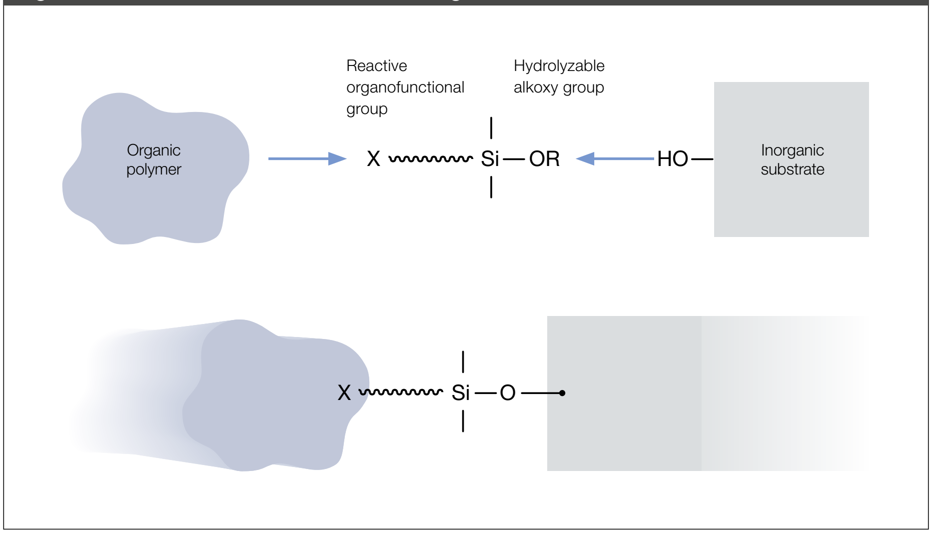
WACKER SILANES FOR COATINGS APPLICATIONS

Silanes are an integral component of modern paints and coatings. The particular role which they are called on to play in the formulation of paints and modification of binders depends on their individual chemical structure. There are essentially two ways to incorporate them into coatings. The first is to use them as an additive for the binder or for the finished coating formulation while the second is to chemically integrate them into the binder by means of an addition-polymerization, copolymerization or grafting reaction. Silanes also serve as feedstocks for numerous industrial sol-gel processes, which yield coatings that are very thin, yet extremely durable.

Organofunctional Silanes as Molecular Bridges

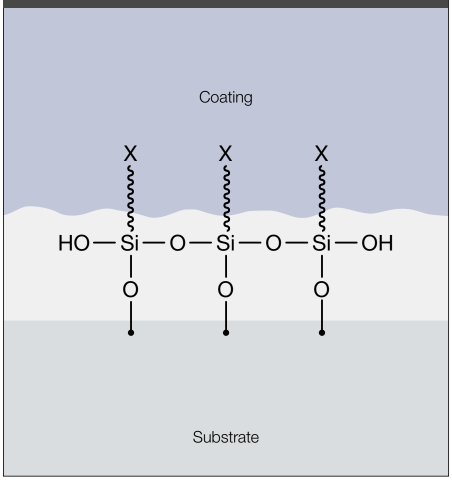


Silanes as Adhesion Promoters

Organofunctional silanes promote the adhesion of many types of coatings to a wide variety of substrates. An organofunctional silane is a hybrid compound that combines the inorganic functionality of an alkyl silicate, with the functionality of a reactive organic group – all in a single molecule. The inorganic functionality of the silane reacts with the different OH groups present in the fillers or polymers. This is a two step process, in which the alkoxy group (usually methoxy or ethoxy) is first hydrolyzed. In the subsequent step, after the alcohol is released, the silaneol groups thus obtained react with available OH groups.

The organic portion of the silane is usually compatible with, or reactive towards, the binder incorporated in the coating. This hybrid character - inorganic and organic – that silanes exhibit allows them to act as a 'bridge' between two dissimilar materials. By establishing a chemical bond at the interface with the substrate, and attaching themselves to suitable chain ends in the coating binder, silanes increase the adhesion of the coating binder to the substrate, creating stronger adhesive bonding that can even withstand extreme loads. In practical use, the silane is either admixed with the formulated coating or is applied as a separate prime coat formulation.

Adhesion Promotion



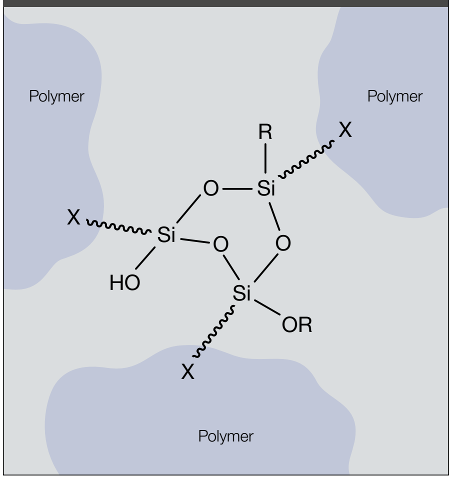
Organofunctional silanes enhance adhesion of coatings to a wide variety of substrates.

GENIOSIL® is a registered trademark of Wacker Chemie AG.

Silanes as Crosslinkers

Organofunctional silanes are capable of reacting at room temperature with complementary chemical groups on different polymers which make up the different coating binders (e.g. hydroxyl, epoxy, carboxyl, acrylic). This capability is exploited in numerous coatings applications, e.g. heat-resistant coatings, polysiloxane topcoats and fouling-release coatings for vessels.

Crosslinking



Organofunctional silanes function as crosslinkers for organic polymers in coatings.

Silanes for Sol-Gel Processes

Organosilanes without a functional group (e.g. methyltrie**m**ethoxysilane or methyltri**e**thoxysilane) serve as feedstocks for the production of aqueous or alcoholic colloidal solutions for use in sol-gel processes. The sols are applied to the substrate, dried and then heat-cured to yield very thin, extremely resilient layers. Such silicate layers are growing more popular for coating plastic, metal or glass surfaces in the automotive industry, the domestic appliance sector and many industrial applications on account of their ability to render these surfaces scratch-proof, heat-resistant and hydrophobic.

Silanes as Water Scavenger

The most commonly encountered water scavenger in coatings formulations is vinyltrimethoxysilane. Due to the electron interactions of the vinyl group, the Si-methoxy groups in this silane hydrolyze substantially faster than in saturated aliphatic alkylalkoxysilanes. Any moisture inherently present in the formulation is removed as the methoxy groups hydrolyze (methanol is split off) and the vinylsilane condenses. Only when the latter reaction is essentially complete will the remaining silane building blocks crosslink. The amount of silane added will depend on the water content of the formulation constituents; usually about one percent by weight is required.

Discover the Versatility of WACKER Silanes

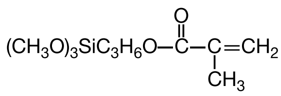
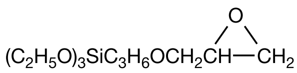
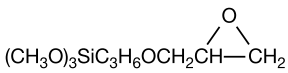
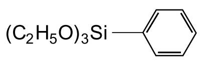
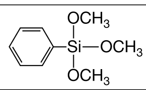
WACKER offers a large number of organofunctional silanes under the brand name GENIOSIL®. Aside from established standard products, the GENIOSIL® brand is home to a series of unique new products. These include alpha-silanes, which are more reactive than their gamma-silane analogues. (For a detailed description, please see WACKER brochure 6085: "For Powerful Connections – Organofunctional Silanes.")

At a Glance

Advantages of organic and organofunctional silanes (GENIOSIL®) from WACKER

- Wide selection of organosilanes for coating applications
- High-quality organofunctional silanes

Product Selection (Additional Products Available on Request)

Product Name Functional Group	Chemical Name	Structural Formula	Molecular Weight	CAS-No
GENIOSIL® APTE Amino	3-Aminopropyltriethoxysilane	$(C_2H_5O)_3SiC_3H_6NH_2$	221.4	[919-30-2]
GENIOSIL® APTM Amino	3-Aminopropyltrimethoxysilane	$(CH_3O)_3SiC_3H_6NH_2$	179.3	[13822-56-5]
GENIOSIL® DAPDM Amino	N-(2-Aminoethyl)-3-aminopropyl-methyldimethoxysilane	$(CH_3O)_2Si(CH_3)C_3H_6NHC_2H_4NH_2$	206.4	[3069-29-2]
GENIOSIL® DAPTM Amino	N-(2-Aminoethyl)-3-aminopropyltri-methoxysilane	$(CH_3O)_3SiC_3H_6NHC_2H_4NH_2$	222.4	[1760-24-3]
GENIOSIL® GF 56 GENIOSIL® VTE Vinyl	Vinyltriethoxysilane	$(C_2H_5O)_3SiCH{=}CH_2$	190.3	[78-08-0]
GENIOSIL® XL 10 GENIOSIL® VTM Vinyl	Vinyltrimethoxysilane	$(CH_3O)_3SiCH{=}CH_2$	148.2	[2768-02-7]
GENIOSIL® MPTM Methacryl	3-Methacryloxypropyl-trimethoxysilane		248.4	[2530-85-0]
GENIOSIL® GPTE Glycidoxy	3-Glycidoxypropyltriethoxysilane		278.4	[2602-34-8]
GENIOSIL® GPTM Glycidoxy	3-Glycidoxypropyltrimethoxysilane		236.3	[2530-83-8]
WACKER® Silane M1-Triethoxy Methylalkoxy	Methyltriethoxysilane	$(C_2H_5O)_3SiCH_3$	178.3	[2031-67-6]
WACKER® Silane M1-Trime-thoxy Methylalkoxy	Methyltrimethoxysilane	$(CH_3O)_3SiCH_3$	136.2	[1185-55-3]
WACKER® Silane P-Triethoxy Phenylalkoxy	Phenyltriethoxysilane		240.4	[780-69-8]
GENIOSIL® PTM Phenylalkoxy	Phenyltrimethoxysilane		198.3	[2992-92-1]
GENIOSIL® TE 28	Tetraethylorthosilicate Tetraethoxysilane	$Si(OC_2H_5)_4$	208.3	[78-10-4]

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