

WACKER

CREATING TOMORROW'S SOLUTIONS

GENIOSIL®

ADHESIVES & SEALANTS | SILANE MODIFIED POLYMERS

FORMULATING THE FUTURE
WITH GENIOSIL®

α -HYBRID POLYMERS RESPONDING TO FUTURE TRENDS

Silane modified polymers (SMPs) continue to grow in adhesive, sealant and coating applications across the globe. Whereas sealants and adhesives generally see only single digit growth across all applications and systems, SMPs often enjoy 2-digit growth in many parts of the world.



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As ecological and performance requirements increase, the range of candidate adhesives and/or sealants decreases – if all such demands must be taken into account. With SMPs, applications can be addressed where previously only hazardous products appeared to offer the solution sought.

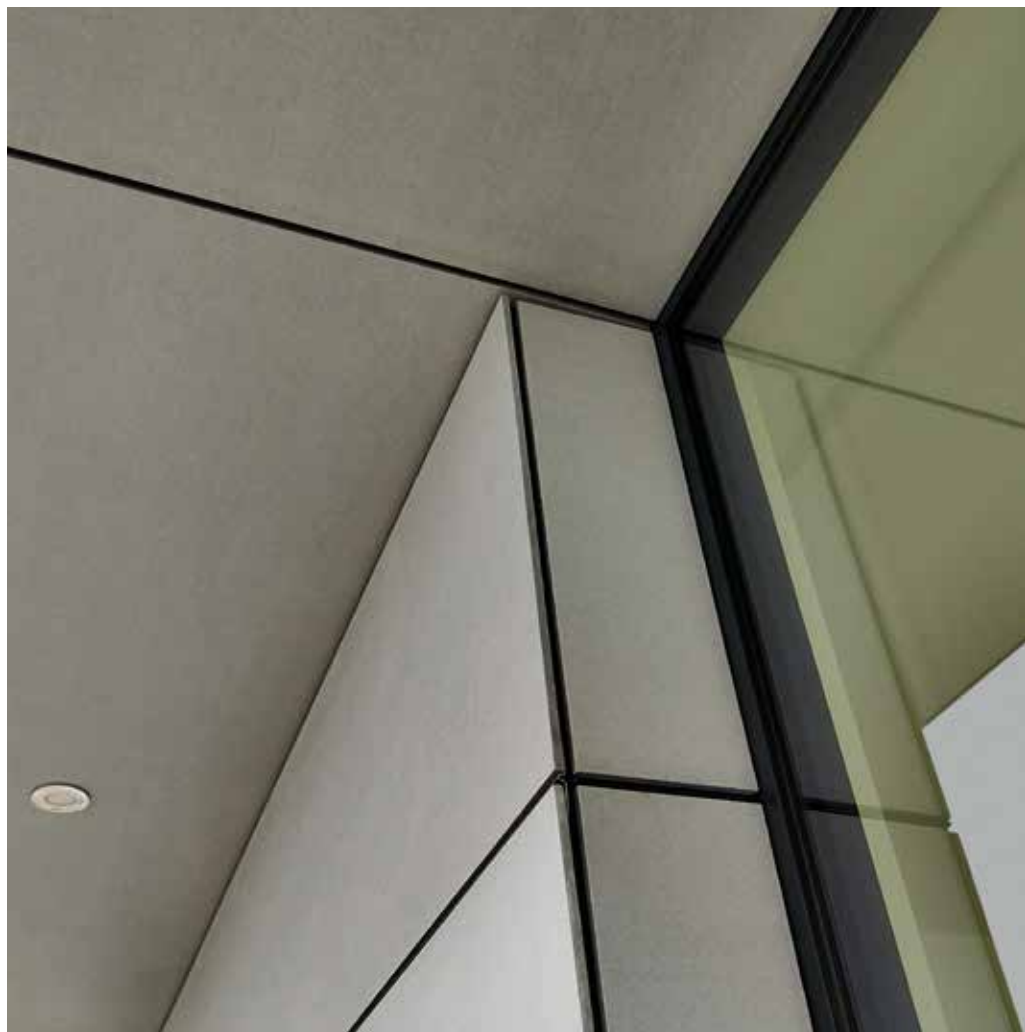
A brief overview of state-of-the-art adhesive, sealant, coatings applications.

CONSTRUCTION ASSEMBLY ADHESIVES & SEALANTS

Typical adhesives used for construction substrates are now subject to stringent scrutiny by various safety authorities across Europe. SMP based concepts are increasingly favoured due to their versatility, broad adhesion profile and ecologic acceptance.

Candidate Polymers:
GENIOSIL® STP-E10, GENIOSIL® STP-E35

Typical Properties & Features Attainable				
	Shore A 35		Shore A 55	
System	Filled	Transparent	Filled	Transparent
Tensile Strength [N/mm ²]	2.3	1.6	2.1	3.8
Elongation at Break [%]	500	250	350	200



LOW MODULUS SEALANTS



The construction sector looks to hybrid systems when it comes to bonding and sealing facades where the ISO standard 11600 Class 25 [Class 25 LM / Class 25 HM] with defined recovery values are required. Alternative systems were used for decades, but these often saw drawbacks. Depending on the porosity of a substrate, some sealants were suitable, others not. If the façade displayed residual moisture (concrete) this also proved problematic for some technologies. If the applicator is now seeking a sealant that

meets the typical standards with respect to recovery, adheres to a variety of substrates – ideally without primer, can tolerate painting if desirable, he will reach for a hybrid. Low modulus sealants typically find application in a building that is naturally exposed to movement. The sealant must not exhibit greater strength than the material held together and is thus the ideal solution for exterior and interior applications. Typical applications include perimeter sealing of u-PVC windows, doors or concrete panel elements.

Candidate Polymers:
GENIOSIL® STP-E35, GENIOSIL® XM 25

Typical Properties & Features Attainable		
	Shore A 25	Shore A 25
System	Filled	Filled
Tensile Strength [N/mm ²]	1.0	1.6
Elongation at Break [%]	800	900
Recovery [%]*	> 65 / > 75	> 75 / > 85
Modulus 100% [N/mm ²]	< 0.4	< 0.3

* DIN EN ISO 11600 F – Class 25 LM, Recovery methods A & B acc. to ISO 7389





MOISTURE VAPOR DIFFUSION RETARDER

Certain resins, traditionally used to bind subfloor screeds are being increasingly displaced for toxicological reasons. SMP based moisture vapor barriers are finding their place on the market, where a barrier against residual capillary humidity is needed. These applications now favor SMPs as an alternative that sees no compromise on performance, yet endeavours to consider ecological and toxicological requirements on the building site.

Candidate Polymers:
GENIOSIL® XT, GENIOSIL® XB, GENIOSIL® STP-E

Typical Properties & Features Attainable		
	Filled	Transparent
Hardness Shore D	68	33
Sd [m]	1	0.5
Tensile strength [N/mm ²]	6.3	5.6
Elongation [%]	0	5
Brookfield Viscosity Spindle 6 50 rpm [mPas]	~ 6000	~ 500
Skin Formation Time [min]	22	64



PARQUET ADHESIVES

As we all become ecologically conscious yet do not wish to compromise on quality, we see the SMP technology dominating today's European parquet adhesive market. A parquet adhesive must be simple and straightforward to apply. Worker exposure to hazardous components is constantly under evaluation. Wood is a living material so the adhesive must display strength yet exhibit movement capability. Taking all these components into consideration sees SMP based parquet adhesives now the product of choice – certainly in the main European markets.

The DIN ISO 17178 assigns a parquet adhesive into 3 categories as outlined in the table to the right. An adhesive based on one of the GENIOSIL® STP-E grades will meet these DIN ISO 17178 requirements. If a high-end wood type has been selected for flooring and it is desirable that the adhesive does not leach out, plasticizer-free formulations are possible without impairing spreadability and peak formation of the adhesive.

Candidate Polymers:

GENIOSIL® STP-E15, GENIOSIL® STP-E10, GENIOSIL® XM 25, GENIOSIL® XB502

Typical Properties & Features Attainable			
	Elastic	Hard Elastic	Hard, Plasticizer Free
Lap Shear 3d/28d [N/mm ²]	1.7 / 2.8	2.3 / 2.6	3.5 / 4.0
Viscosity 1s-1/25s-1 [Pas]	261 / 58	133 / 22	124 / 50
SFT [min]	60	31	50





NON-STRUCTURAL ADHESIVES



Wood adhesives found for years on the market only met D4 standards if the systems used conventional isocyanates. Whether as a 2 component PVAc adhesive or a polyurethane system only these concepts could achieve the stringent requirements of the EN 204 standard. Meantime alternatives were required as issues with health and safety saw the isocyanate topic gain momentum.

Especially developed silylated polymer grades give the strength values needed whether for wood bonding or more challenging for dissimilar material bonding. The latter is found increasingly in the furniture sector where modern designs see the use of glass and / or metal bonded to wood. In the event that a strong yet elastic bond is required, here too Wacker has invested extensive developmental work to meet such industry needs.

Candidate Polymers:

GENIOSIL® XB 502, GENIOSIL® XT 50, GENIOSIL® STP-E

Typical Properties & Features Attainable		
	Unfilled	Filled
Skin Formation Time [min]	70	33
Viscosity [mPas]	3.000	80.000
D4/1 – dry storage [N/mm ²]	11,6	14,3
D4/3 – cold water storage [N/mm ²]	4,1	5
D4/5 – hot water storage [N/mm ²]	4,3	4,1
Watt 91 – heat storage [N/mm ²]	10,6	10,1

ELASTIC INDUSTRIAL STRONG BONDING

With the success of the new range of SMPs for strong bonding adhesives, the next challenge addressed was a polymer that could achieve outstanding tear strength properties yet still exhibit elasticity. Such properties were never believed possible with hybrid technology. Now adhesives and/or sealants could be formulated with strength values of $> 10\text{N/mm}^2$ which are also elastic [500% and more if desirable]. This meant that applications such as windscreen adhesives [aftermarket] or adhesives exposed to dynamic stress could now think to use hybrid systems. The resultant properties displayed characteristics traditionally only synonymous with polyurethane chemistry.

Candidate Polymers:
GENIOSIL® STP-E, GENIOSIL® XT

Typical Properties & Features Attainable		
	Filled (chalk)	Filled (carbon black)
Hardness Shore A	55	65
Tensile strength [N/mm ²]	5	6
Elongation [%]	700	600
Tear Resistance [N/mm]	30	40



HIGH TACK ADHESIVES

For many years now mechanical fastening has been increasingly replaced by chemical bonding such as an adhesive. The market has now recognized that such adhesives must be strong, environmentally friendly without toxic emissions with no compromise on performance. Based on this, SMP based adhesives have proven to be a viable alternative. Such adhesives that exhibit high tensile strength and outstanding green strength based on SMPs are favored on a construction site so as to reduce time and ensure maximum savings.

Candidate Polymers: GENIOSIL® STP-Es

Typical Properties & Features Attainable

Hardness Shore A	85
Tensile strength [N/mm ²]	4.0
Elongation [%]	100
Skin Formation Time [min]	5 – 20



WATERPROOFING MEMBRANES

Communities and municipalities constantly look to sustainable and ecologically viable solutions when it comes to roofing, roofing terraces or patio refurbishment for public buildings as well as residential housing. Alternative concepts either require particular annual application training of the craftsman or see the craftsman kitted out in extensive personal protection equipment. SMP based membranes became the accepted alternative – membranes until recently could only be applied if these contained high amounts of flammable solvents. As governments looked to ban such questionable concepts, an

SMP based membrane became possible as the market saw the launch of an SMP that was low in viscosity and was still capable of fulfilling the ETAG 005 construction standard. The resultant membrane not only met today's ecological requirements, but could be formulated tin free, thus taking into consideration future legislative issues. Continued developments saw additional alpha based polymers introduced. These could provide the solution where waterproofing of patios or balconies was sought where high traffic and a resultant high strength coating with outstanding clarity is needed.

Candidate Polymers:

GENIOSIL® WP1, GENIOSIL® XT 50

Typical Properties & Features Attainable

	Filled	Transparent
Hardness Shore A	68	82
Tensile strength [N/mm ²]	2.3	8.8
Elongation [%]	250	250
Brookfield Viscosity Spindle 6, 50 rpm [mPas]	~ 5000	~ 800
Skin Formation Time [min]	35	95



ADHESIVES FOR LOW SURFACE ENERGY SUBSTRATES

Now that the world looks to using lighter materials, whether in the automotive sector to reduce fossil fuel usage or in residential applications, we now see various plastics used where previously wood, glass or metal were favoured – window & door frames of uPVC, polycarbonates instead of glass for housing, non-polar plastics in automotive interiors. With the move to the use of such plastics, the more difficult it becomes to bond these materials without compromising on performance. To achieve good bonding to such low surface energy substrates, special silylated polymers were developed which display outstanding adhesion properties.

Candidate Polymers:
GENIOSIL® STP-E; GENIOSIL® XM 20; GENIOSIL® XM 25

Typical Properties & Features Attainable			
	Polyether	Trimellitate	GENIOSIL® XM 20
Skin over Time [min]	15	10	40
Elongation [%]	350	250	350
Elongation 100% [N/mm²]	1.5	1.7	1.5
Tensile Strength [N/mm²]	2.6	2.5	2.5
Shore A	47	51	45

Adhesion Profile on Various Substrates						
	Polyether		Trimellitate		GENIOSIL® XM 20	
	dry	wet	dry	wet	dry	wet
PMMA	-	-	+	+	+	+
PMMA filled	-	-	+	+	+	+
ABS	-	-	-	-	-	-
PVC	-	0	-	-	+	+
PC	+	-	+	0	0	+
PS	-	-	-	-	+	+

- Adhesive failure
- + Cohesive failure
- 0 Partial cohesive failure

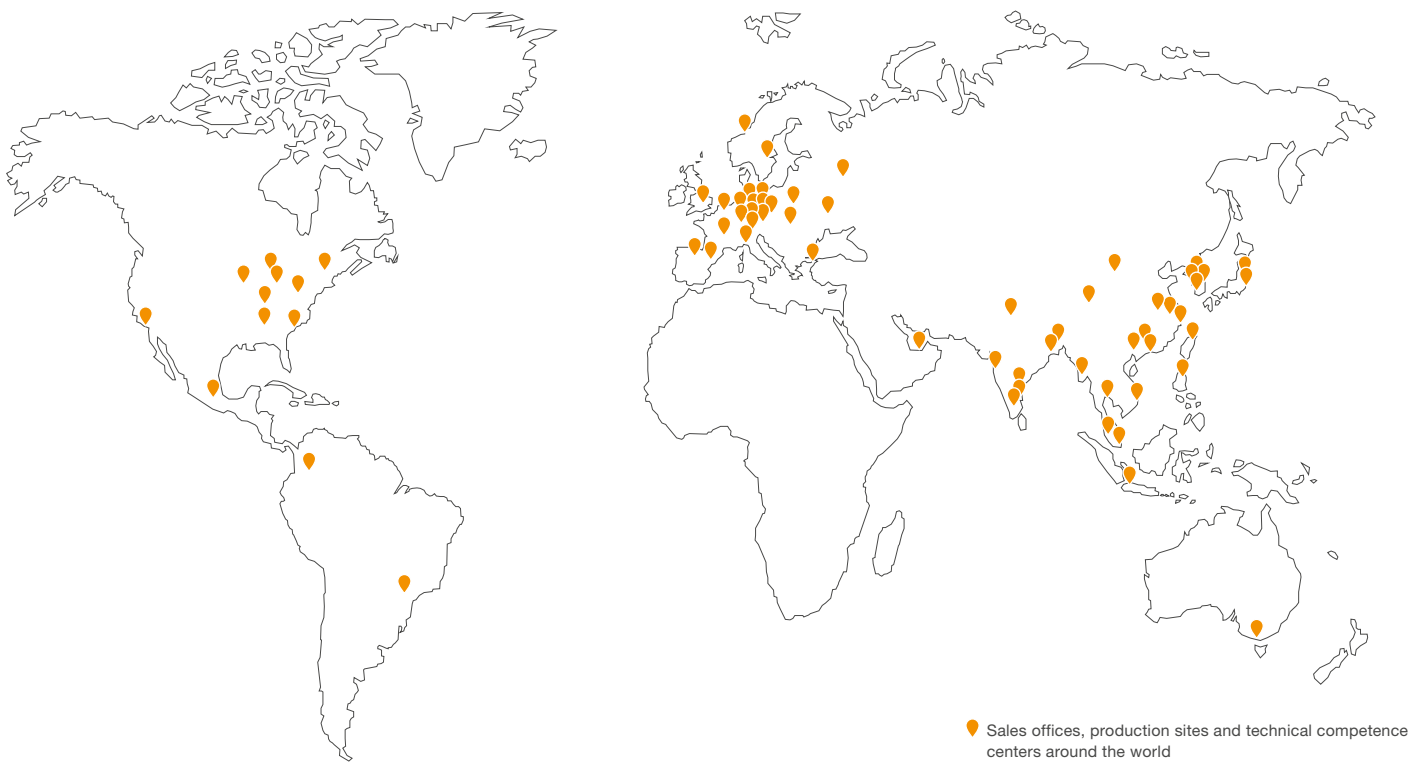
Using GENIOSIL® XM 20 in place of a typical plasticizer in standard sealant formulations sees improved adhesion profile on many plastics, the mechanical properties are comparable to those attainable with industry standard plasticizers.



Your Wacker Sales and Technical Service team will be happy to respond to your specific questions and offer expert guidance when it comes to formulation selection.



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 €4.93bn. Products range from silicones, binders and polymer additives for diverse industrial sectors to bioengineered 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 4 business divisions, we offer our customers highly-specialized products and comprehensive service via 24 production sites, 23 technical competence centers, 14 WACKER ACADEMY training centers and 51 sales offices in Europe, North and South America, and Asia – including a presence in China. With a workforce of some 14,700, we see ourselves as a reliable innovation partner that develops trailblazing solutions for, and in collaboration with, our customers. We also help them boost their own success. Our technical competence 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



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