

ULTRASIL®

Coupsil®

Silica/Silane System for the Rubber Industry

Silica and silanes for
technical & special rubber applications



SELECTED PRODUCT PORTFOLIO

PRECIPITATED SILICA	FUNCTIONAL SILANES
HIGHLY DISPERSIBLE SILICA	SULFUR FUNCTIONAL SILANES
ULTRASIL® 9100 GR ULTRASIL® 7000 GR** ULTRASIL® 5000 GR ULTRASIL® 4000 GR	Si 69® Si 264™
STANDARD SILICA	SILANE ADMIXTURES
ULTRASIL® VN3** ULTRASIL® VN3 GR** ULTRASIL® VN2** ULTRASIL® VN2 GR** ULTRASIL® 360**	X 50-S® Si 466™ EXT
CALCIUM SILICATE	SILANE TREATED SILICA
ULTRASIL® 880**	COUPSIL® 8113 COUPSIL® 8113 GR COUPSIL® 6109 COUPSIL® VP 6411 COUPSIL® VP 6508
SODIUM ALUMINIUM SILICATE	RESORCINOL ADMIXTURES
ULTRASIL® AS 7**	COFILL® 11
FUMED SILICA	NON-SULFUR FUNCTIONAL SILANES
AEROSIL® 380 AEROSIL® 300 AEROSIL® 200 AEROSIL® 150 AEROSIL® R 7200 AEROSIL® R 972	Dynasylan® VTEO Dynasylan® GLYEO Dynasylan® MEMO Dynasylan® AMEO Dynasylan® CPTEO Dynasylan® 6498 Dynasylan® 6598
PRECIPITATED SILICA FOR SENSITIVE APPLICATIONS	
SIPERNAT® 2200* SIPERNAT® 160* SIPERNAT® 160 PQ* SIPERNAT® 50* SIPERNAT® 50S* SIPERNAT® 22* SIPERNAT® 22S* SIPERNAT® D17* SIPERNAT® 340	

* HACCP conform ** Food Contact approved from selected production plants

When it comes to rubber, we are continuously shaping our product portfolio and application know-how to meet our customers' challenges. The rubber team of Evonik is backed with a full range of silica and silane products and is ready to provide technical support to tailor-design compounds according to your specific needs of reinforcement.

Our precipitated silica and silicates are known under the brand name ULTRASIL®. As the only world-wide supplier with silica and silane, Evonik offers various silane products like e.g. Si 69® and COUPSIL® which are well suited for numerous mechanical rubber goods. Our fumed silica products sold under the brand name AEROSIL® complement the product portfolio of reinforcing white fillers for this industry.

Precipitated and fumed silica can contribute significantly to rubber performance in many applications providing unique benefits. Due to the high surface area and the chemical nature, synthetic amorphous silica provides excellent reinforcement potential and enables you to compound coloured or transparent rubber articles with high strength and durability. Depending on the required reinforcement and necessary processability, the right silica can be chosen from our product portfolio adding excellent tear properties to your rubber articles.

With the use of the right organosilane, the reinforcement capabilities of silica in rubber compounds are brought to an optimum. Chemical crosslinks between two otherwise non reacting materials are formed during mixing and vulcanization. Even if used in polar rubbers like NBR or ACM, which are compatible with the polar silica, an additional silane coupling reaction – taking place from 120°C onwards – enhances the strength and the durability of the compound.

Depending on the required reinforcement level the silane dosage needs to be adjusted. Typical silane concentration for mechanical rubber goods varies between 2 to 6 phf.

By offering silane treated silicas, i.e. COUPSIL®, Evonik provides a solution to shorten the compounding process without performance loss. COUPSIL® products are available for sulfur and peroxide cured compounds and may be used directly or in a blend with untreated silica. The benefits of the Silica/Silane system are significantly improved dynamic properties, such as dynamic stiffness and damping behavior (i.e. hysteresis loss). When it comes to the highest requirements in abrasion or tear resistance there is no better choice than this reinforcing filler system. Depending on the type of rubber and the chosen vulcanization system, the required reinforcement is reached by the right choice of silica and silane. The specific surface area of the silica determines the reinforcement capability, but also has an influence on the processability and the preferred filler loading. The best suited silane is determined by the applied curing system: The table on page 4 enables you to choose the right silane for your application.

In some applications bonding of rubber to steel cords or metal parts is of crucial importance. The use of silica improves the bonding ability of your compounds significantly – adding an extra piece of confidence to your rubber metal bond in such applications like conveyor belts or metal carriers for gaskets.

Suitability by Application

MECHANICAL RUBBER GOODS

EVONIK SILICA GRADES	TYPICAL VALUE SPEC. SURFACE AREA BET/(m ² /g)	PROCESSING	REINFORCEMENT	DISPERSION	COMPRESSION SET
ULTRASIL® 880* white powder	35	+++	+	++	+++
ULTRASIL® 360 white powder	55	+++	+	++	+++
ULTRASIL® AS7** white powder	65	+++	+	++	+++
ULTRASIL® VN2 white powder	130	++	++	++	++
ULTRASIL® VN2 GR white granules	130	++	++	++	++
ULTRASIL® VN3 white powder	180	+	+++	++	+
ULTRASIL® VN3 GR white granules	180	+	+++	+	+
ULTRASIL® 4000 GR white granules	85	+++	++	+++	+++
ULTRASIL® 5000 GR white granules	115	++	++	+++	++
ULTRASIL® 7000 GR white granules	175	++	+++	+++	+
ULTRASIL® 9100 GR white granules	235	+	+++	+++	+

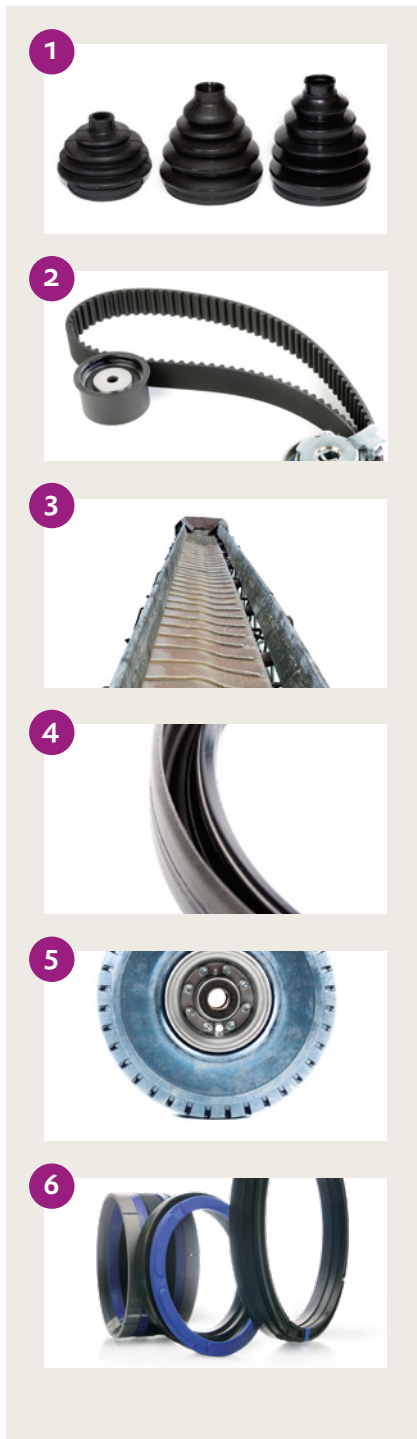
* Ca-Silicate ** Sodium aluminium Silicate + good ++ very good +++ excellent

Suitability by Functionality

SUITABILITY BY CURING SYSTEM							
		Diene rubbers (SBR, NBR, BR)	EP(D)M	CR	ACM	ECO	BIIR
TYPE OF CURING SYSTEM							
EVONIK SILANE	FUNCTION-ALITY	SULFUR, (PEROXIDE)	(SULFUR), PEROXIDE	METAL OXIDE	SOAP/ SULFUR	PEROXIDE/ TAIC	METAL OXIDE/ SULFUR
Si 69°	-Sx-						
Si 466™ EXT	-S ₂ -	++	(+)				++ /
Si 264™	-SCN						
Dynasytan® AMEO	Amino-	+ /		+ /	++ /	++	+ /
Dynasytan® VTEO	Vinyl-		(+)				
Dynasytan® 6498 or 6598			++				
Dynasytan® MEMO	Methacryl-		++		+		
Dynasytan® GLYEO	Epoxy-				++		
Dynasytan® MTMO*	Mercapto-	++ /		++		++ /	

*available upon request as triethoxysilane ++ strongly reinforcing + reinforcing / pre-scorch tendency

- Evonik offers silica with different surface areas and delivery forms. Either for mixing in a kneader or on a two-roll mill the dispersion of ULTRASIL® in your compounds may not only be enhanced by choosing a HD (highly dispersible) ULTRASIL® grade but also by using powder instead of granules where appropriate.
- Different polymers require different curing chemistry. Evonik's product portfolio includes different functionalized silanes such as sulfur-, amino-, vinylsilanes and others. The right choice of silane chemistry enables you to optimize the silane-rubber-coupling thus taking the best advantage from the Silica/Silane reinforcement potential.
- The silane Si 69° enables the compounder to balance reinforcement and curing behavior in sulfur-cured compounds. The occurrence of a prescorch at mixing temperatures higher than 165 °C should be avoided. At mixing temperatures below 150 °C, e. g. on a two-roll mill, Si 264™ or COUPSIL® products are recommended.
- Peroxide curing is a fast and effective way to achieve good heat stability and excellent compression set properties. In combination with vinyl – or methacryl-silanes, silica provides improved tear resistance and tensile strength of your compounds. In case the low flash point of Dynasytan® VTEO is of concern, we recommend the oligomeric silanes Dynasytan® 6498 or 6598, respectively the pre-reacted silica COUPSIL® VP 6508.
- To find the optimal solution for our customers, Evonik's Applied Technology Tire & Rubber team provides global technical support when it comes to testing our Silica/Silane combinations. To give a short overview about application potentials, the next page shows basic information for the use of silica and silanes in different rubber applications and compounds.



1 Rubber parts for damping and vibration applications like engine mounts are facing extreme dynamic stress. Optimized dynamic properties, excellent metal bonding and highest tear resistance are provided by Silica/Silane systems from Evonik and by ensuring proper silanization with the right silane such as Si 264™, a low compression set can be achieved.

2 In compounds with polar rubbers, e.g. NBR, silica is able to provide an enormous reinforcement potential. Products that require a high rigidity combined with highest abrasion resistance like timing belts and rollers strongly gain benefits from the reinforcement potential of the silica in combination with Si 69°.

3 Conveyor belts transport goods over high distances thus requiring highest stiffness, lowest abrasion, high tear resistance and long durability. With ULTRASIL® VN3 GR or ULTRASIL® 7000 GR your compounds fulfill these needs. In combination with a silane the performance is further enhanced, e.g. reduced heat build-up. Excellent steel cord adhesion can be achieved by usage of COFILL® 11.

4 Fastest processing and perfect appearance of rubber profiles require highest green strength and good flow behavior for optimum extrusion output. With the reinforcement of silica such as ULTRASIL® 880 and ULTRASIL® 360 and in combination with silanes your compounds provide excellent extrusion properties and enable to optimize the tackiness and appearance. The use of VESTENAMER®, which is a thermoplastic synthetic polymer from Evonik, can further improve processability and flow behavior.

5 Solid tires are used for vehicles such as fork trucks that operate in clean environments where black tracks are not accepted. White filled rubber compounds, reinforced by ULTRASIL® VN3 GR or ULTRASIL® 7000 GR allow products with lowest abrasion leaving no unwanted traces. And when it comes to highest loads and durability, the addition of a coupling agent such as Si 69° provides highest reinforcement and lowest rolling resistance for your solid tires.

6 Gaskets and seals often require a metal rubber bond and must fulfill a broad range of specifications withstanding highest loads in harsh environments. The excellent rigidity of rubber compounds reinforced with Silica/Silane systems and their perfect bonding behavior enable highest stiffness combined with longest elongation and optimized tear resistance. A good compromise between compression set and reinforcement is achieved with ULTRASIL® 360 and in cases where highest tensile strength is required higher surface area silica may be the right choice.

Special polymers such as HNBR, ACM, and FKM are often used for applications with low swell behavior and excellent form stability. In these cases fumed silica i.e. AEROSIL®, may be the perfect choice. Furthermore, AEROSIL® offers the highest transparency in clear compounds.

*VESTENAMER® brochures available at Evonik's [High Performance business line](#)

Evonik – Your partner for your special needs

- With Evonik you choose a reliable and trustworthy partner.
- Together with our customers we develop customized solutions and give technical support – globally!
- Applied Technology labs in Germany, Taiwan, and in the USA.
- In addition to the ULTRASIL® product range, our SIPERNAT® product range provides precipitated silica for sensitive applications as rubber in food contact.
- Our AEROSIL® range provides various grades of fumed silica for special applications you, or your customers, might have.
- Our Applied Technology is building up rubber know-how and experience since 30 years and will find together with you a suitable solution.
- Evonik is the only supplier of both, silica and silanes, and provides the combined technical expertise.

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The Silica specialists at Evonik – Inside to get it right.