Adhesives & Sealants

Many applications ...

... one partner

Our World of Additives and Binders for Adhesive & Sealant Applications

April 2020
The perfect bonding - Planned and not by chance

We want to be a valuable supplier for the Adhesive & Sealant industry who convinces the market by

- a broad, proven and innovative portfolio of various additives, performance enhancers, selected binder systems and base materials
- a broad chemical and interfacial knowledge to solve technical challenges of our customers
- the willingness to develop new solutions together with our customers to follow trends and market needs
- a strong customer relationship by our commercial and technical teams or by our well selected partners in the market
Global partner in improving performance and processing

Industry needs we see

- Heat management in electronic applications
- Increasing demand for adhesive bonding of dissimilar surfaces, reliable adhesion properties
- High performance adhesives & sealants to address certain environmental & safety expectations (e.g. food compliance)
- Resistance to extreme environmental conditions (e.g. temperature, humidity)

We offer

- A balanced portfolio of binders & additives
- Support by technical experts and multiple application labs able to synthesize dispersions, to formulate and test according to industry standards
- Specific know-how of interfacial technologies
- Development of customized solutions, molecular design

Some applications we address

Paper & Packaging: PSAs for label stocks, flexible film packaging, direct food contact related applications

Electronics: Chip bonding, electronic underfill materials.....

Transportation: structural adhesives for automotive, assembly...

Construction: facade sealants, parquet adhesives, liquid membranes...
### Interface & Performance – Our product portfolio for adhesives & sealants

<table>
<thead>
<tr>
<th>Category</th>
<th>Product</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reactive Adhesives &amp; Sealants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEGOPAC® Polymer ST</td>
<td>Silane-modified polymers</td>
<td>Defoamers</td>
</tr>
<tr>
<td>Modifier OH</td>
<td>Condensation curing silicones</td>
<td>TEGO® Antifoam</td>
</tr>
<tr>
<td>Polymer VS Catalyst</td>
<td>Addition curing silicones</td>
<td>Dispersants</td>
</tr>
<tr>
<td>Catalyst VQM</td>
<td></td>
<td>TEGOMER® ZetaSperse®</td>
</tr>
<tr>
<td>ALBIDUR® ALBIFLEX®</td>
<td>Reactive resin modifiers</td>
<td>Wetting agents</td>
</tr>
<tr>
<td>ALBIPOX®</td>
<td></td>
<td>SURFYNOL®, TEGOPREN®</td>
</tr>
<tr>
<td>TEGOMER®</td>
<td>Reactive siloxanes / UV curing</td>
<td>Thickener</td>
</tr>
<tr>
<td>NANOPOX® NANOCRYL®</td>
<td>Nanosilica concentrate</td>
<td>TEGO® Rheo</td>
</tr>
<tr>
<td>TEGOMER® TEGOPREN®</td>
<td>Dispersants/Deaerators</td>
<td>Emulsifiers</td>
</tr>
<tr>
<td>TEGO® Antifoam</td>
<td></td>
<td>TEGO® SHO, TEGO® SMO, REWOPOL®</td>
</tr>
<tr>
<td><strong>Solvent-based Adhesives &amp; Sealants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEGOMER® TEGOPREN®</td>
<td>Dispersants</td>
<td>TEGOMER®, TEGOPREN®</td>
</tr>
<tr>
<td>TEGO® Antifoam</td>
<td>Deaerators</td>
<td>TEGO® Antifoam</td>
</tr>
</tbody>
</table>

**Binders & additives for adhesives & sealant applications**
### Additives for production of dispersions
- Emulsifier
- Defoamer

### Additives for adhesive formulations
- Defoamer
- Wetting Agents
- Thickeners
- Dispersants
- Water-based & reactive adhesives (liquid/pasty)

### Adhesive application area
- Pressure Sensitive Adhesives
- Paper & Packaging
- Building & Construction
- Transportation
- Woodworking
- Nonwoven & Hygiene

**Additives are needed**
- for production of dispersions
- for improvement of production & application processes
- to optimize adhesive formulations
Defoamer are based on different oil types

Basic material:

- Polydimethylsiloxane (PDMS or silicone oil)
- Vegetable oil
- Mineral oil
- White oil
- Polyethers
- Polydimethylsiloxane + Organic ligands

OMS combine benefits of organic oils and silicone oils
# Defoamer for adhesive formulations

<table>
<thead>
<tr>
<th></th>
<th>Defoamer</th>
<th>Mineraloil-free defoamer</th>
<th>Siloxane-free defoamer</th>
<th>Broad food contact compliance</th>
</tr>
</thead>
</table>
| **100% active concentrate** | TEGO® Antifoam 2290  
TEGO® Antifoam 2291  
TEGO® Antifoam 2450  
TEGO® Antifoam 2460  
TEGO® Antifoam 3045  
TEGO® Antifoam D 2315  
TEGO® Antifoam D 3020  
TEGO® Antifoam KS 53 | TEGO® Antifoam 2450  
TEGO® Antifoam 3045  
TEGO® Antifoam D 2315  
TEGO® Antifoam D 3020  
TEGO® Antifoam KS 53 | TEGO® Antifoam 2290  
TEGO® Antifoam 2291  
TEGO® Antifoam 2450  
TEGO® Antifoam 2460  
TEGO® Antifoam 3045  
TEGO® Antifoam KS 53 | TEGO® Antifoam 2291  
TEGO® Antifoam 3045  
TEGO® Antifoam D 2315  
TEGO® Antifoam KS 53 |
| **Emulsion**       | TEGO® Antifoam 1488  
TEGO® Antifoam 2-57  
TEGO® Antifoam 2-80  
TEGO® Antifoam 2-89  
TEGO® Antifoam 204  
TEGO® Antifoam 4-94  
TEGO® Antifoam KE 600 EC  
TEGO® Antifoam 4-88 | TEGO® Antifoam 1488  
TEGO® Antifoam 2-57  
TEGO® Antifoam 2-80  
TEGO® Antifoam 2-89  
TEGO® Antifoam 204  
TEGO® Antifoam 4-94  
TEGO® Antifoam KE 600 EC  
TEGO® Antifoam 4-88 | TEGO® Antifoam 4-88  
TEGO® Antifoam 4-94  
TEGO® Antifoam KE 600 EC  
TEGO® Antifoam 4-88 | TEGO® Antifoam 4-88  
TEGO® Antifoam 4-94  
TEGO® Antifoam KE 600 EC  
TEGO® Antifoam 4-88 |
What benefits can we achieve with our wetting agents?

- Wetting of low surface energy surfaces
- Improvement of Adhesion
- Improved levelling of thick layers
- Improved gloss
Wetting agents in our portfolio

More hydrophobic
- low foaming
- lower water solubility
- less whitening
- wetting

Gemini surfactants, acetylenic
- Gemini
- OMS

Organomodified siloxanes (OMS)

More hydrophilic
- high foaming
- higher water solubility
- more whitening
- wetting & dispersing

Alcohol alcoxylate

Anionic surfactants
## Wetting agents - Available technologies in our portfolio

<table>
<thead>
<tr>
<th>Technology</th>
<th>Product</th>
<th>Properties</th>
</tr>
</thead>
</table>
| Sulfo succinate          | Surfynol® AS 5160 Surfynol® AS 5140 Surfynol® AS 5120 | ▪ common wetting agent for different applications;  
▪ high foaming properties  
▪ low water resistance → whitening effects are possible  
▪ broad food contact compliance  
▪ hydrophilic character: AS 5160 > AS 5140 = AS 5120 |
| Alcohol alcoxylate       | Surfynol® AS 5180                            | ▪ for curtain coating processes & applications on fast running machines  
▪ low foaming properties  
▪ hydrophobic character |
| Organomodified siloxane (OMS) | TEGOPREN® 5840 TEGOPREN® 5860 (blend with Gemini, acetylenic) TEGOPREN® 5890 | ▪ for wetting of substrates with low surface energy  
▪ medium foaming properties  
▪ 5840 & 5860: for low surface energy substrates  
▪ 5890: for applications requiring food contact compliance; hydrophilic character; helps to keep a coated adhesive layer “in form” on low energy substrates (low shrinkage of wet film, stabilizes wetting effects) |
| Gemini (OMS)             | TEGOPREN® 5885                               | ▪ product for niche applications; works well in dispersions which contain relative high quantities of emulsifiers  
▪ good balance between defoaming and wetting properties  
▪ very hydrophobic character |
| Gemini (acetylenic)      | Surfynol® AS 5000 Surfynol® AS 5020 Surfynol® AS 5040 Surfynol® AS 5060 Surfynol® AS 5080 Surfynol® AS 5100 (blend with sulfo succinate) | ▪ dynamic wetting agents for curtain coating processes & applications on fast running machines  
▪ for wetting of substrates with low surface energy  
▪ low foaming properties |
Wetting agents - Available technologies in our portfolio

**Sulfo succinate**

![Sulfo succinate structure]

- Surfynol® AS 5160
- Surfynol® AS 5140
- Surfynol® AS 5120

Common wetting agent for different applications

**Organomodified siloxane (OMS)**

- TEGOPREN® 5840
- TEGOPREN® 5890
- TEGOPREN® 5860 (blend with Gemini, acetylenic)

Wetting of substrates with low surface energy e.g. laminate

**Gemini (OMS)**

- TEGOPREN® 5885

**Gemini (acetylenic)**

- Surfynol® AS 5000
- Surfynol® AS 5020
- Surfynol® AS 5040
- Surfynol® AS 5060
- Surfynol® AS 5080
- Surfynol® AS 5100 (blend with sulfo succinate)

Dynamic wetting agents with low foaming properties

Curtain coating & fast running machines
Rheology modifier for water-based adhesive formulations (associative PU-thickeners)

TEGO® Rheo 8510: Pseudoplastic flow behavior; APEO/NPEO-free

TEGO® Rheo 8600: Newtonian flow behavior; for applications requiring food compliance (complies to EU Regulation 10/2011 & to CFR 21 FDA 175.105); APEO/NPEO-free

<table>
<thead>
<tr>
<th></th>
<th>TEGO® Rheo 8510</th>
<th>TEGO® Rheo 8600</th>
<th>Standard PU thickener</th>
<th>Standard Acrylic thickener</th>
</tr>
</thead>
<tbody>
<tr>
<td>no solvents</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>no emulsifiers</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>stable against electrolytes</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>good water resistance</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>suitable on a broad pH range (3-11)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>good performance in PVAc &amp; VAE</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>high shear stability</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

+ meets property  - do not meet property
Reactive siloxanes

Modification of polymers is possible during the production process of dispersions by addition of reactive siloxanes which are incorporated into the polymeric network.

By polymeric modification final properties of a dispersion and of an adhesive can be influenced, e.g. reduction of water up-take, improvement of chemical resistance, improvement of low-temperature adhesion properties.

Potential benefits: better fiber wetting and bonding, improved adhesion, improved water resistance, higher flexibility, improved scratch resistance, low temperature impact
What benefits can we achieve with our dispersants?

- Improved stability of dispersions without settlement
- Improved mechanical properties
- Lower viscosities for easier processing
- Strong viscosity reduction in highly-filled formulations
- Higher filler loading
## Dispersing agents for adhesive formulations

<table>
<thead>
<tr>
<th>Dispersing agent</th>
<th>Chemical base</th>
<th>delivered as</th>
<th>Ionogenity</th>
<th>Chalk</th>
<th>Talc</th>
<th>Glass or polymeric fiber</th>
<th>Micronized filler</th>
<th>Organic pigments</th>
<th>Application area</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEGOMER® DA 626</td>
<td>Polymeric nature</td>
<td>≥ 98% active concentrate</td>
<td>Nonionic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>PUR, Epoxide, Vinyl ester, UP resins *</td>
</tr>
<tr>
<td>TEGOMER® DA 640</td>
<td>Polyether phosphate</td>
<td>30% active solution</td>
<td>Anionic</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td>water-based systems</td>
</tr>
<tr>
<td>TEGOMER® DA 646</td>
<td>Modified Polyether</td>
<td>100% active concentrate</td>
<td>Nonionic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>water-based systems, PUR, Epoxide, SMP</td>
</tr>
<tr>
<td>TEGOMER® DA 850</td>
<td>Polymeric nature</td>
<td>40% active solution</td>
<td>Nonionic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>water-based systems</td>
</tr>
<tr>
<td>ZETASPERSE® 3100</td>
<td>Polymeric nature</td>
<td>40% active solution</td>
<td>Anionic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>water-based systems</td>
</tr>
<tr>
<td>ZETASPERSE® 3600</td>
<td>Polymeric nature</td>
<td>52% active solution</td>
<td>Anionic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>water-based systems</td>
</tr>
<tr>
<td>ZETASPERSE® 3800</td>
<td>Polymeric nature</td>
<td>40% active solution</td>
<td>Nonionic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>water-based systems</td>
</tr>
<tr>
<td>CARBOWET® 103</td>
<td>Alcohol ethoxylate</td>
<td>100% active concentrate</td>
<td>Nonionic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>SMP</td>
</tr>
<tr>
<td>CARBOWET® 106</td>
<td>Alcohol ethoxylate</td>
<td>100% active concentrate</td>
<td>Nonionic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>SMP</td>
</tr>
<tr>
<td>TEGOPREN® 6875</td>
<td>Alkyl modified siloxane</td>
<td>100% active concentration</td>
<td>Nonionic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Epoxide, Vinyl ester, UP resins *</td>
</tr>
</tbody>
</table>

TEGO® Antifoam D 3020 & SURFYNOL® AS 5000 can be used as dispersing agents for SMP-based (reactive) systems, too.

For moisture curing reactive adhesive & sealant formulations water-free additives (100% active substance) are needed!
## Dispersing additives in water-based formulations

<table>
<thead>
<tr>
<th>Active content (%)</th>
<th>NBR-latex dispersion</th>
<th>NBR-latex dispersion</th>
<th>SBR-latex dispersion</th>
<th>SBR-latex dispersion</th>
<th>Styrene-acrylic dispersion</th>
</tr>
</thead>
<tbody>
<tr>
<td>no additive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEGOMER® DA 640</td>
<td>30</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>TEGOMER® DA 646</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TEGOMER® DA 850</td>
<td>40</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>ZETASPERSE® 3100</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>ZETASPERSE® 3600</td>
<td>52</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>ZETASPERSE® 3800</td>
<td>40</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Dispersing additives influence viscosity of a high filled system; use of a dispersing additives allows to increase filler quantity in a formulation:

→ a decrease of formulation costs is possible
→ improvement of mechanical properties is possible (e.g. higher strength, higher hardness)

Typical amounts to be used: 0.5 – 2% active on pigment!
Additives for SMP-based formulations (reactive adhesives)

<table>
<thead>
<tr>
<th>Defoamer/Deaerator</th>
<th>Chemical base</th>
<th>delivered as</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Surfynol® DF 178</td>
<td>Polysiloxane + acetylenic gemini</td>
<td>100% active</td>
<td></td>
</tr>
<tr>
<td>Tegopren® 5863</td>
<td>Polyether siloxane</td>
<td>100% active</td>
<td></td>
</tr>
<tr>
<td>TEGO® Antifoam D 3944</td>
<td>Polymeric mixture</td>
<td>100% active</td>
<td></td>
</tr>
</tbody>
</table>

For moisture curing reactive adhesive & sealant formulations water-free additives (100% active substance) are needed!
Dispersing additives in SMP-based formulations (reactive systems)

For moisture curing reactive adhesive & sealant formulations water-free additives (100% active substance) are needed!

TEGOMER® DA 646: small viscosity reduction already with 1% additive*; viscosity reduction with 1% and 2% additive* is similar

CARBOWET® 103 & CARBOWET® 106:
2% additive is needed to reach good viscosity reduction; with 1% additive* only a small viscosity reduction detected

Test system:
SMP-based liquid formulation, highly filled (approx. 50% ATH (Apyral 40 CD))

<table>
<thead>
<tr>
<th>Tegopac® Bond 170 / Tegopac® RD 2 [g]</th>
<th>Dispersing additive [g]</th>
<th>AoP * [%]</th>
<th>Apyral 40 CD [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.9 / 18.6</td>
<td>0</td>
<td>0</td>
<td>50.65</td>
</tr>
<tr>
<td>25.9 / 18.6</td>
<td>0.51</td>
<td>1</td>
<td>50.65</td>
</tr>
<tr>
<td>25.9 / 18.6</td>
<td>1.01</td>
<td>2</td>
<td>50.65</td>
</tr>
</tbody>
</table>

* = active on pigment/filler
Additives for low viscous SMP-based formulations – defoaming/deaeration

- during application of a liquid membrane by pouring or spreading (with a roller/brush), it is possible that air bubbles are included into the sealant layer
- because of formulation viscosity and a relatively short open time (skin formation takes place approx. 30-60 minutes after application of the moisture curing membrane formulation), such air bubbles can be included
- the air bubbles disturb the optical aspects of such a sealing layer. In some cases also negative effects on adhesive properties are possible.
Additives for low viscous SMP-based formulations – defoaming/deaeration

<table>
<thead>
<tr>
<th>Guiding formulation liquid membrane</th>
<th>wt %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tegopac® Bond 170</td>
<td>25,90</td>
</tr>
<tr>
<td>Tegopac® RD2</td>
<td>18,60</td>
</tr>
<tr>
<td>Apyral 40 CD (ATH)</td>
<td>49,65</td>
</tr>
<tr>
<td>TiO2</td>
<td>0,50</td>
</tr>
<tr>
<td>Additive „Defoaming/Deaeration“</td>
<td>1 - 2</td>
</tr>
<tr>
<td>Antioxidant/UV-Absorber</td>
<td>1,5</td>
</tr>
<tr>
<td>Dynasylan VTMO</td>
<td>1,10</td>
</tr>
<tr>
<td>Dynasylan AMMO</td>
<td>0,95</td>
</tr>
<tr>
<td>Dynasylan 1146</td>
<td>0,40</td>
</tr>
<tr>
<td>TIB KAT 223 (catalyst)</td>
<td>0,40</td>
</tr>
<tr>
<td></td>
<td>100,00</td>
</tr>
</tbody>
</table>

- a screening with different additives took place in a plasticizer-free liquid membrane formulation
- 1-2 % of defoaming/deaeration additive was added

For moisture curing reactive adhesive & sealant formulations water-free additives (100% active substance) are needed!
## Additives for low viscous SMP-based formulations – defoaming/deaeration

<table>
<thead>
<tr>
<th>w/o additive</th>
<th>TEGO® Antifoam D 3944 1.5%</th>
<th>TEGO® Antifoam D 3944 2.0</th>
<th>Surfynol® DF 178 1%</th>
<th>Surfynol® DF 178 2%</th>
<th>Surfynol® DF 178: TEGO® Antifoam D 3944 (1 : 1) 1%</th>
<th>Surfynol® DF 178: TEGO® Antifoam D 3944 (1 : 1) 2%</th>
<th>Tegopren® 5863 1%</th>
<th>Tegopren® 5863 2%</th>
<th>Tegopren® 5863: TEGO® Antifoam D 3944 (1:1), 1.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBB 177-1</td>
<td>PBB 177-3</td>
<td>PBB 173-5</td>
<td>PBB 177-4</td>
<td>PBB 177-5</td>
<td>PBB 177-6</td>
<td>PBB 177-7</td>
<td>PBB 177-9</td>
<td>PBB 177-10</td>
<td>PBB 181-8</td>
</tr>
<tr>
<td>&quot;Top area&quot;</td>
<td>-</td>
<td>-/ +</td>
<td>+</td>
<td>-/ +</td>
<td>+</td>
<td>-/+</td>
<td>-/+</td>
<td>-/+</td>
<td>+</td>
</tr>
<tr>
<td>&quot;Bottom area&quot;</td>
<td>+</td>
<td>+</td>
<td>-/+</td>
<td>+</td>
<td>+</td>
<td>-/+</td>
<td>-/+</td>
<td>-/+</td>
<td>-/+</td>
</tr>
</tbody>
</table>

Decrease of air bubbles in a SMP-based liquid membrane formulation is possible with:

- SURFYNOL® DF 178: quantity of 1% is needed, best results with 2%
- TEGO® Antifoam D 3944: quantity of 1.5% is needed, best results with 2%
- Combination SURFYNOL® DF 178: TEGO® Antifoam D 3944 (ratio 1:1): quantity of 1% is needed, best results with 2%
- only TEGOPREN® 5863: no convincing results
- Combination TEGOPREN® 5863: TEGO® Antifoam D 3944 (ratio 1:1): good results with 1.5%

"Top area":
liquid formulation is poured onto a substrate, additional treatment with a tooth-scraper takes place 1 min after application to bring in additional air bubbles

"Bottom area":
liquid formulation is poured onto a substrate, no additional treatment