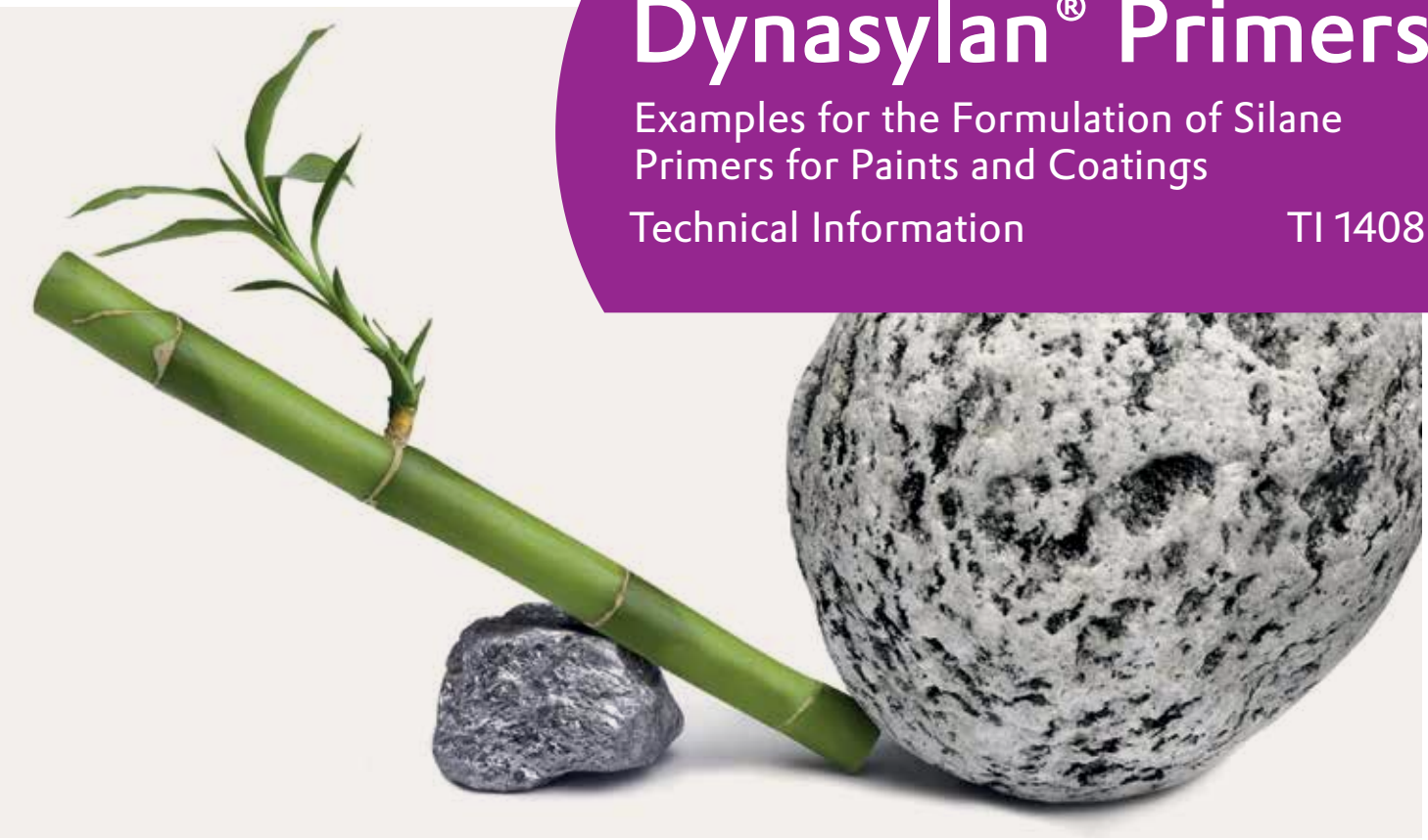
EVONIK INDUSTRIES

Dynasylan® Primers

Examples for the Formulation of Silane Primers for Paints and Coatings

Technical Information TI 1408



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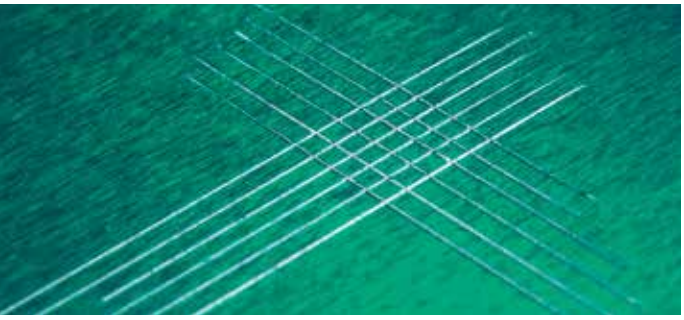
Dynasylan® Primers

Examples for the Formulation of Silane Primers for Paints and Coatings

Dynasylan® organofunctional silanes have successfully been used for years as adhesion promoters for coatings on a wide range of substrates. The use of silanes is usually done in one of two ways.

Firstly, as a paint additive and secondly, using a silane primer for substrate pre-treatment. As paints usually are multi component systems, the additive method often fails due to side reactions with the paint components. In these cases, pre-treatment with a silane primer is advised.



Aluminum substrate pretreated with Dynasylan® HYDROSIL 2909 – Primer

Coated without silane pre-treatment

New investigations, summarized in the table below, show that the amounts and identity of the components are of utmost importance to achieve good surface wetting properties. The wetting is also influenced by the surface properties of the substrate. The surface must be clean, free of crease and dust. For some substrates a cleaning procedure with organic solvents could be sufficient, for other substrates a cleaning with alkaline or acidic cleaners at elevated temperatures could be necessary. In some cases an alkaline cleaning can also activate the surface and the activation can improve the performance, e.g. on metal substrates.

It is very important that the primer solution is wetting the substrate surface. If small droplets are formed on the surface the cleaning procedure has to be modified or a wetting agent has to be used.
The amounts given in the table are intended as an aid for the formulation of silane primers.

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Dynasylan®		Functional group	Solvent		Water	Acetic Acid
GLYMO	1 %	(Epoxy-)	Methoxypropanol	88,8 %	10,0 %	0,2 %
VTMO	1 %	(Vinyl-)	Methoxypropanol	94,0 %	5,0 %	-
VTEO	1 %	(Vinyl-)	Methoxypropanol	93,8 %	5,0 %	0,2 %
MEMO	1 %	(Methacryl-)	Methoxypropanol	93,8 %	5,0 %	0,2 %
AMEO	1 %	(Amino-)	Isopropanol	98,5 %	0,5 %	-
HYDROSIL 2909	0,6 %	(Amino/Alkyl)	Methoxypropanol	99,4 %	-	-
DAMO	2 %	(Amino-)	Methoxypropanol	96,5 %	5,0 %	-
1122	2 %	(Amino-)	Isopropanol	96,8 %	-	1,5 %
SIVO 210	2 %	(Amino-)	Methoxypropanol	96,7 %	-	1,3 %
1189	2 %	(Amino-)	Methoxypropanol	96,6 %	-	1,4 %
SIVO 214	2 %	(Amino-)	Methoxypropanol	96,8 %	-	1,2 %
SIVO 160	10 %	(Amino-)	H_2O	90,0 %	-	-
HYDROSIL 2776	4,0 %	(Amino-)	H_2O	96,0 %	-	-
HYDROSIL 2627	4,0 %	(Amino-)	H_2O	96,0 %	-	-

The proposed formulation examples are summarized in the table. They contain on the order of 1 – 2 % (w/w) silane. The required silane concentration depends very much on the surface roughness. For a good performance smooth surfaces need a lower silane and a rough surface usually needs a higher silane concentration.
The best silane concentration should be evaluated in a screening test with different silane concentrations. E.g. SIVO 160 can be used in a concentration range of 4,0 to 14,0 % depending on the application and surface roughness. The amounts of solvent and water have been chosen in order to obtain transparent films that are not visible. If the wetting of the surface is not sufficient the cleaning of the surface has to be modified or the solvent has to be changed. An application of the primer can be done using usual methods (spraying, dipping, roll coating). Screening tests are useful to find the best curing temperature for the application and performance.

Application of the paint should only occur when the primer has been dried onto the substrates.

Formulation of a silane primer solution:

- Add the solvent.
- If needed, water and hydrolysis catalyst (acetic acid) is added.
- The silane is added slowly under stirring.
- The solution is stirred for one hour.
- The final primer solution should be clear and could be slightly yellow.
- The primer solutions with the ethoxy silanes should be stirred for more than 2 hours.
- **Caution:** The addition of aminosilanes to the liquid can result in a final temperature of up to 50 °C.
- The useful life of the primer solution can vary between one week to one year depending on the application and silane formulation. The exact stability needs to be tested.

Substrate Recommendations

Dynasylan®	Aluminum[1)]	Steel[1)]	Copper	Glass
GLYMO	●	●	●	●
VTMO	●	●	●	
VTEO	●	●	●	
MEMO	●	●	●	
HYDROSIL 2909	●	●	●	●
AMEO	●*	●*	●	●
DAMO	●	●	●	●
1122	●	●	●	
SIVO 210	●	●	●	●
1189	●	●	●	●
SIVO 214	●	●	●	●
SIVO 160	●		●	●
HYDROSIL 2627	●	●	●	●

● **recommended** ●* **Not recommended for dip coating**

[1)] Indication to the tested substrates:
Steel: cold rolled steel (CRS), abraded surface 0,3–0,6 % Mn / 0,08–0,13 % C / 0,05 % S / 0,04 % P
Aluminum: alloy (3105 H 24) 96,8–97,4 % Al / 1,0–1,5 % Mn / 0,6 % Si / 0,05–0,2 % Cu

Dynasylan® organofunctional silanes act as bridge between the organic coating and the inorganic substrate and thus are excellent adhesion promoters. Formation of silanol groups results from the hydrolysis of the silane's alkoxy groups. These react with the OH – groups of the inorganic or metallic substrate to form a chemical bond. The organofunctional group of the silane then reacts with the organofunctional groups of the binder, resulting in a stable adhesion bridge.

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RE-68-1-JUL16MS