Silane-modified Polymers for Liquid Applied Membranes (LAM)

1-component solutions
for demanding applications

EVONIK
Leading Beyond Chemistry

Liquid applied membranes (LAM) – the modern way of building

Safe & easy to apply by hand or machine

Flexible in application even for demanding building designs

Fully bonded systems offer additional protection

Economic due to fast installation even on humid surfaces

Liquid applied membranes (LAM) – the modern way of building

A flexible, reliable and efficient protection against water

- Various different systems are used as liquid applied membranes in construction applications since many years
- Liquid applied membranes are based on different technologies (PUR, Polyurea, Epoxide or Silicone based formulations are common in the market)
- Liquid membranes are applied via a brush, a roller, etc. or via spray application
- Roofs, terraces, balconies or basements are the most important applications for liquid applied membranes
- Liquid membranes based on silane-modified polymers represent a new generation of products in this application area: they are easy to apply 1-component systems, do not contain free isocyanate monomers like PUR based formulations and are convenient to apply even on humid surfaces at lower temperatures

Advantages of a new LAM generation

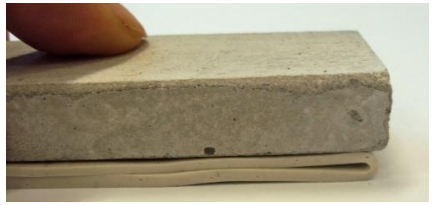
Liquid applied membranes based on silane-modified polymers

- 1-component liquid membrane formulations based on SMPs are quick, safe and easy to apply with a roller, a brush or spraying equipment.
- SMP-based formulations show good adhesion properties to many substrates even without usage of a primer pre-coating
- Application of the formulations is possible on humid surfaces and under cold conditions
- Good mechanical strength & high flexibility
- Good weather resistance & good resistance against chemicals
- Our silane-modified polymers for LAMs formulations do not contain isocyanates, solvents or plasticizers.
- LAM formulations based on our SMPs (especially with our Tegopac polymers) show excellent over-coatability properties (even after >24hours)
- SMP-based formulations show low odor properties in comparison to other

Specific performance of the EVONIK portfolio

Liquid applied membranes based on silane-modified polymers

Portfolio:	▪ Various different SMP polymers available (terminal & lateral structures, Methanol & Ethanol-release) ▪ Reactive diluents based SMP technology ▪ Performance additives (dispersants, deaerators, etc.)
Guide formulations:	▪ Various formulations are available to support developments for different needs
Technical performance:	▪ Excellent overcoatability (expecially with Tegopac polymers) ▪ High flexibility and recovery (“folding test”) ▪ Good mechanical strength ▪ Methanol-free formulation possible



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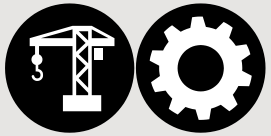
We offer much more than just polymers

Individual solutions based on silane-modified polymers (SMPs) from EVONIK

Easy to apply

Application:

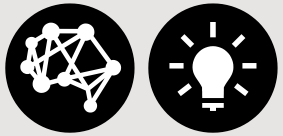
- 1-component formulations
- Easy to apply via brush, roller, etc.
- Works even on humid surfaces & cold temperatures



Versatile & innovative solutions

Portfolio:

- Broad portfolio to fulfil versatile needs
- Binder and additive solutions



Formulations & technical support

Consultancy:

- We offer guide formulations as starting point for individual solutions
- Support by experienced technical team

Adjustable to environmental needs

Environmental fit:

- Unique portfolio allows individual adjustments to specific regional or application driven needs
- SMP polymers are “labelling-free” polymers (not sensitizing!)
- No use-restrictions in comparison to PUR products

Silane-modified Polymers

Portfolio

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Interface & Performance – Our product portfolio for adhesives & sealants

TEGOPAC® Polymer ST	Silane-modified polymers	**Reactive Adhesives & Sealants**	**Water-based Adhesives & Sealants**	Defoamers	TEGO® Antifoam
Modifier OH Polymer OH Crosslinker	Condensation curing silicones			Dispersants	TEGOMER® ZetaSperse®
Polymer VS Catalyst Crosslinker VQM	Addition curing silicones			Wetting agents	SURFYNOL® TEGOPREN®
ALBIDUR® ALBIFLEX® ALBIPOX®	Reactive resin modifiers			Thickeners	TEGO® Rheo
TEGOMER®	Reactive siloxanes / UV curing silicones			Emulsifiers	TEGO® SHO TEGO® SMO REWOPOL®
NANOPOX® NANOCRYL®	Nanosilica concentrate		**Solvent-based Adhesives & Sealants**	Dispersants	TEGOMER® TEGOPREN®
TEGOMER® TEGOPREN® TEGO® Antifoam	Dispersants/Deaerators			Deaerators	TEGO® Antifoam

Binders & additives for adhesives & sealant applications

REACH restriction of diisocyanates: Silane-modified polymers (SMP) are an alternative to PUR

- The European Commission has classified diisocyanates as a Category 1 respiratory sensitizer (EC 2008). Multiple cases of sensitization to the respiratory tract due to its exposure in occupational settings, including spray painting and polyurethane production, have also been reported - as cited by OCED 2006.

- The Committee for Risk Assessment (RAC) and the Committee for Socio-economic Analysis (SEAC) agreed to restrict the use of diisocyanates at the workplace.

Our SMP portfolio: Polymer ST and TEGOPAC®

for adhesive & sealant Applications	polymer with plasticizer	ST 48 ST 77
	100% polymer	ST 81 ST 80
	100% polymer + ethanol-releasing	Seal 100 Bond 150 Bond 170 Bond 160
	100% polymer + ethanol-releasing + modified backbone	Bond 251
for parquet adhesive formulations	100% polymer	ST 61 ST 61 LV
	Modulus	
	Elongation	
Reactive diluents SMP	100% polymer + ethanol-releasing	TEGOPAC® RD 1 TEGOPAC® RD 2 TEGOPAC® XP RDS 1
Plasticizer	polyether plasticizer	Plasticizer 860

Our SMP portfolio: Polymer ST and TEGOPAC®

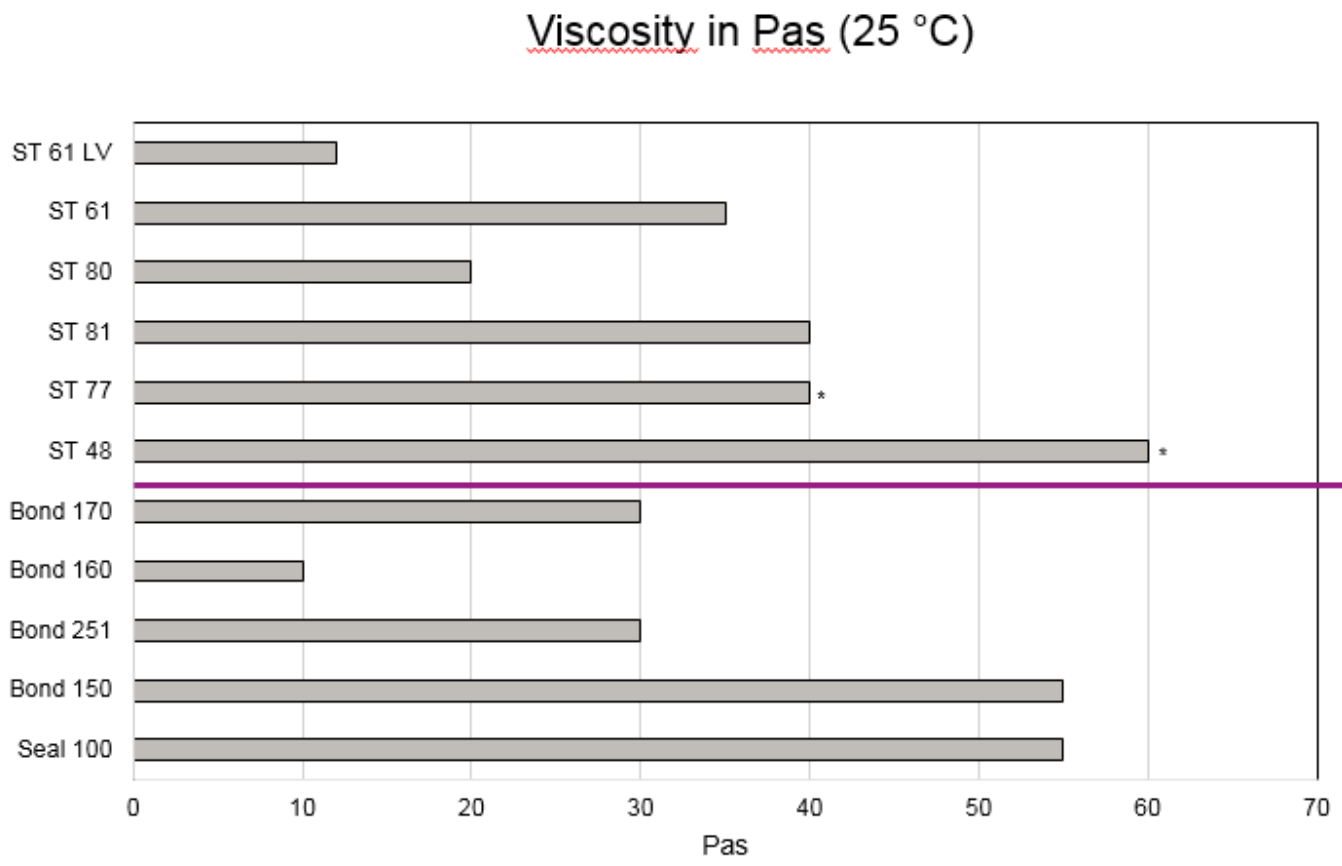
POLYMERS

	Release of	Modulus of formulation	Polymer backbones	Plasticizer	Viscosity at 25°C [mPas]	Position of cross-linking groups
Polymer ST 48	Methanol	low-medium	PPG	DPHP	60,000	terminal
Polymer ST 77	Methanol	low-medium	PPG	Elatur® CH	40,000	terminal
Polymer ST 61	Methanol	high	PPG	none	35,000	terminal
Polymer ST 61 LV	Methanol	high	PPG	none	12,000	terminal
Polymer ST 80	Methanol	high	PPG	none	20,000	terminal
Polymer ST 81	Methanol	high	PPG	none	40,000	terminal
TEGOPAC® Seal 100	Ethanol	low-medium	PPG	none	55,000	lateral
TEGOPAC® Bond 150	Ethanol	medium	PPG	none	55,000	lateral
TEGOPAC® Bond 160	Ethanol	medium	PPG	none	10,000	lateral
TEGOPAC® Bond 170	Ethanol	medium	PPG	none	30,000	lateral
TEGOPAC® Bond 251	Ethanol	medium	modified	none	30,000	lateral

REACTIVE DILUENTS *To adjust viscosity of formulations and for development of "non-bleeding" formulations*

	Release of	Modulus of formulation	Polymer backbones	Plasticizer	Viscosity at 25°C [mPas]	Position of cross-linking groups
TEGOPAC® RD 1	Ethanol	reactive diluent	modified	none	1,000	lateral
TEGOPAC® RD 2	Ethanol	reactive diluent	modified	none	1,500	lateral
TEGOPAC® RDS 1	Ethanol	reactive diluent	PPG	none	300	lateral

Our SMP portfolio: Polymer ST and TEGOPAC®



terminal crosslinking groups

Methanol release during curing process

lateral crosslinking groups

Ethanol release during curing process

* contains plasticizer

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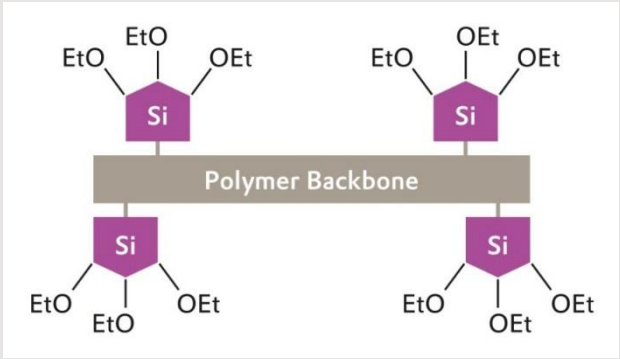
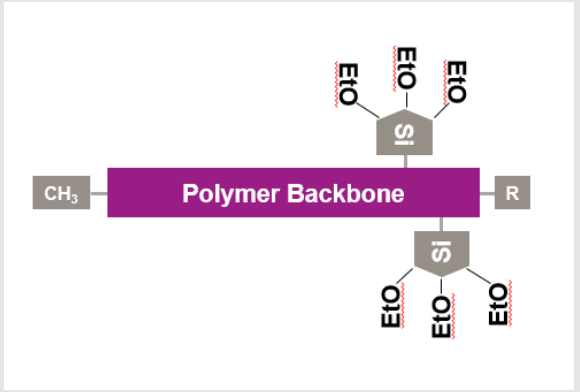
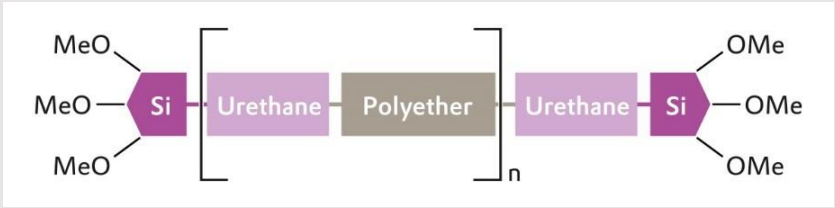
Silane-modified polymers – different technologies



Tegopac® polymers
(Ethanol-release)



Tegopac® reactive diluents (RD)
(Ethanol-release)



Polymer ST
(SPUR, Methanol release)

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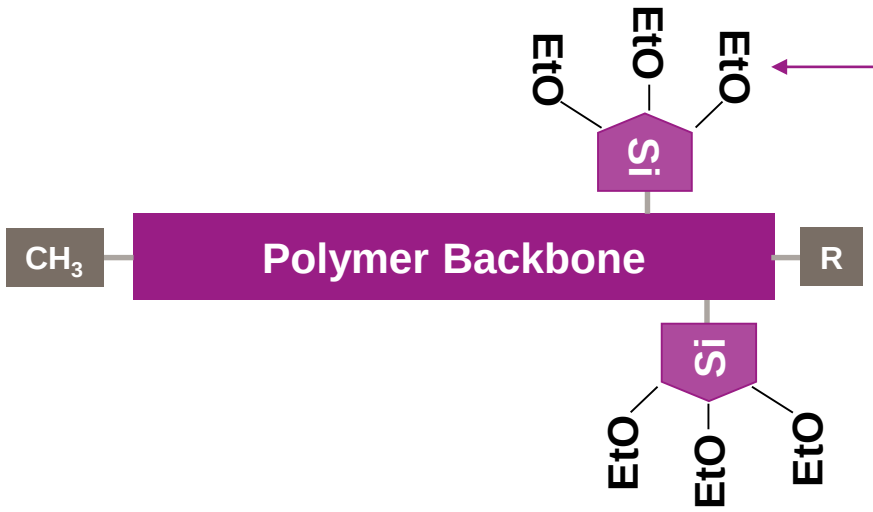
TEGOPAC® reactive diluents



Evaporation of Ethanol instead of Methanol

- no harmful reaction products

TEGOPAC® reactive diluents need to be combined with a co-polymer to reach good mechanical properties

TEGOPAC® RD 1 (low crosslinking density): ~1 Pas

TEGOPAC® RD 2 (higher crosslinking density): ~ 1.5 Pas

TEGOPAC® XP RDS 1 (reduced water pick-up): ~ 0.3 Pas

lateral cross-linking reaction points

- improved cure-through properties
- implementation into polymer structures; no migration effects

Where to use TEGOPAC® reactive diluents?

Application fields

- As a raw material for parquet adhesives or roof sealing
- For the production of self-levelling moisture cure formulations
- For migration-free /-reduced adhesive application
- As a raw material in pressure sensitive adhesives
- For epoxy blended adhesive formulations

Target market

- Construction industry
- Flooring industry
- Industrial assembly adhesives

Grade	Viscosity	Formulation Target
TEGOPAC® RD1	1000 mPas	Highest Elasticity
TEGOPAC® RD2	1500 mPas	Highest Mech. Strength
TEGOPAC® XP RDS1	300 mPas	Lowest Viscosity

Reasons to use TEGOPAC® reactive diluents

- Viscosity reduction of a polymer or of an adhesive/sealant formulation
- Avoid migration effects through partial or total replacement of plasticizers
- Improve through cure properties, because of lateral crosslinking groups
- Increase cured formulation toughness (TEGOPAC® RD2)
- TEGOPAC® XP RDS 1: has lower water-pick-up properties in comparison the other reactive diluents, because of a more hydrophobic character
- TEGOPAC® RD1, TEGOPAC® XP RDS 1 or TEGOPAC® RD2 can be combined with different silane-modified polymers (high compatibility & good storage stability)

Remarks:

- TEGOPAC® reactive modifiers need to be combined with a co-polymer to reach good mechanical properties
- Viscosity of TEGOPAC® RD 1 (low crosslinking density): approx. 1 Pas
- Viscosity of TEGOPAC® RD 2 (higher crosslinking density): approx. 1.5 Pas
- Viscosity of TEGOPAC® XP RDS 1 (reduced water pick-up): approx. 0.3 Pas

Liquid membranes – Key Features

Excellent „Intercoat-Adhesion“:

application of a second formulation layer is possible even after several days with reliable adhesion build-up

Important for

- Double-coat systems with textile reinforcement
- Reworking of coated areas
- Continuous coating of very large areas

Good results in „folding tests“

Some very low viscous systems in the market show fractures due to insufficient elasticity.

TEGOPAC® Bond 160 – Liquid membrane

Formulation examples
„Self-levelling, plasticizer-free liquid membrane”:

Properties	based on TEGOPAC® Bond 160 & TEGPAC® RD 1	based on TEGOPAC® Bond 160 & TEGOPAC® RD 2
Skin formation time	approx. 60 min	approx. 60 min
Shore A	39	63
Elongation	100%	60%
Tensile strength	1,3 N/mm^2	3,1 N/mm^2

Formulation samples and guiding recipes are available on request.

TEGOPAC® Bond 170
Example: Self-levelling formulation (roofing)

Ingredient	Dosage (%)	Dosage (%)
Tegopac® Bond 170	25,9	25,9
Tegopac® RD 1	18,1	
Tegopac® RD 2		18,1
ATH	51,1	51,1
TiO2	0,5	0,5
Dynasylan VTMO	1,1	1,1
Dynasylan 1146	0,4	0,4
Dynasylan AMMO	1,0	1,0
Irganox 1135	0,3	0,3
Tinuvin 292	0,6	0,6
Tinuvin 1130	0,6	0,6
TIB KAT 223	0,4	0,4
	MA 909P	MA 911P

- Application: liquid membrane, self-levelling
- excellent „intercoat-adhesion“ properties
- Shore A: 39 / 65
- Elongation film: 180 % / 80 %
- Tensile strength: 1,8 N/mm^2 / 3,4 N/mm^2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