL ROAD

Originally, the road was just made out of laterite that was compacted with a steel roller and had neither an asphalt nor a concrete pavement.





2 LATERITE

Laterite, a reddish soil formed by persistent weathering of various layers is typically found in countries close to the equator.

3 MARKING OUT

To ensure that the calculated quantity of cement is spread evenly, rectangles are marked out on the road. Each one will be filled with a bag of cement.

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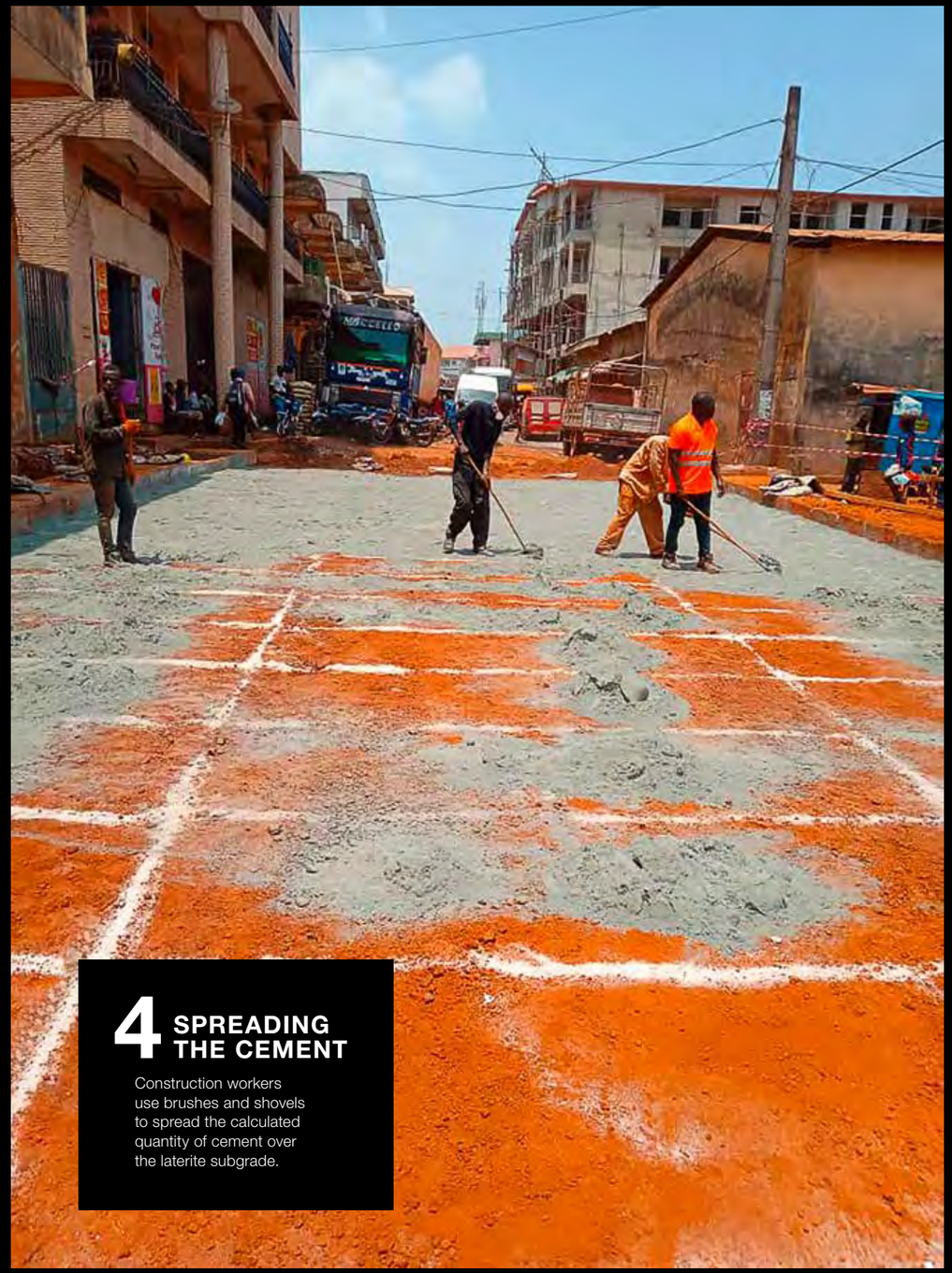
The challenges facing road-builders in countless equatorial countries are many and varied: warm, humid tropical air; high rainfall levels and thus high water tables; intense UV radiation and elevated temperatures that cause the soil to dry out quickly and turn to dust; and road networks that are often no more than compacted earth that is quickly undermined or washed away during downpours. The situation in Guinea, West Africa, is no different. Clearly, roads exposed to such detrimental effects need to be strengthened so that they can cope with all these loads and be repaired less frequently.

With applications like this in mind, WACKER joined forces with Gravel Lock NZ Ltd., a New Zealand-based supplier of building materials, to develop a soil stabilizer based on ETONIS® polymeric dispersion and various additives that can be used in conjunction with cement.

SOLID, BUT FLEXIBLE

Mixing cement with gravel, sand and water produces concrete, a high-strength building material. However, concrete is also brittle and prone to cracking and that makes its use in road building particularly problematic. Nevertheless, if a polymeric dispersion such as ETONIS® 1400 S is applied to the earth, it will develop binding forces between the particles of earth or aggregate on the one hand and the particles of hydrated cement on the other. ETONIS® 1400 S is responsible for the long,



4 SPREADING THE CEMENT

Construction workers use brushes and shovels to spread the calculated quantity of cement over the laterite subgrade.

WWW 2.20 ▸ SOLUTIONS ▸ **ROAD CONSTRUCTION**

> "The flexibility removes the brittleness from the stabilized layer, a fact which is reflected in much-improved flexural strength."
>
> **Badarul Faruqui,** Sales Manager

5 APPLYING THE DISPERSION

The VAE dispersion can now be applied. A tanker sprays it over the subgrade.

molecular structural bonds that link the mixture of earth, aggregate, cement and polymer together – the outcome is a durable, water-resistant material that is solid, but flexible.

"Due to the nature of this flexibility, the consolidated layer loses its brittleness, as evidenced by a marked increase in flexural strength," explains Badarul Faruqui, the Dubai-based sales manager for Construction Polymers for the Middle East and Africa (MEA) region. "The rehabilitated road will thus last longer and maintenance costs will be lower over the long term."

The performance capability of the ETONIS® 1400 S soil stabilizer was recently demonstrated in a pilot project conducted in West Africa by WACKER POLYMERS and Gravel Lock in conjunction with Topaz Multi Industries, a local paints and coatings company. The project concerned the resurfacing of 7,000 square meters of road in the urban sub-prefecture of Matam in Guinea – and it was completed in just two weeks.

The concrete surface course is reinforced with steel – this is a complex solution that speaks to the high quality of the road structure.

A NEED FOR SPEED

"One of the challenges was that the road is located near a busy market. Naturally, we didn't want to close the entire area for months of construction work," emphasizes Faruqui.

The advantage of the technology is that it combines several complex and cost-intensive work steps into one. The soil is chopped up and a mixture of cement and polymer dispersion is worked in evenly, before being compacted and leveled with a roller.

ETONIS® 1400 S yields very good results particularly in combination with the widespread, usually reddish laterite soil (from Latin *later* meaning brick) that is formed by persistent weathering of the underlying rock in tropical regions such as Guinea. "The polymeric dispersion boosts the resistance and load-bearing capacity of the laterite to a multiple of what it was before," stresses Faruqui.

7 THE FINISHED PAVEMENT

A concrete surface course forms the pavement, atop a resilient, yet flexible subbase of laterite, cement and ETONIS®.

> "This project is a major milestone for our Construction Polymers business and reflects our strategy of developing new business fields."
>
> **Christian Montaldier,** Regional Business Manager for Polymers

6 MULTI-LAYER STRUCTURE

The stabilized laterite subgrade is covered with a concrete intermediate course (darker-colored area) followed by a concrete surface course (lighter-colored area).

The Guinean road construction company involved managed to complete the project much earlier than planned, due to the rapid curing of ETONIS® 1400 S and the cement. In addition, the binder protects the road from penetration by groundwater. This is a constant problem in tropical countries that have high rainfall levels and water tables.

ONLINE ADVICE

The project was commissioned at the start of this year, just as global travel restrictions due to the coronavirus pandemic came into effect. On-site support by WACKER technical service engineers was therefore not possible. For this reason, the WACKER POLYMERS team in Dubai, UAE, which has responsibility for marketing on the African continent, provided online technical support for the duration of the project. The technical staff in Guinea and Dubai shared the results of various tests and soil analyses electronically and then held discussions about possible adjustments to the dosage. The original plan had been to complete the project in three to four days. Even though an online approach had to be adopted, the project was completed in just two weeks.

"We are very pleased with the results," says Dr. Bhana Sidibe, site engineer at Topaz Multi Industries. "Stabilizing the soil with ETONIS® 1400 S makes the subgrade more compact and resistant, and suppresses dust formation."

SHOWCASE FOR FURTHER PROJECTS

"This project is an important milestone for our Construction Polymers business and is in line with our strategy to develop further opportunities outside our main focus on the dry-mix mortar industry," says Christian Montaldier, regional business manager for Polymers in MEA. "With the ongoing soil stabilization projects in Kuwait and sub-Saharan Africa, this success in Guinea gives us the confidence to accelerate and expand our activities in the new segments." ■

MORE LIFT WITH SILICONES

A hot-air balloon's fabric envelope is exposed to many stresses during use – high operating temperatures, weathering, UV radiation and mechanical loads take their toll on the nylon fabric. An extremely thin silicone coating protects the textile and makes it airtight and tear-resistant.

On November 21, 1783, in front of tens of thousands of spectators, a 22-meter-high hot-air balloon took off with two men on board and covered a distance of some eight kilometers over the rooftops of Paris. This is how the history of manned aviation began. To freely soar in the air and see the world from above – this ancient dream of mankind was realized by the brothers Joseph and Étienne Montgolfier, sons of a paper manufacturer from the small town of Annonay in southern France, with their invention of the hot-air balloon.

In principle, hot-air balloons are built no different today than they were during their pioneering age. A balloon envelope, which is open at the bottom and filled with hot air, has a wicker basket attached to it that carries the people on the flight. Hot-air balloons use static lift: the hot air within the envelope is lighter than the air surrounding the envelope on the outside and is thus less dense. The balloon rises up when the buoyancy is greater than the weight that pulls the balloon down. When the two forces are balanced, the balloon floats, i.e. stays at the same altitude. If the weight is greater, the balloon sinks.

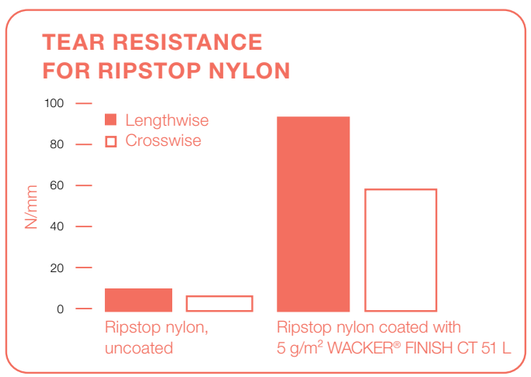
Hot-air balloons are still real eye-catchers today. The sheer size of the envelope is surprising time and again, especially when the balloon is observed up close. The pear-shaped envelope is around 20 to 25 meters high and thus as tall as a five- or six-story building; its diameter usually exceeds 16 meters. Balloons invariably attract attention when they are underway as well – due to their slow, largely silent motion, the direction and speed of which is decided by the wind. Only an occasional hissing of the burner disrupts the peace: the pilot has to fire up briefly in order to balance heat losses. In this way, he can keep the lifting force constant and the balloon floats.

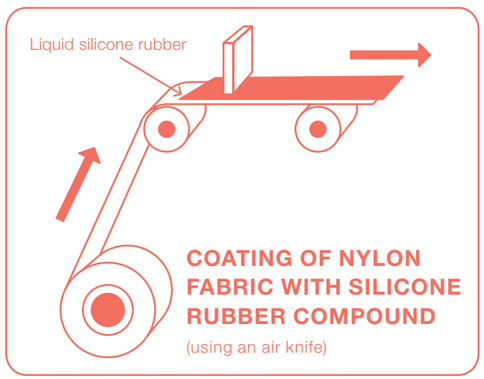
SAME PRINCIPLE, DIFFERENT MATERIAL

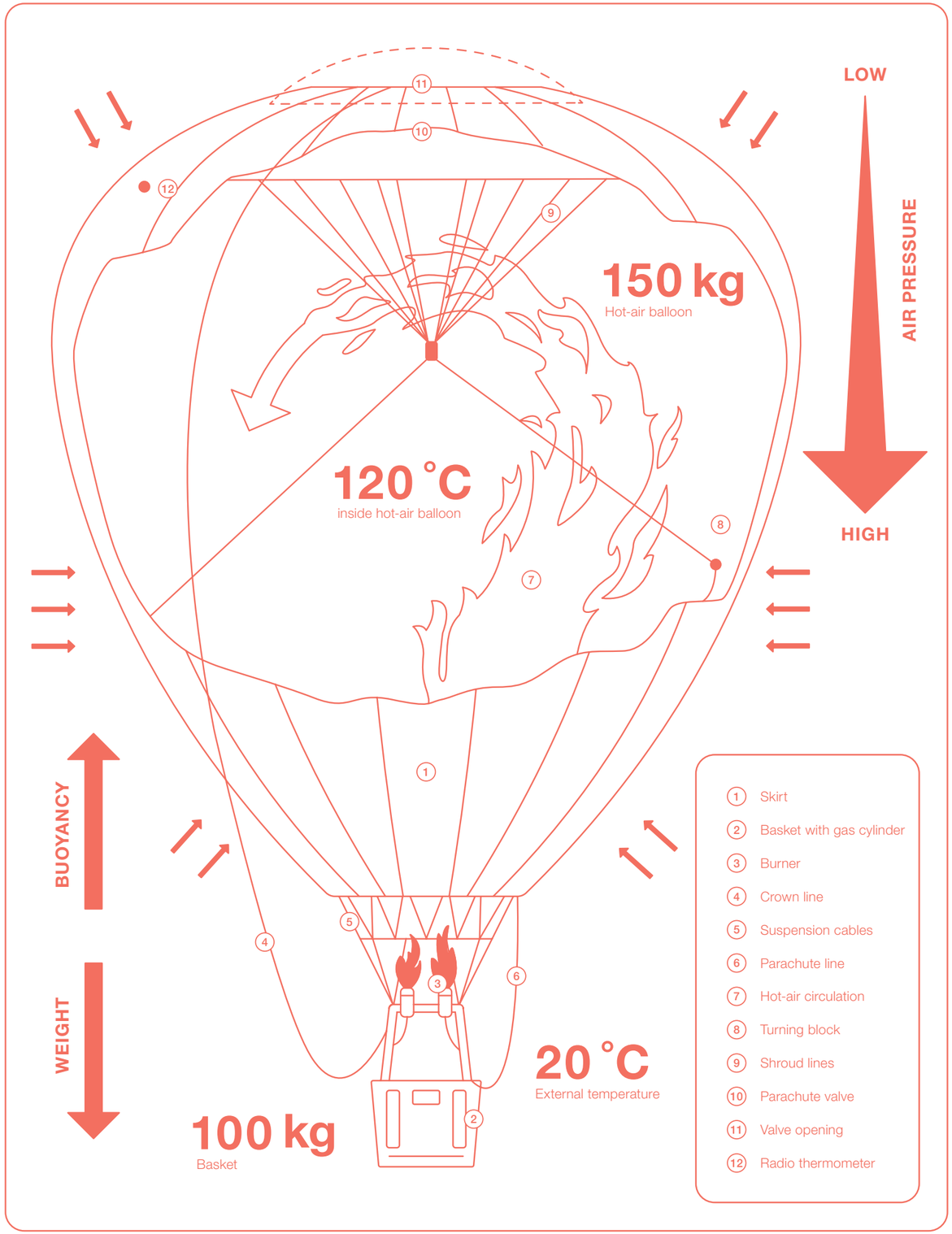
What has changed over the course of the centuries is the material from which the balloon envelope is made. The Montgolfier brothers' envelopes were made of paper and canvas. Today, balloon manufacturers mainly use coated ripstop nylon fabrics. "Silicone rubber compounds are being used more and more often to coat envelope fabrics," says Dr. Martin Bortenschlager. As a senior marketing manager at the WACKER SILICONES business

"Silicone rubber compounds are being used more and more to coat envelope fabrics. WACKER® FINISH CT 51 L has proved to be a particularly effective product."

Dr. Martin Bortenschlager, Senior Marketing Manager, WACKER SILICONES



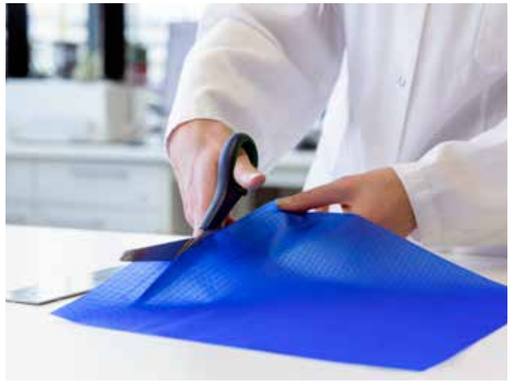




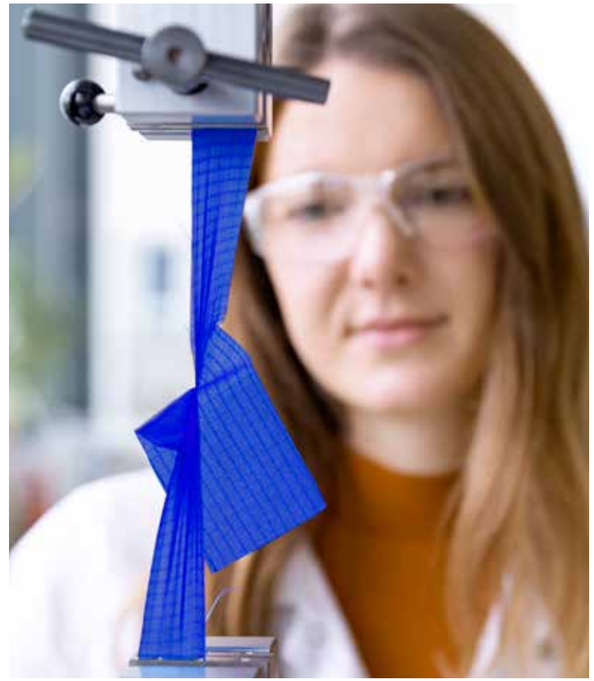
SILICONE ELASTOMERS

Silicone elastomers are rubber-elastic solids derived from polyorganosiloxanes. They are obtained from silicone rubber in a process known as curing or vulcanization. Here, the polymer chains of the organosilicon macromolecules form a three-dimensional network. Silicone elastomers are characterized by a property profile that makes them indispensable in many industrial applications: extraordinary heat resistance, low-temperature flexibility, chemical inertness and biocompatibility.

Silicone elastomers have a strongly hydrophobic, i.e. water-repellent, surface – water droplets simply roll off. Moreover, they do not absorb water, are very good electrical insulators and, with a thermal conductivity of 0.2 watts per meter kelvin, are poor heat conductors. A typical characteristic is their high resistance to a large number of physical and chemical influences, which is why, unlike organic rubber compounds, they do not age quickly. As a result, their chemical, physical and technical properties remain virtually constant between around -45 and +200 degrees Celsius; they can also withstand persistent mechanical stress and continued exposure to oxygen, ozone and ultraviolet (UV) radiation. What is more, silicone elastomers absorb UV-C and, to an extent, UV-B radiation. As coatings, silicone elastomers can permanently protect vulnerable substrates against environmental influences such as high temperatures. Since the silicone layer makes the heat transfer between the surroundings and the substrate difficult, it reduces the thermal stress on the substrate upon exposure to heat. Unlike organic coatings, it readily withstands high temperatures, remains intact even under persistent exposure to UV radiation and keeps some UV radiation away from the substrate. Nevertheless, even a silicone coating cannot offer complete UV protection.



An applications lab employee in Burghausen cuts a piece of ripstop nylon fabric to size so as to measure its tear resistance.



The test shows that the balloon fabric is able to withstand greater loads when it is coated with silicones.

division, the chemist is in charge of the textile-coating product range among other things. WACKER has a portfolio of suitable silicone products and additives at the ready for these kinds of coating applications. “WACKER® FINISH CT 51 L has proved to be a particularly effective product here,” adds Bortenschlager.

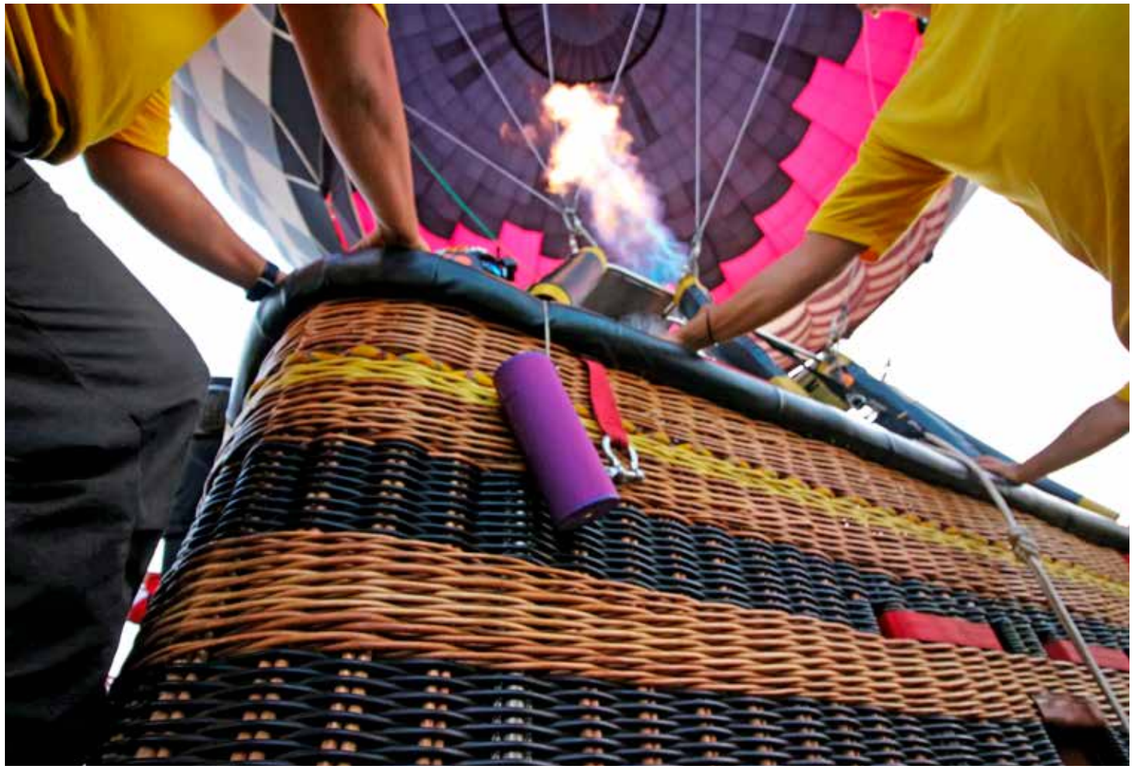
TYPICAL CHECKED PATTERN

Ripstop nylon is a tear-resistant polyamide fabric. This high-performance textile is created by incorporating thicker nylon yarns at regular intervals, which reinforce the fabric. As a result, a small tear in the fabric cannot just continue to rip unchecked, but stops at the next thicker yarn – as long as the acting tensile force is not too great. The woven-in reinforcement yarns produce the checked pattern typical of ripstop fabric.

Balloon manufacturers can choose from a number of ripstop nylon fabrics supplied by different textile manufacturers that are either coated with polyurethane or silicone. The fabric and coating that balloon manufacturers decide on to sew their envelope depends on customer requirements and expectations. The following questions, in particular, offer crucial decision-making criteria: is the balloon intended for private flights, sports competitions or commercial passenger transport? How long is the envelope expected to last?

One basic requirement must be met by all balloon envelope materials: they must be airtight. If air was to leak out from inside the envelope through fabric pores, the lift would be reduced and the balloon would sink. Uncoated nylon fabric itself is porous. The coating’s core function is to ensure the necessary impermeability. Both polyurethane and silicone coatings are up to this task.

What is more, the coating has the task of providing the balloon envelope with as long a service life as possible. Uncoated nylon fabric is not suitable for use at temperatures between 90 and 100 degrees Celsius, which are typical inside the envelope during flight. This kind of nylon is also very sensitive to ultraviolet (UV) radiation. This short-wave and thus high-energy radiation can damage polyamide fibers, causing the nylon fabric to age quickly and become brittle. In particular, silicone coatings considerably extend the service life of coated fabric. This is where the physicochemical and technical properties of silicone elastomers come in (see Silicone Elastomers box), especially their resistance to heat, radiation and aging; their low thermal conductivity;



A hot-air balloon before takeoff: the upper half of the envelope is under particularly high thermal stress – as this is where the hot air accumulates – and thus lends itself to being coated with silicone.

and their ability to repel water and absorb some of the UV radiation. A silicone coating can thus prevent rapid aging of the envelope fabric – even if the coated textile is exposed to high temperatures and direct sunlight again and again – thanks to silicone's durability.

HIGHER RESISTANCE TO THERMAL STRESS

Heat resistance is paramount here, since the inside of the fabric is in constant contact with hot air while the balloon is in flight. The upper half of the envelope, where the hot air gathers, is under particularly high thermal stress – so it's not surprising that a relatively heavy, yet highly robust, silicone-coated ripstop nylon fabric is often used for this particular area. Balloon manufacturer manuals indicate a temperature resistance for this silicone-coated fabric that's 20 to 30 degrees higher than that of polyurethane-coated envelope fabrics. This allows the pilot to heat up the air in the balloon more and thus create greater lift.

The envelope should, furthermore, not immediately tear when it is spread out after landing and pulled over the ground. If the tear strength is too low, a small hole in the fabric could trap a stone and get bigger and bigger as the envelope is dragged along. Here, too, a silicone coating offers a reliable degree of safety. It makes a ripstop nylon fabric considerably more tear-resistant than its uncoated counterpart. Tests carried out at WACKER's applications laboratory have shown this.

"The silicone elastically bonds the fabric yarns to each other so that, if there is a tear, the tensile stress is distributed across the surrounding fabric and thus across many yarns," explains Dr. Steffen Jungermann, the WACKER chemist in charge of testing. The stress on each individual yarn is thus lower and the fabric can withstand a higher tensile force. "With our product WACKER® FINISH CT 51 L, the tear resistance already increases by a factor greater than five at a coating weight of just five grams per square meter in many cases," emphasizes Jungermann, who works in technical support at WACKER SILICONES and is responsible for textile coatings. His customers include textile finishers who coat nylon fabrics for balloon envelopes.

Up to a few years ago, an envelope was seldom made entirely from silicone-coated nylon. That's because only relatively heavy silicone-coated fabrics were available. These are still popular for the upper half of the envelope today. One square meter of such a material weighs some 90 to 100 grams – an entire envelope made of such a fabric can weigh over 130 kilograms, depending on the size of the balloon. This kind of envelope is too heavy for competitive balloonists.

FOCUS ON DURABILITY

For air transport enterprises, however, the envelope weight is not of such great importance – since a commercial pilot has passengers on board, there are enough people around to actively help to prepare takeoff and lend a hand after landing. That's why entirely silicone-coated envelopes only used to be ordered, if at all, by such enterprises if durability and low repair costs were a primary focus.

Meanwhile, however, there are silicone-coated ripstop nylon fabrics available that only weigh around 45 to 70 grams per square meter, yet are highly tear-resistant. These kinds of textiles are light enough to be of interest to non-commercial pilots, too – whenever a balloon buyer values an envelope that lasts for an exceptionally long time.

More and more textile finishers are using the liquid silicone product WACKER® FINISH CT 51 L for coating these kinds of lightweight fabrics. "This product is a solvent-based silicone rubber dispersion, which our customers combine with further components – crosslinker and catalyst are a must – and solvent to produce their ready-to-use coating compounds," explains Jungermann. Once applied, the rubber compound cures to form a silicone elastomer upon exposure to heat. This makes fine coatings possible, down to coating weights of five grams per square meter.

The textile industry refers to a coating as being fine if its weight is less than 50 grams per square meter. For innovative nylon fabrics for balloon envelopes, silicone coating weights are typically 15 to 20 grams per square meter. With such low coating weights, the largest portion of the silicone is found between the individual yarns and seals the fabric's pores. Only an extremely thin layer of silicone then remains on the fabric.

The tactile properties of a nylon fabric coated finely with WACKER® FINISH CT 51 L impress balloon manufacturers and textile finishers alike. Textile engineer Pirli Gurbanmammedov, who works at Ammeraal Beltech in Switzerland as Coating & Lamination project leader, for instance, describes finely coated ripstop nylon fabric as soft, flexible and less rigid than copy paper. It has a slightly glossy and non-tacky surface that feels not at all rubber-like, but dry and smooth. He explained that this surface made it easier to spread out the balloon envelope in preparation for the next flight. At Ammeraal Beltech, fine silicone coatings of textile substrates are part of everyday life. "We've had very good experiences

> "Depending on the coating weight, the tear resistance of the fabric increases by a factor greater than five."
>
> **Dr. Steffen Jungermann,** Head of Technical Support for Rubber Solutions, WACKER SILICONES

with WACKER® FINISH CT 51 L," says Gurbanmammedov.

Fine silicone coatings are produced with an air knife that applies the silicone coating compound to the textile. The process runs from roll to roll: the material is unrolled, fed through the unit and then rolled up again. In the air-knife unit, the textile is run over two rollers that support it from underneath. A doctor blade is located in the area between the support rollers. The liquid coating compound is applied to the textile just in front of this blade. The knife is in constant contact with the fabric and presses the compound down into it. The fabric then runs through a heating tunnel in which the silicone cures to form a silicone elastomer at temperatures of up to 180 degrees Celsius.

The faster the textile moves under the air knife and the less taut it is while doing so, the thicker the coating. What's more, the coating compound's viscosity greatly influences the coating weight: the more viscous the compound, the more of it is applied. That's why the silicone coating compound is often diluted with further solvent for fine coatings. However, if the viscosity is too low, the doctor blade presses the compound through the fabric's pores. So coating companies keep the exact formulation of their ready-to-use compounds strictly confidential.

Textile finishers must thus possess a wealth of experience and expertise in order to precisely tailor their silicone coating compounds to the process and adjust their equipment correctly. It is worth the effort, though. An industry rule-of-thumb is that a balloon envelope has a service life of around 400 to 600 operating hours. If the envelope is coated with silicone rubber compounds, however, it is able to withstand the various stresses – wind, weather, hot air and sunlight – for considerably longer. Experienced balloon pilots say that 800 and sometimes even 1,000 operating hours are possible, too. ■

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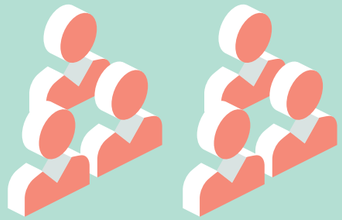
WACKER IN FIGURES

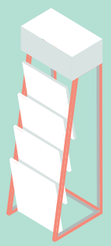
Successful customer relations are all about systematically classifying customers into segments that address each customer specifically in terms of their individual needs. Such an approach includes modern digital solutions, as well as the personal contacts established by our key account managers, who support the most important customers, and by our sales managers. Distributors represent another distribution channel. They supply a considerable number of small-sized customers with WACKER products.



Roughly
5,000
active relationships with other customers generate about 75% of Group sales.

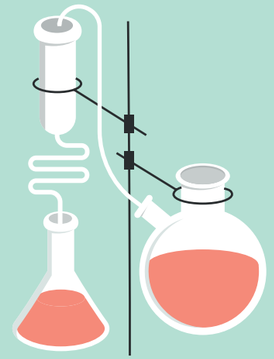
54%
of WACKER's chemical-division sales are handled via online channels.

114
tradeshows around the world were attended by WACKER in 2019.



25%
of WACKER's sales are accounted for by its distributors.

Roughly
400
sales managers work for the WACKER Group across the globe. This figure includes our key account managers, who solely or primarily support a single key customer.



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customer categories are covered by WACKER's chemical business: key accounts, regional and interregional accounts, as well as distributors, who purchase certain WACKER products and then sell them to third parties.

GENTLE CARE

Hairstyles have been shaped by fashion trends or social customs since way back when. In ancient Egypt, men shaved their heads while women curled or plaited their hair. They mainly used plants or animal fats to care for their hair or protect it from heat. A mixture of plant ash and oils were used to wash hair. Today, shampoos, conditioners and detangling agents containing BELSIL® DM 3200 E silicone emulsion take the hassle out of caring for difficult hair. The new product ensures that wet hair is easy to brush and dry hair is soft and supple.

WACKER

BELSIL® DM 3200 E is a dimethiconol emulsion that protects the scaly surface of the hair and makes it soft to the touch and easy to comb.