

WACKER

CREATING TOMORROW'S SOLUTIONS



GENIOSIL®

ADHESIVES & SEALANTS | HYBRID POLYMERS | GENIOSIL® STP-E

VERSATILITY STARTS HERE:
α-HYBRIDS FOR ELASTIC
SEALING AND BONDING

LOOKING FOR A
GREENER WORLD?



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LET'S LOOK TOGETHER!

Today the sealants and adhesives industry is caught between conflicting demands: customers seek raw materials that meet stringent environmental regulations yet do not compromise on performance. With WACKER, you are at the forefront of developments.

In our environmentally conscious world, adhesives and sealants are subject to increasingly stringent health and safety legislation. Regulatory changes across the globe require manufacturers to find substitutes for potentially harmful raw materials. Solvents, isocyanates (used as curing agents in polyurethanes) and tin compounds (used as catalysts) are under legislative scrutiny; legislation in countries across the globe is at last forcing the various markets to eliminate potentially hazardous materials from use and production.

Solutions from a Technology Leader

WACKER is not only one of the leading producers of silicones, but also one of the most research-intensive chemical companies. We have developed an exciting range of hybrid polymers based on an innovative range of organofunctional silanes as well as the α -silane chemistry unique to WACKER.

Discover the Future!

These new-generation hybrid polymers can be used as the binder for elastic sealants and adhesives that fulfill today's demands both technically and environmentally. Furthermore, they are easy to formulate, exhibit low viscosity for exceedingly efficient production, and are masters of versatility. This brochure can thus only give a glimpse of the possibilities offered. To learn more about this exciting technology, please talk to our experts.

BREAKING NEW GROUND: WACKER'S HYBRID TECHNOLOGY

As the specific disadvantages of existing technologies, such as polyurethanes, became more apparent, the greater the need became for viable alternatives. Hybrid systems began to establish themselves in various markets. With the advent of the GENIOSIL® STP-E polymer range, the shortcomings of hybrid polymers found in the market to date could be overcome. WACKER thereby succeeded in taking the hybrid concept a step further.

What Distinguishes Hybrid Polymers?

Hybrids are silane-crosslinking organic polymers that can combine advantageous properties typical of both silicones and polyurethanes. Hybrid polymers can be formulated into sealants and adhesives displaying the high elasticity attainable with silicones, – as well as additional benefits such as paintability, rapid cure and high mechanical strength. The latter property was thought to be achievable only with polyurethanes. Thus hybrids are highly versatile yet easy and safe to use.

What Makes GENIOSIL® STP-E Polymers Stand out?

Silane-modified polymers generally contain terminal silane components coupled to an organic polymer backbone, allowing curing via hydrolysis and subsequent condensation. WACKER's STP-E technology includes a new selection of silane-terminated polyethers that, via unique and patented synthesis, exhibit a number of unparalleled properties.

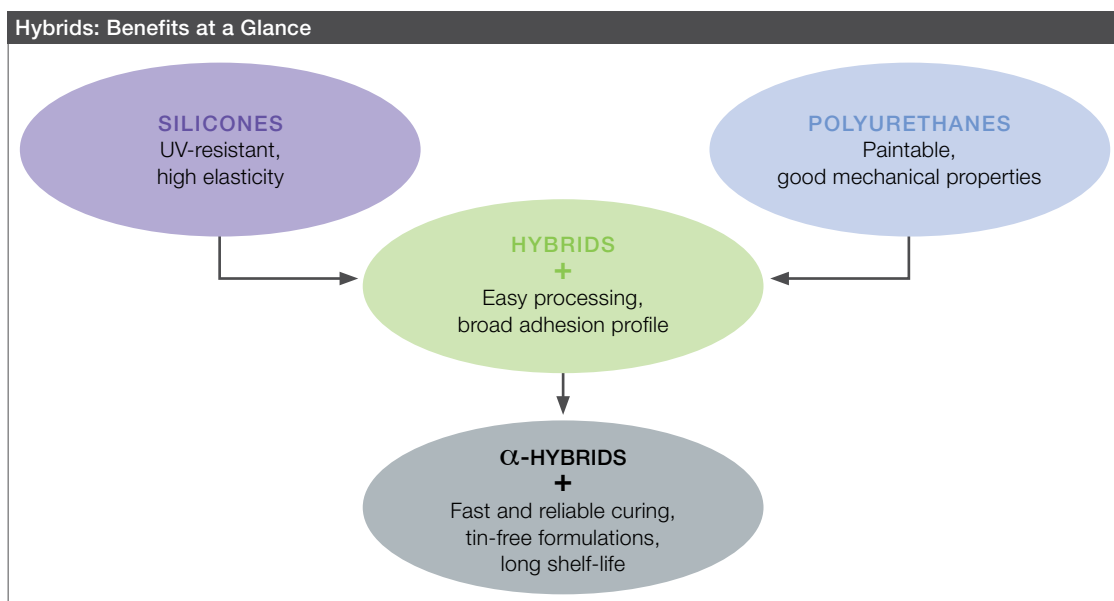
Unique Chemistry

GENIOSIL® STP-E polymers have a polyether chain as their organic polymer backbone with di- or tri-alkoxysilyl end-groups. This structure is achieved through urethane coupling, with an aliphatic bridge positioned between the urethane group and the silane component. In those grades commercially available at WACKER, this aliphatic bridge is either a methylene or a propylene group. The methylene group leads to an α -silane-terminated polyether, the propylene group results in a γ -silane-terminated polyether. (The advantages possible with α -silane-terminated polymers will be outlined later.)

For Outstanding Properties

WACKER's silane-terminated polymers render adhesive and sealant systems that build on traditional systems but which eliminate a number of drawbacks previously regarded as insuperable. The complete functionalization of the polymers during their synthesis means no residual tack in finished products. The resultant polymers are low in viscosity and easy to handle during compounding – even allowing for higher filler loading. At the same time, the systems are easy to gun. These polymers thus possess the characteristics the formulator is familiar with from existing systems – isocyanate-free, paintable, solvent-free – yet take him a step further by offering even more advantages. In 2011, the industry recognised WACKER's achievements in this area.¹⁾

¹ Frost & Sullivan New Product Innovation Award 2011



What are hybrids?
Hybrids are silane-crosslinking organic polymers that combine properties typical of both silicones and polyurethanes. They are highly versatile yet easy and safe to use as they are isocyanate- and solvent-free and – in case of the α -hybrids – do not require tin-catalysts for curing.



Application Example 1: A New Generation of Joint Sealers

Traditionally, containers and refrigeration units have been sealed with a silicone sealant, but the subsequent joint seal could not be painted. Furthermore, silicone-based systems tend to be too soft and flexible compared with an elastic adhesive that combines sealing properties with mechanical reinforcement, giving the joint the required structural stiffness. Hybrids have thus established themselves in this demanding application, where paintability, high temperature resistance and good mechanics are of the essence. Such sealers based on GENIOSIL® STP-E polymers are the product of choice in this ever-growing application area.

LOOKING FOR MORE:

GENIOSIL® STP-E

GENIOSIL® STP-E polymers allow the formulation of elastic sealants and adhesives that combine eco-friendly solutions with no compromise on technical performance. This future-oriented portfolio of products forms the perfect basis needed to substitute critical ingredients in formulations today and tomorrow.

Eco-Friendly

GENIOSIL® STP-E based formulations are isocyanate-free and solvent-free. If based on WACKER's proprietary α -silane technology, they are also both tin-free and catalyst-free. This enables the formulator to fulfill today's and tomorrow's EH&S requirements.

Cost Effective

GENIOSIL® STP-E products are fully functionalized polymers – in contrast to alternative systems available on the market. This results in systems with reduced polymer loadings that will still yield an industry-standard property profile.

Easy to Process

GENIOSIL® STP-E polymers are low in viscosity, and no heating is required e.g. when charging the mixing vessel. Heating and drying processes often found in competitive systems are unnecessary with the GENIOSIL® STP-E range, hence simplifying the entire compounding procedure.

Reproducible Quality

GENIOSIL® STP-E polymers have been synthesized via unique patented chemistry where all the polyol groups have reacted with the end-capping silane. There are no residual unreacted groups – meaning the formulator obtains polymers of consistent quality.

Universal in Use

GENIOSIL® STP-E polymers can be used to formulate systems, ranging from low-modulus, low Shore A products to high-modulus, high-strength adhesives. This opens up real scope for the formulator.

Long Shelf-Life

Despite the high reactivity of the α -polymers, the absence of problematic tin compounds in adhesives and sealants formulated with α -GENIOSIL® STP-E leads to a longer shelf-life of the finished products.

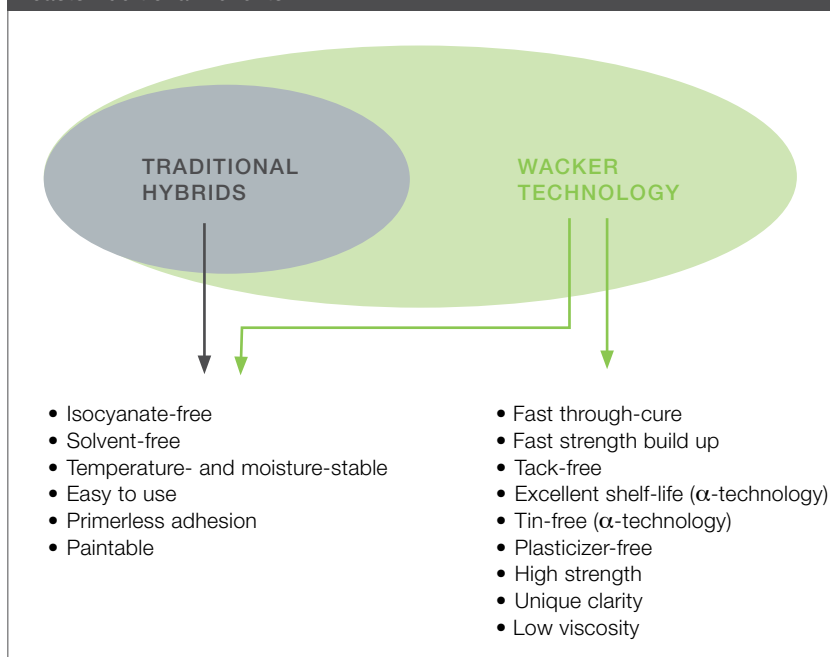
Robust Formulations

Systems based on GENIOSIL® STP-E polymers are less sensitive to moisture. Furthermore, formulations do not suffer if there is variation in the quality of the fillers.

Superior Products

- Fast-curing parquet adhesives that are simple and economic to compound
- Eco-friendly adhesives for DIY applications
- Exceedingly fast-cure yet strong industrial adhesives
- Easy-to-apply sealants for construction joints
- Universal systems that can fill, seal and bond
- High-strength assembly adhesives

WACKER's Technology Embraces the Characteristics of Traditional Hybrids yet Boasts Additional Benefits





Application Example 2: A New Generation of Assembly Adhesives

In the construction area, lighting, skirting, mirrors – to name just a few applications – essentially depended on mechanical fixation in the past if reliable mounting was required. Where previously screws were the only feasible solution, hybrid adhesives are now finding increasing use, whether to bond, assemble, or repair. To meet the specific bonding requirements, the market sought a universal solution – a system that is strong yet flexible. And the universal solution is a hybrid adhesive. Not only does it offer the technical features sought by the craftsman, but when based on GENIOSIL® STP-E polymers, it meets environmental demands by being tin- and plasticizer-free, where desirable.

VERSATILITY AT ITS BEST: THE GENIOSIL® STP-E PORTFOLIO

To date, WACKER has launched four versatile polymers suitable for an extensive range of adhesive requirements, with further new ideas in the pipeline. Application areas that have been targeted include industrial applications where sealing, bonding or filling are required.

Characteristics of GENIOSIL® STP-E Polymers		
Varying silane-capping functional groups		
	STP-E based on α -dimethoxy	STP-E based on γ -trimethoxy
Varying polyether backbone	Viscosity: ~ 10 Pas GENIOSIL® STP-E10 α – effect curing characteristics → highly versatile adhesives	GENIOSIL® STP-E15 More densely crosslinked network → high-modulus adhesives
	Viscosity: ~ 30 Pas GENIOSIL® STP-E30 High strength and elasticity → high-end performance	GENIOSIL® STP-E35 Excellent elastic recovery → high-elastic sealants

GENIOSIL® STP-E α -Grades

WACKER's α -technology allows for formulations that cure completely and rapidly and confer outstanding adhesive properties. The finished products are tin-free, and can be plasticizer-free if desired. These systems require no further catalysts, as the catalytic effect of the amino silane (included as the adhesion promoter) suffices to cure the system.

GENIOSIL® STP-E10

- Suitable for high-modulus, elastic adhesives
- Tin-free formulations – no special catalyst required
- Reliable and robust in curing
- Low viscosity, can be highly filled
- Particularly suitable for parquet adhesives

GENIOSIL® STP-E30

- Suitable for high-strength, highly elastic adhesives
- Typical α -curing characteristics
- Moderate viscosity allows for broad formulation latitude in sealants and adhesives
- Particularly suitable for transparent, elastic adhesives

GENIOSIL® STP-E γ -Grades

WACKER selected a γ -trialkoxo functional silane as the endcapper for these STP-E grades. This yields greater crosslink density, resulting in reliable recovery properties in sealants and adhesives.

GENIOSIL® STP-E15

- Suitable for high-modulus construction adhesives
- Low viscosity allowing for high degree of filling
- Swift cure possible with conventional catalysts
- Particularly suitable for parquet adhesives with greater movability requirements

GENIOSIL® STP-E35

- Suitable for elastic bonding
- Moderate viscosity allows for broad formulation latitude in sealants and adhesives
- Good recovery properties
- Particularly suitable for a wide range of elastic sealants in construction applications
- Suitable for low-modulus sealants in construction



Application Example 3: A New Generation of High-End Adhesives and Sealants

In the marine sector, hybrid adhesives and sealants based on GENIOSIL® STP-E polymers are now favoured over the polyurethanes traditionally used. The latter confer bonding strength but can be messy to work with, quite apart from the associated toxicity issues currently under scrutiny. And in applications where dissimilar materials require bonding, hybrids are now the system of choice, with an excellent adhesion profile across a number of challenging substrates.

QUICK AND EASY: PROCESSING GENIOSIL® STP-E

Adapting formulations or starting up with a new technology can often be a daunting task. Not so with the GENIOSIL® STP-E polymer range. In contrast to alternative silylated polymers available on the market, compounding with the STP-E range is exceedingly straightforward. Production of a batch can take less than an hour and even swifter depending on the chalks and thixotropic agents used.

Low Viscosity

GENIOSIL® STP-E polymers are available in low-viscosity versions which enable the formulator to increase the number of batches per manufacturing day. They can be formulated plasticizer-free if required.

Cold Process

Mixing of the polymer with the remaining ingredients takes place at room temperature without heat, thus allowing the formulator to increase the number of batch cycles per day.

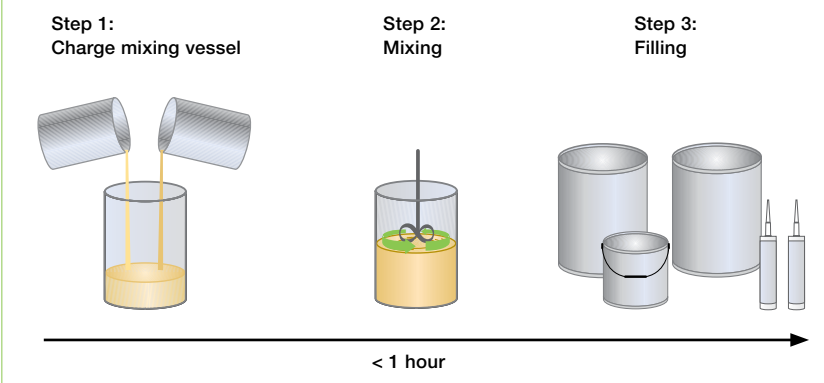
Standard Equipment

Virtually any standard equipment is suitable for the compounding of GENIOSIL® STP-E polymers. Entering the manufacturing of hybrid adhesives and sealants thus requires no new investments in mixing equipment.

Compounding Benefits at a Glance

- No heat activation in the mixing vessel required
- No pre-drying of fillers
- No moisture monitoring during mixing
- No specific compounding parameters
- No special raw materials
- No hazardous ingredients
- No critical control of additives when charging vessel

Fast and Easy Compounding Process





Application Example 4: A New Generation of Wood Flooring Adhesives

Many countries in Europe have chosen to replace solvent-based adhesives following numerous accidents during application. Polyurethanes briefly offered the alternative the market was looking for. In the meantime, however, toxicity issues have called polyurethanes into question, and the use of monomeric isocyanates as a curing mechanism is under intensive scrutiny by EU legislators. Hybrid adhesives have now established themselves in this application. The craftsman has a viable alternative, is no longer exposed to sensitizing by-products, and finds the adhesive easy to apply. Parquet adhesives based on GENIOSIL® STP-E require less polymer than other hybrid polymers – without compromising on performance and positively impacting formulation costs. Additionally, the formulation can be both Sn-free and DBU (Diazobicycloundecene)-free, yet exhibit superior mechanics as well as swift curing.

GETTING STARTED: TYPICAL FORMULATIONS

Formulating with the GENIOSIL® STP-E range allows high versatility and is exceedingly simple. Some exemplary formulations shown below demonstrate this simplicity, yet are only illustrative. If you are interested in getting started, please contact us for further information and advice. Our technical staff looks forward to sharing its expertise.

Universal Adhesive – Typical Formulation

GENIOSIL® STP-E10	15.0%
Plasticizer (PPG*)	24.8%
Water scavenger (GENIOSIL® XL 10)	1.0%
Filler – ground marble (5 µ)	54.0%
Pyrogenic silica (HDK® H18)	3.0%
Stabilizers	0.2%
Adhesion promoter/catalyst (GENIOSIL® GF 96)	2.0%

Universal Adhesive – Properties

Skin-formation time (min) 23 °C/50% r.h.	30
Tensile strength at break (N/mm ²) ISO 37 – rod1	2.0
Elongation at break (%) ISO 37 – rod1	150
Shore A hardness ISO 868	50

Crystal-Clear Sealant – Typical Formulation

GENIOSIL® STP-E30	49.5%
Plasticizer (PPG*)	34.0%
Water scavenger (GENIOSIL® XL 10)	2.0%
Pyrogenic silica (HDK® H18)	12.0%
Stabilizers	0.5%
Adhesion promoter/catalyst (GENIOSIL® GF 96)	2.0%

Crystal-Clear Sealant – Properties

Skin-formation time (min) 23 °C/50% r.h.	40
Tensile strength at break (N/mm ²) ISO 37 – rod1	2.0
Elongation at break (%) ISO 37 – rod1	300
Shore A hardness ISO 868	35


Elastic Sealant – Typical Formulation

GENIOSIL® STP-E35	25.0%
Plasticizer (PPG*)	25.0%
Water scavenger (GENIOSIL® XL 10)	2.0%
Filler – fine coated GCC	21.8%
Filler – ultrafine coated PCC	21.8%
Pyrogenic silica (HDK® H18)	2.0%
Stabilizers	0.2%
Adhesion promoter (GENIOSIL® GF 96)	1.0%
Catalyst (dioctyltin dilaurate)	0.2%

Elastic Sealant – Properties

Skin-formation time (min) 23 °C/50% r.h.	30
Tensile strength at break (N/mm ²) ISO 37 – rod1	2.5
Elongation at break (%) ISO 37 – rod1	600
Shore A hardness ISO 868	35

* Polypropylene glycol



Application Example 5: A New Generation of Versatile Adhesives

When low maintenance is a must for a sports arena, the use of artificial turf is now favoured, with such pitches displaying greater resistance to wear than natural covering. Here too, hybrid adhesives are displacing polyurethanes – the latter being problematic to apply where extreme temperatures and high moisture conditions prevail. Using a hybrid adhesive means moving from a 2-K to a 1-K system, thus reducing potential mixing-ratio errors. Reduced installation time, as well as bonding reliability, also promote the increasing use of hybrid adhesives for this application.

GREATER FORMULATION LATITUDE WITH APPROPRIATE RAW MATERIAL SELECTION

Products that can be formulated range from a low-modulus sealant to a high-strength adhesive.

GENIOSIL® STP-E Polymers: Advantages at a Glance

Formulator advantages:

- No tin catalysts = no requirement to store hazardous materials in specially designated warehousing
- Simplicity of formulation using essentially standard equipment (planetary mixers)
- Low viscosity – fast batch times, easy mixing
- Robust formulations, thus no specific complications when mixing

End-user advantages:

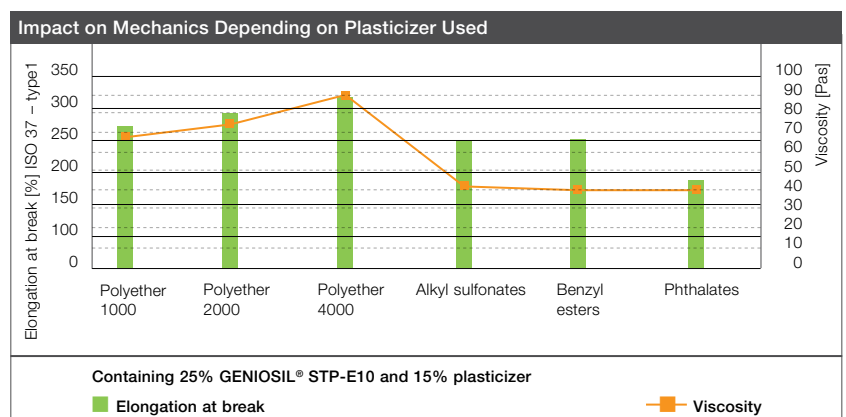
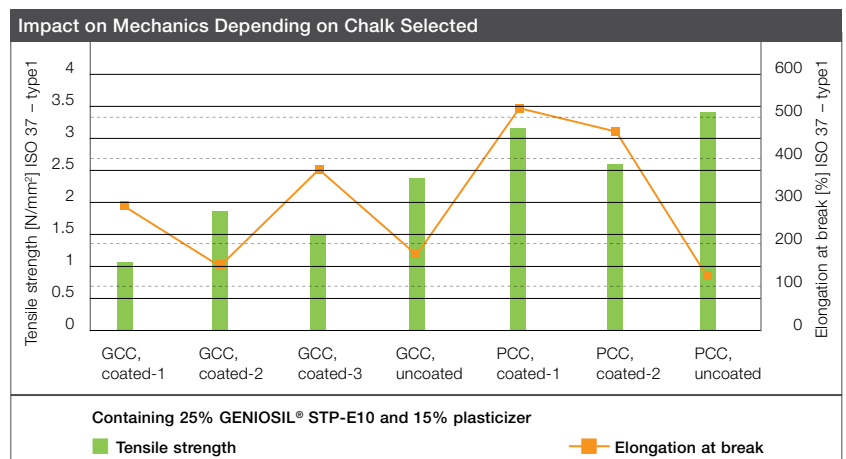
- One-part system, no risk of mixing-ratio errors
- Solvent-free
- Universal products for a multitude of applications
- Easy to gun and work with

Our Expertise in Raw Material Selection

In contrast to alternative polymer sealants and adhesives, hybrid systems benefit tremendously by incorporating chalk (calcium carbonate). These are not added merely to extend an adhesive or sealant (filler function); as a result various chalk types were screened – e.g. ground calcium carbonate (GCC) and precipitated calcium carbonate (PCC) – and their impact on the end product's mechanics was cataloged.

Not only the type of chalk selected will impact the mechanics of a given adhesive or sealant, the choice of plasticizer will influence elongation at break and, naturally, the viscosity of a given system. Polypropylene glycol plasticizer grades were examined due to their compatibility with the GENIOSIL® STP-E polymers. Their higher viscosity leads to softer formulations as opposed to phthalates, where harder systems result.

The harder the system, the greater the loss of elongation. As the plasticizer can impact the adhesion profile, the final choice will depend on the targeted application as well as the substrate and surface requirements.



EXPERTISE AND SERVICE NETWORK ON FIVE CONTINENTS



WACKER is one of the world's leading and most research-intensive chemical companies, with total sales of €4.91 billion. Products range from silicones, binders and polymer additives for diverse industrial sectors to bio-engineered pharmaceutical actives and hyperpure silicon for semiconductor and solar applications. As a technology leader focusing on sustainability, WACKER promotes products and ideas that offer a high value-added potential to ensure that current and future generations enjoy a better quality of life based on energy efficiency and protection of the climate and environment. Spanning

the globe with five business divisions, operating 25 production sites, WACKER is currently active in over 100 countries. The Group maintains subsidiaries and sales offices in 29 countries across Europe, the Americas and Asia – including a solidly established presence in China. With a workforce of 17,200, WACKER sees itself as a reliable innovation partner that develops trailblazing solutions for, and in collaboration with, its customers. WACKER also helps them boost their own success. Our technical centers employ local specialists who assist customers worldwide in the development of products

tailored to regional demands, supporting them during every stage of their complex production processes, if required. WACKER e-solutions are online services provided via our customer portal and as integrated process solutions. Our customers and business partners thus benefit from comprehensive information and reliable service to enable projects and orders to be handled fast, reliably and highly efficiently. Visit us anywhere, anytime around the world at: www.wacker.com



WACKER

Wacker Chemie AG
Hanns-Seidel-Platz 4
81737 München, Germany
Infoline: +49 89 6279-1741
info@wacker.com

www.wacker.com

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