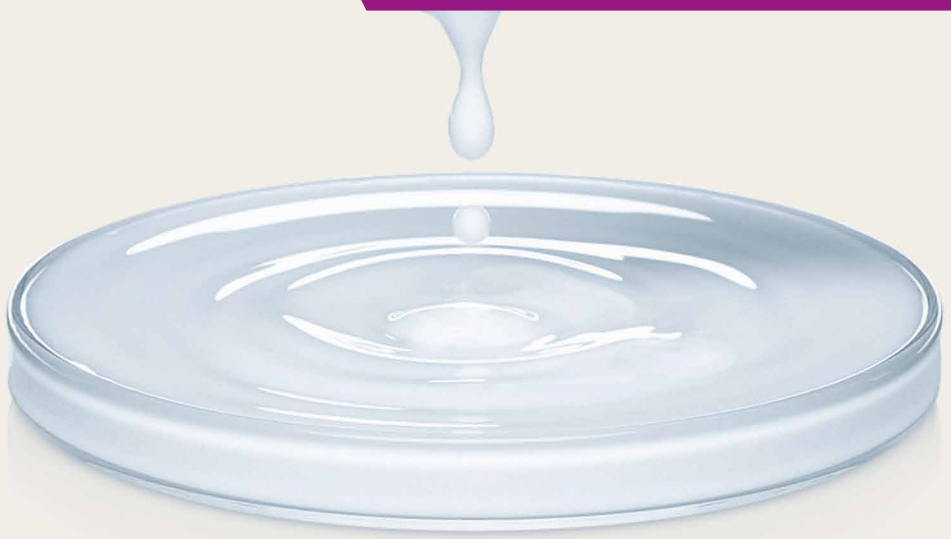
EVONIK INDUSTRIES

# Additives for Polymer Dispersions



Evonik. Power to create.

# About Us

Evonik Industries is the creative industrial group from Germany which operates in three business areas: Chemicals, Energy and Real Estate. Evonik is a global leader in specialty chemicals, an expert in power generation from hard coal and renewable energies, and one of the largest private residential real estate companies in Germany. Our strengths are creativity, specialization, continuous self-renewal, and reliability. Evonik is active in over 100 countries around the world.

The Business Line Industrial Specialties of Evonik Goldschmidt GmbH has its base in all kinds of organic specialty surfactants and organomodified siloxanes. We hold strong positions with antifoams, emulsifiers, corrosion inhibitors, dispersing aids, hydrophobing and wetting agents, softeners and radiation curable release coatings. Our broad product range, technological background and application know-how addresses several industries like plastics, rubber, label, tape and release liner manufacturing, construction, lubricants, agro, textile and tissue industry.

# Technology Solutions for Polymer Dispersions

Aqueous systems have become the preferred choice for various applications in numerous industries. Dispersions require additives and process aids during production and in their final application to provide the desired performance.

**Our Product Range**
- Antifoams
- Wetting agents
- Dispersing agents
- Thickeners
- Emulsifiers

**Utilization for**
- Polymerization process
- Dispersion compounding
- Final application of the polymer dispersion

Organosiloxane based additives – which represent our core technology – outperform conventional organic and silicone based products in most aspects.

In contrast to standard silicone oil formulations organomodified siloxanes combine high surface activity and efficiency with excellent compatibility in all common dispersion systems. This opens the door to new solutions, particularly in demanding applications. Organomodified siloxanes are a proven and invaluable tool in enhancing product quality and improving production efficiency.

This brochure will give you an overview about the chemistry and the additives that we offer for the production and application of polymer dispersions. We invite you to talk to our technical experts so that we can find the optimum solutions to your problem.

**Production**
- Acrylate
- Polyvinyl acetate (PVAc)
- Styrene butadiene rubber (SBR)
- Polyvinyl chloride (PVC)
- Polyurethane (PU)

- Antifoam agents
- Emulsifiers

**Application**
- Adhesives
- Paper refinement
- Paper impregnation

- Antifoam agents
- Wetting agents
- Dispersing agents
- Thickeners

# Antifoam Agents

## Walking a Tightrope between Efficiency and Compatibility

**Our production of antifoam agents is based on three classes of raw materials:**

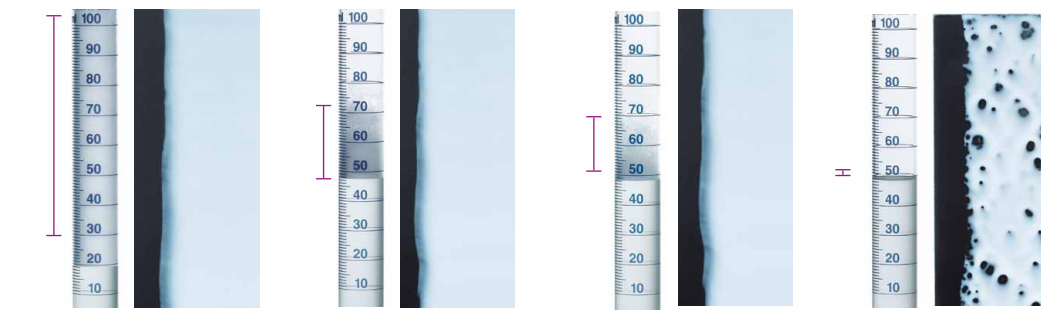
- Organomodified siloxanes
- Organic oils
- Silicone oils

Silicone oil-based antifoams are characterized by outstanding surface activity. This leads to excellent defoaming properties. But in addition to this positive characteristic of this product class, it shows some serious disadvantages. Silicone oils are quite incompatible and,therefore, may cause fish eyes and craters in many systems.

Organic oil-based antifoams are usually very compatible, causing no adverse effects in e. g. adhesive films. They show inferior defoaming action compared to silicone oil-based additives.

In order to overcome these problems, Evonik has selected organomodified siloxanes as being the additive class, which combines both the positive effects of organic oils and silicone oils, while at the same time lacking their disadvantages.

### Antifoam Performance versus Antifoam Compatibility




The carefully selected and formulated base materials provide excellent foam control and maximum compatibility at the same time. The well balanced raw material base leads to a wide range of excellent defoamers, suitable for a multitude of industry applications. Our antifoams do not adversely affect the performance of dispersions and have long-term stability, providing enhanced efficiency even after storage of the formulated dispersions. Our antifoams permit a high efficiency of production processes due to the avoidance of foam.

**Benefits of the TEGO® Antifoam Product Range**

- High efficiency
- Attractive cost/performance ratio
- Superior compatibility
- No negative side effects
- Long term efficiency
- Good handling characteristics

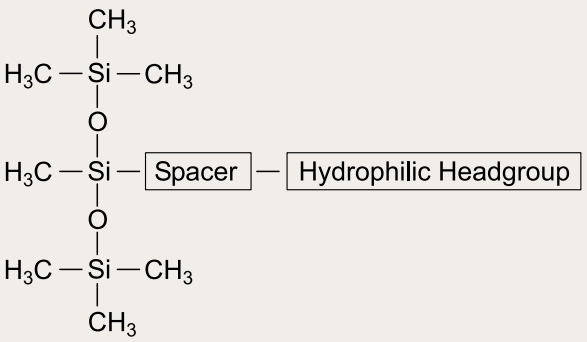
**Test Capabilities**

Defoaming is one of the core competencies of the Business Unit Consumer Specialties. The laboratories are able to perform various test methods. They are designed to reflect production as well as application processes.

- **Stirring test:** to determine foam behavior in the application of polymer dispersions (e.g. adhesives)
- **Sintered glass test:** to select appropriate antifoams for water based polymerizations
- **Draw down test:** to evaluate wetting and surface defects in film applications

# Wetting Agents

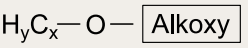
## Adding a Droplet for Perfect Surfaces

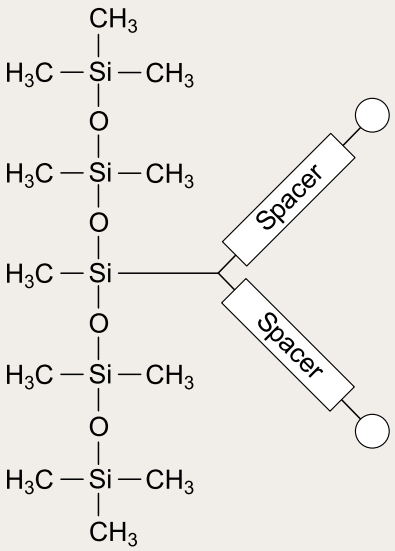


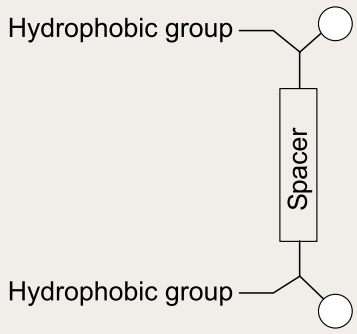

Wetting agents improve the wetting behavior of dispersions on substrates and diminish the defects caused by other additives at the same time. Wetting agents are very efficient even at low dosage rates. In order to cover the whole range of wetting applications in the dispersion market, we offer four lines of wetting agents.

For high performance applications (e.g. application of pressure sensitive adhesives on siliconized papers) our wetting agents, based on organomodified siloxanes, are perfectly suited to meet demanding requirements.

Alcohol alkoxylates are preferably recommended for highly dynamic processes. This product class is characterized by a very fast migration to the surface and by low foaming, which is beneficial for demanding applications of dispersion.



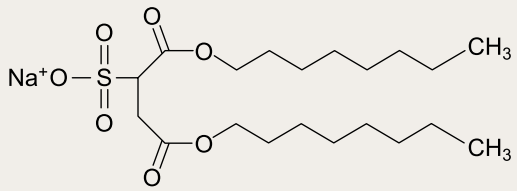



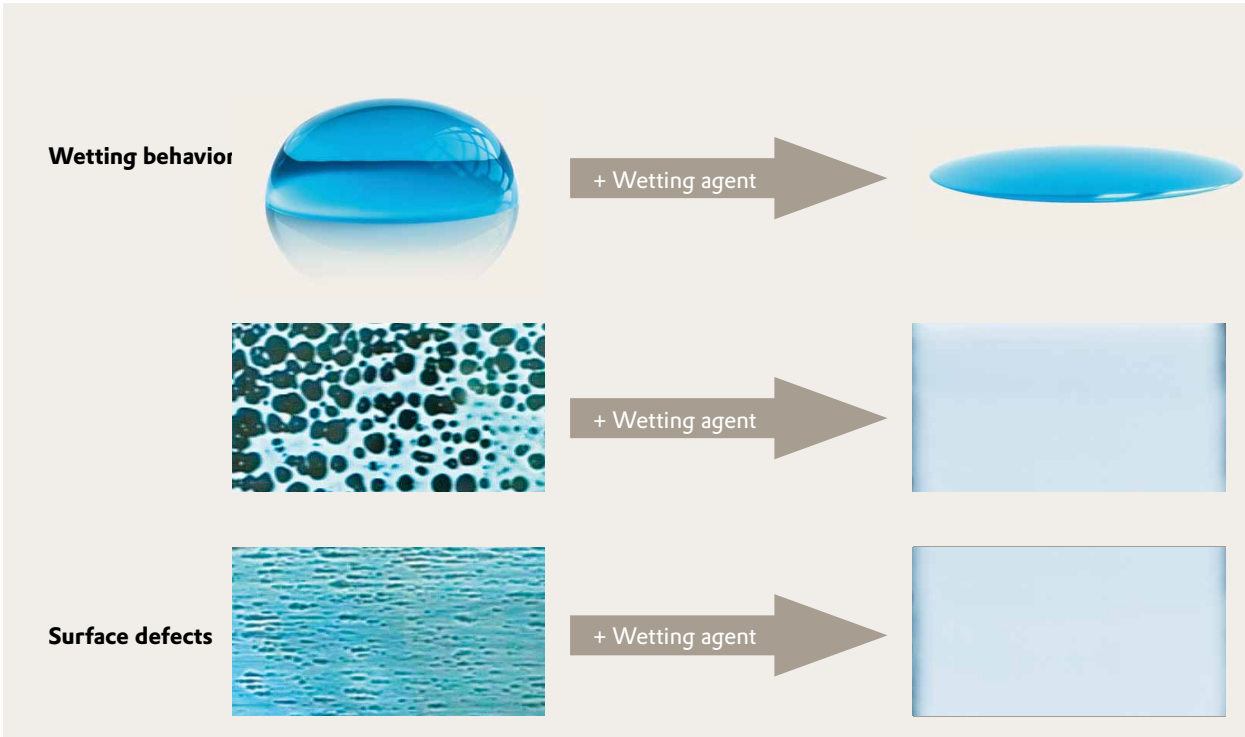

The Gemini Technology is characterized by very efficient wetting agents, which can act as such, even at lower concentrations.

They can be considered as two-in-one additives providing a combined property profile of excellent wetting behavior and good defoaming properties.

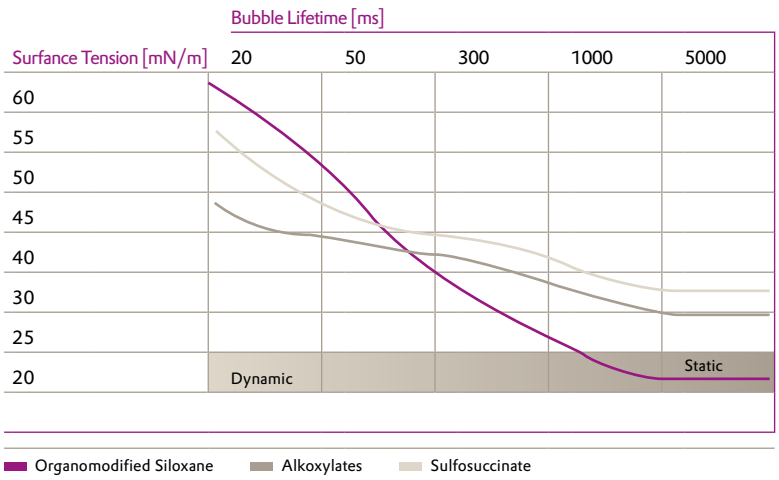
For standard applications, products based on sulfosuccinates are available.




## Improvement of Wetting Behavior and Decrease of Surface Defects

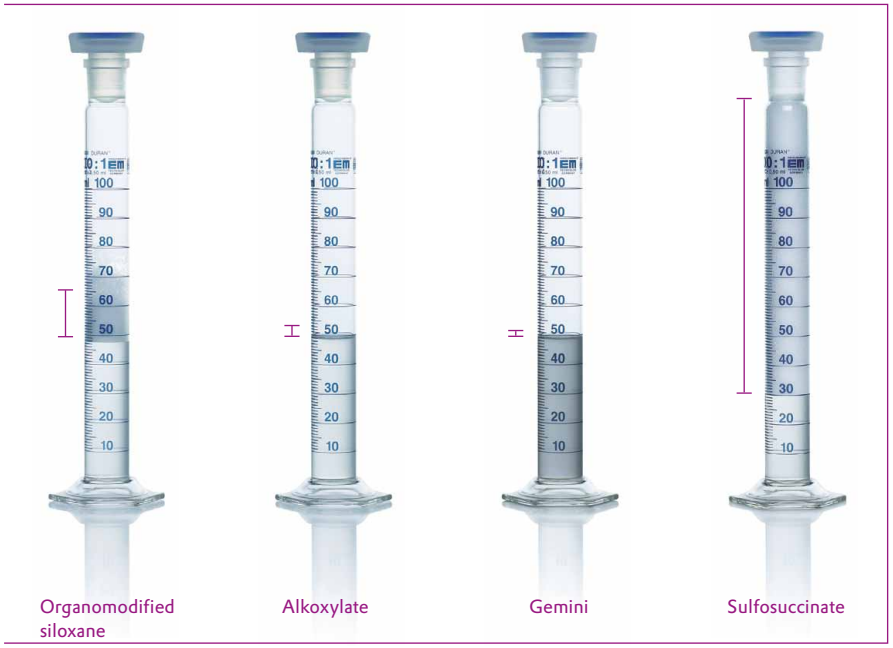


## Surface Tension (Bubble Pressure Tensiometer)




With our range of wetting agents we offer solutions for different application demands, ensuring outstanding lowering surface tension.

## Foam Tendency




Shaking tests of surfactants in water show the low foaming behavior of our special wetting agents. There are suitable products in our portfolio for your specific demand.

**Water Resistance**

The influence on the water resistance of polymer dispersions is oftentimes a critical issue. Although wetting agents are known to influence the water resistance significantly, they are indispensable in many applications. Common wetting agents like anionic surfactants, e.g sulfosuccinates show significant influence on the water resistance, which results in reduction of adhesion power and turbid films. Due to that reason, other wetting agent technologies are needed to meet this requirement.

Within our product range we offer wetting agents providing both good wetting abilities and good water resistance.


**Performance Benefits**

- Sulfosuccinates are the most common wetting agents. They show good wetting properties, but also significant foam formation.
- Organomodified siloxanes are oustandingly lowering the surface tension of aqueous media while showing a low foam formation.
- Alcohol alkoxylates are very fast and low foaming wetting agents.They are recommended for highly dynamic processes.
- Two-in-one gemini additives providing excellent wetting behavior and good-defoaming properties.

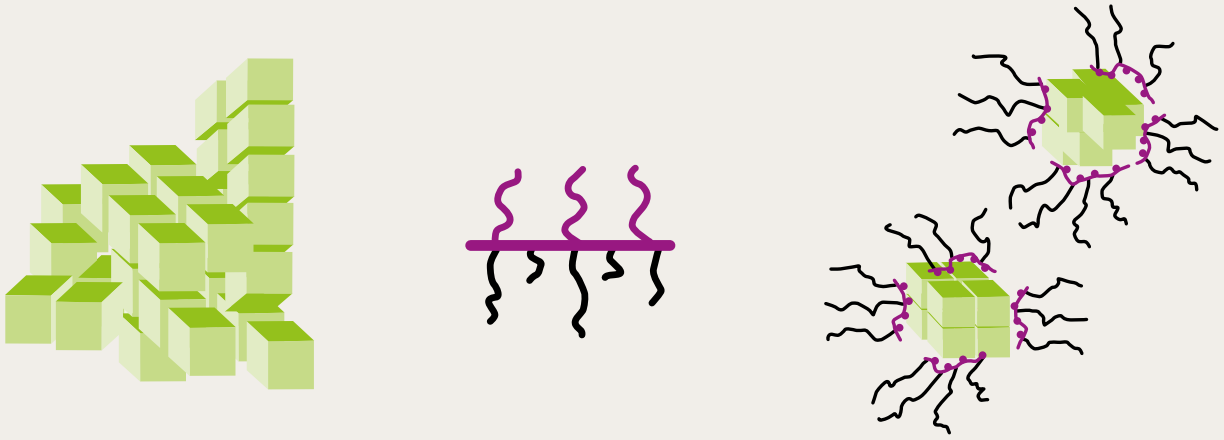
We are able to provide the right solution for your application.

# Dispersing Agents

## Stabilizing with Know How

Dispersing agents are surface-active ingredients, which ease the incorporation of pigments and fillers into a liquid. Agglomerates are broken up by shearing whereby new surfaces are created. They are wetted by dispersing agents which stabilize the aggregates of pigments or fillers. Dispersing agents have an amphiphilic structure which combines the following requirements:

They must be capable of being strongly adsorbed onto the particle surface and therefore possess specific anchoring groups. As a second requirement the molecule must contain polymeric chains that give steric stabilization in the required system. Dispersing agents can provide ionic stabilization if they contain anionic or cationic structure elements.



Low molecular surfactant structures with anionic groups are used in highly-filled inorganic pigment or filler pastes due to strong viscosity reduction, but can be used for organic pigments as well. Amphiphilic structures with high molecular weight have to be used in higher concentrations calculated on pigment in comparison to those discussed above. They are always recommended for pastes with requirements for long-term stability. Especially for expensive organic pigments this structure principle is technically and economically beneficial. Even titanium dioxide as high density material can be stabilized without significant settlement for several months.

Dispersing of $TiO_2$ with TEGOMER® DA

Dispersing of $TiO_2$ without dispersing agent

Dispersing agents do not only allow to make efficient use of the pigments coloration but guarantees stable dispersions without settlement and syneresis as well.

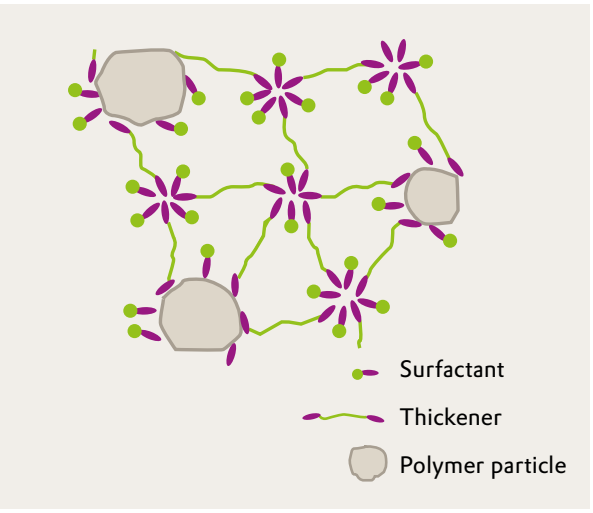
**Benefits of TEGOMER® DA Dispersing Additives**

- Higher loading of pigments and fillers
- Increased coloration or hiding power
- Reduction of specks
- Excellent dilution behavior
- No settlement

# Polyurethane Thickeners

## Providing Optimized Rheological Profiles

Thickeners are not only used to increase the viscosity of dispersions, but to adjust their rheological profiles, required for certain types of application processes. Our TEGO® Rheo additives, associative polyurethane thickeners, provide either newtonian or pseudoplastic flow behavior. The achievable thickening properties are excellent even at low pH-values. Moreover the product offers antimisting properties for gravure roll applications. Our polyurethane thickeners can be used for systems which need to show shear-thinning behavior as well as for systems that require a stable viscosity independent from shear forces, e.g. thick layer applications.



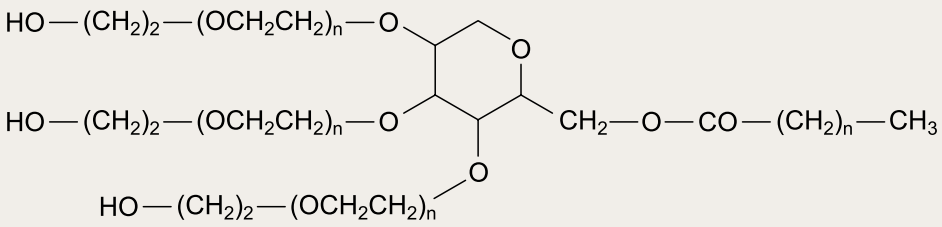

Associative polyurethane thickener – mode of action.

# Emulsifiers

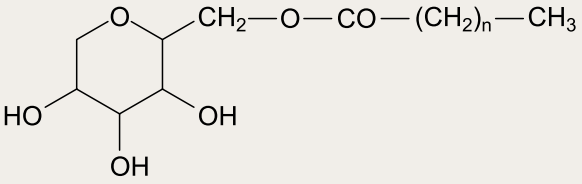
## Working at Interfaces balancing the Amphiphilicity

Evonik offers a broad range of emulsifiers based on different kinds of chemistry. Our emulsifiers are organic chemicals consisting of a hydrophilic and a lipophilic part. This structure allows these materials to work at interfaces. The non-polar lipophilic part of such a surfactant (surface active agent) is commonly a hydrocarbon chain, which can be linear or branched. Therefore, the affinity of the lipophilic part to water is low. On the other hand the hydrophilic part interacts strongly with water due to functional groups such as carboxyl, hydroxyl and phosphate groups. By balancing the hydrophilic and lipophilic parts the properties of a surfactant can be adjusted to the needs of different applications.

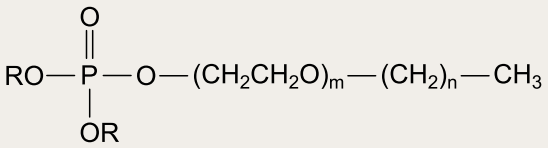
## Available Chemistry for Emulsifiers



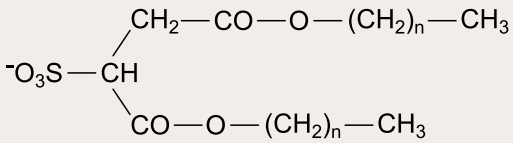
**Ethoxylated sorbitan ester**



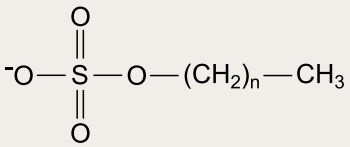
**Sorbitan ester**



**Phosphate ester**



**Sodium sulfosuccinate**



**Sulphate ester**


TEGO® Antifoam

TEGOPREN®

TEGO® Surten W

TEGO® Rheo

REWOPOL®

TEGO® Alkanol

TEGOMER® DA

REWOPHAT®

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