

Essentials for Metalworking Fluids



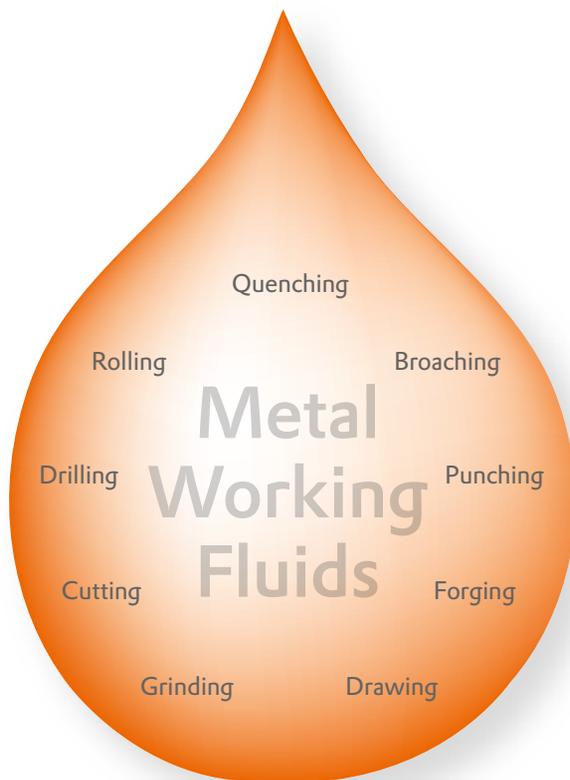
About Us

Evonik, the creative industrial group from Germany, is one of the world leaders in specialty chemicals. Its activities focus on the key megatrends health, nutrition, resource efficiency and globalization. Evonik benefits specifically from its innovative capability and integrated technology platforms. We apply our creativity daily to new, future-oriented solutions, aligning ourselves to future markets with highly promising growth dynamics, and developing essential and indispensable solutions for our customers.

The Business Line Interface & Performance of Evonik Nutrition & Care 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 polymers, rubber, label, tape and release liner manufacturing, construction, lubricants, agro, textile and tissue industry.

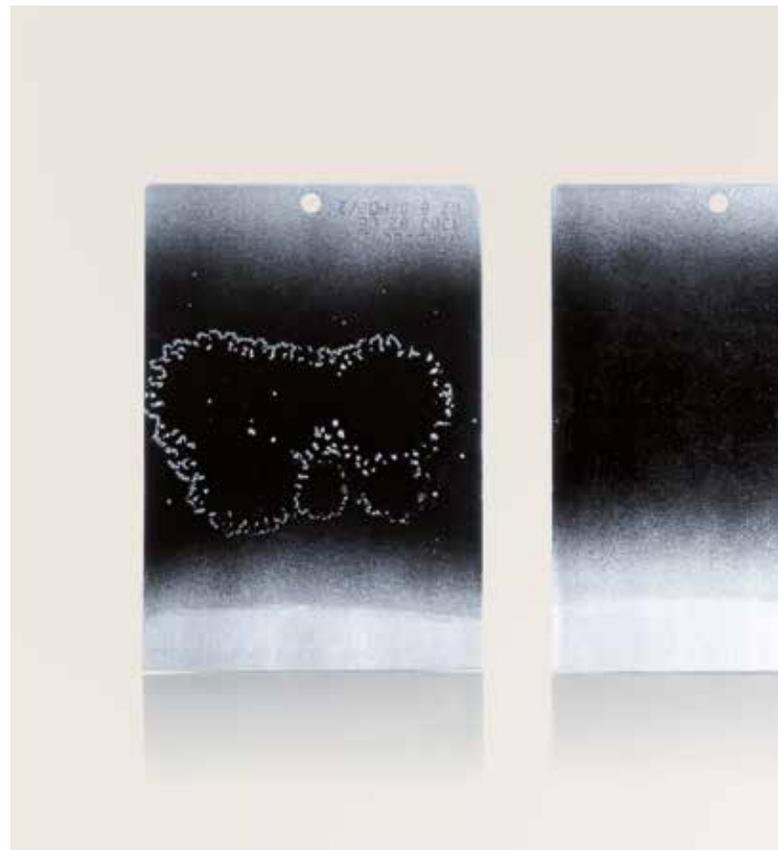
Multifunctional Additives for Metalworking Fluids

Evonik is passionate about developing products, processes and solutions that make a difference. At the same time we are committed to environmental responsibility and worker safety. To a large extent our products are made from renewable resources. Additives are integral components of metalworking fluid formulations and render simple base fluids into high-performance coolants for metalworking applications. By using suitable additives the physical and chemical properties of a given base fluid can be fine-tuned to fulfill the ever increasing requirements of a specific metalworking process. Most of these additives are surface-active products that help control interfacial phenomena. We, as a globally recognized supplier of specialty surface-active additives, offer a wide range of foam control agents, emulsifiers, and corrosion inhibitors as well as chemical and technological know-how for metalworking fluid formulators. Today our additives for metalworking fluids are found in widespread applications in the various individual metalworking operation steps.



Our products are commonly used in many metalworking fluids for the beside mentioned applications/ processes.

TAGAT® and TEGIN® products are commonly applied as emulsifiers for metalworking fluids based on mineral or ester oils for grinding or cutting. REWOCOROS® products provide excellent corrosion resistance to newly formed metal surfaces. They can be used in various operations like drilling. When it comes to control of foam problems the right answer can be found in our well-balanced TEGO® Antifoam product range.



Left picture: CNOMO foam test; Right picture: Paintability test on steel plates treated with silicone oil-based defoamer (left) and TEGO® Antifoam organomodified siloxane-based (right).

Foam Control Agents

Walking a tightrope between efficiency and compatibility

Based on more than 50 years of experience in defoaming technology and in the production of organomodified siloxanes, our defoamers set the benchmark in terms of efficiency, compatibility, and longevity. One of the major advantages of organomodified siloxane based defoamers over silicone oil-based defoamers is that they do not have adverse effects on finishing processes. Our product portfolio also provides solutions for applications in which a defoamer must not contain any silicone, whether in the form of silica, silicone oil or siloxane.

Base materials of TEGO® Antifoam

- Organomodified siloxanes
- Mineral and vegetable oils
- Silicone oils
- Specially designed hydrophobic particles based on silica and organic waxes

TEGO® Antifoam agents are suitable for all kinds of water miscible metalworking fluids including soluble oils, semi synthetic fluids and full synthetic fluids (oil free). They find use in metalworking fluid concentrates and as tank side defoamers.

Benefits of TEGO® Antifoam

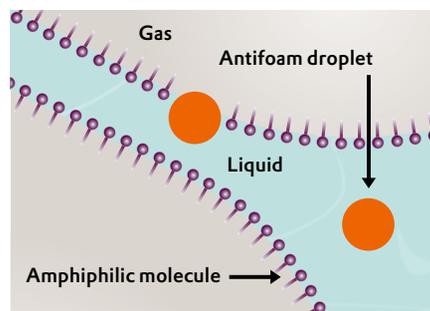
- Highly efficient regarding foam control and foam prevention
- Excellent foam knock down and hold down
- High compatibility
- No adverse effects on finishing processes*
- Good filterability – TEGO® Antifoam agents maintain their excellent performance even after several filtration cycles

* In contrast to silicone oil-containing antifoams where paintability problems may occur

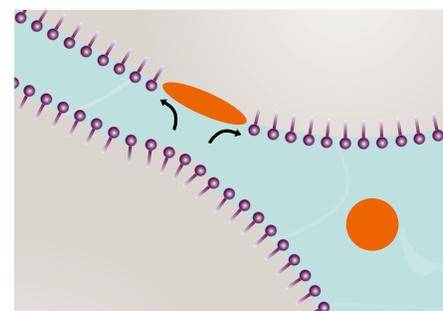


Mode of Action of Defoamers

The mode of action of foam control agents can roughly be described as a two-step process, first the discrete droplets enter the air/water interface and subsequently spread within this interface.



Entering



Spreading

In order to be effective, foam control agents have to form discrete droplets in the metalworking fluid. Against this background it is quite a challenge to achieve the right balance between compatibility of the defoamer with the matrix and foam control efficiency (initial and long term). To walk this tightrope, organomodified siloxanes are the most suitable and versatile products. Taking into account the numerous formulations consisting of different base fluids and a variety of amphiphilic additives, the defoamer of choice is rather system-specific. TEGO® Antifoam agents are highly efficient with respect to control of existing foam, foam prevention and minimization of further foam formation. Thus they can be regarded as defoamers and antifoam agents at the same time.

Due to the constantly increasing shelf life of metalworking fluids, fluid management including processes such as filtration is gaining greater importance. Long term stability of antifoams in metalworking flu-

ids is highly desirable in order to minimize the addition of tank side antifoam. Many antifoams lose their antifoaming efficiency because of the filtration process, wax based antifoams are particularly prone to a loss of efficiency. In contrast TEGO® Antifoam agents maintain their excellent antifoaming performance even after several filtration cycles which results in major cost savings.

In summary, TEGO® Antifoam agents are based on carefully selected and designed base materials in order to provide the best possible antifoam efficiency for a given application while minimizing the potential for negative side effects.



Emulsifiers from Renewable Resources

Caring about nature

The environmentally friendly nonionic emulsifiers and co-emulsifiers of Evonik are based on glycerol fatty acid ester and sorbitan ester chemistry. From either chemistry base emulsifiers and co-emulsifiers are available which additionally improve lubrication. Our emulsifiers combine outstanding performance with excellent toxicological, ecological and dermatological properties.

Benefits of glycerol fatty acid esters

- Excellent emulsifying and stabilizing properties
- Improve lubricating properties of the metalworking fluid
- Allow for reduced amount of antifoam (in the case of TAGAT® V 20 and TAGAT® V 15)
- Enhanced solubility of biocides/ fungicides
- Synergistic effects with ethoxylated fatty alcohols
- Excellent solubility in vegetable and synthetic ester oils
- Derived from renewable resources
- No skin irritation
- Low water hazard classification

Our emulsifiers can be used with most base oils. To emulsify a specific oil, emulsifiers with precisely adjusted HLB values are needed. For this reason the required HLB value needs to be adjusted by blending emulsifiers with appropriate co-emulsifiers. Our regional technical service will assist you in finding the right formulations. Rely on our long-standing experience and know-how and save valuable time.



Multifunctional Corrosion Inhibitors

For a safer working environment

The REWOCOROS® product line includes a broad range of multifunctional corrosion inhibitors for the formulation of water miscible metalworking and non-flammable hydraulic fluids.

Benefits of REWOCOROS® corrosion inhibitors

- Outstanding corrosion protection
- Excellent co-emulsifying properties
- Improved lubricating properties of the metalworking fluid

Corrosion inhibitor product range

- Fatty acid amides
- Boric acid amine blends
- Carboxylic acid derivatives

REWOCOROS® corrosion inhibitors are a basic component for the formulation of water based metalworking fluids and water miscible, non-flammable hydraulic fluids. We also offer products that are particularly suitable for the processing of aluminium.



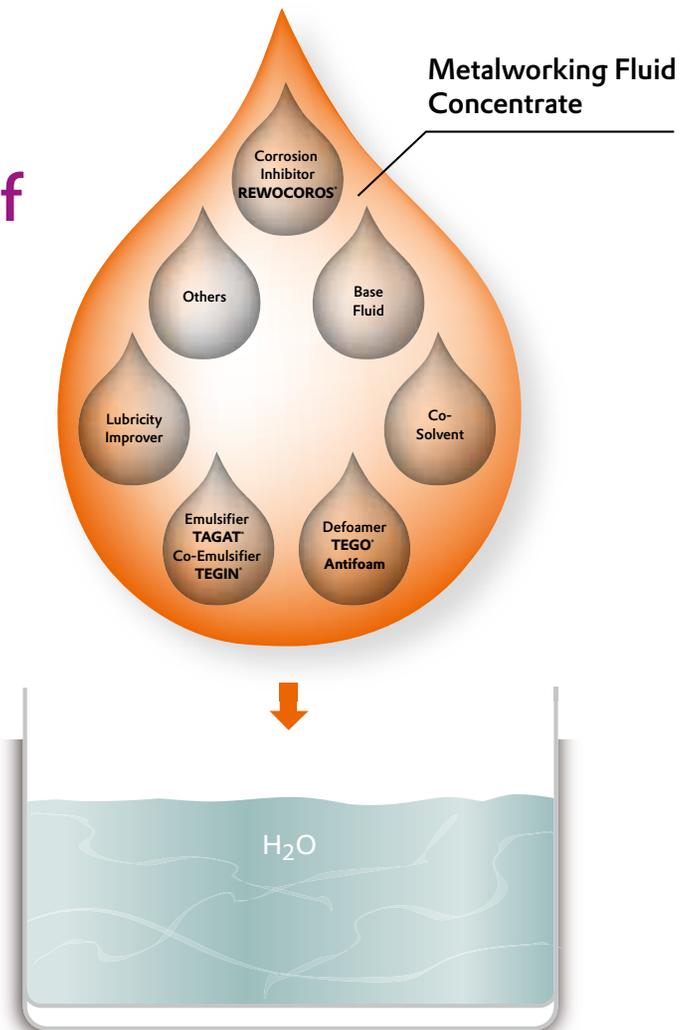
Filter chip test



General Composition of Metalworking Fluids

More than just another bunch of metalworking fluid additives

Evonik products for metalworking fluids are more than just some other additives. Our mission is to add value to our customers' metalworking fluid formulations by offering innovative and multi-functional additives as well as technical expertise. The following exemplary formulations of metal working fluids provide an idea of the diverse ways in which our products may be applied. Of course, we are well aware of the fact that each metalworking fluid formulator has his own know how and techniques to formulate metalworking fluids. Therefore, these guide formulations are meant to be a starting point for further optimization of formulations.



Specific examples

Mineral oil based

77.9 %	NYNAS Base Stock T 22
5.0 %	TAGAT® V 20
5.0 %	PEG-5 Oleyl- / Cetyl alcohol
8.0 %	REWOCOROS® AC 101*
4.0 %	SYLFAT® 2 / Tall oil fatty acid
	TEGO® Antifoam / Biocide, EP- / AW-Additives if necessary

Semi synthetic oil based

32.8 %	SHELL FLAVEX® 913 (= SHELL GADUS® pH 8 / 40)
12.0 %	REWOCOROS® AC 101*
8.5 %	TAGAT® V 20
23.5 %	REWOCOROS® RA B 60 S
14.0 %	Demineralized water
6.0 %	SYLFAT® 2 / Tall oil fatty acid
3.0 %	ISOFOL® 16 / Condea 2-Hexyl-decane-1-ol
	TEGO® Antifoam / Biocide, EP- / AW-Additives if necessary

Ester oil based

65.0 %	SYNATIVE® ES TMP 05 / Cognis, Trimethylolpropane trioleate
25.0 %	TAGAT® V 15
10.0 %	REWOCOROS® AC 101*
	TEGO® Antifoam / Biocide, EP- / AW-Additives if necessary

* Rewocoros® AC 100 US for The Americas

Innovation in Practice

The focus of Evonik is to add value to our customer's metalworking fluid formulations by offering innovative additives and technical expertise. Our analytical department offers almost everything ranging from simple standard wet tests to NMR spectroscopy, GCMS, HPLC, ICP, and FTIR.



Mini Traction Machine

For the development and evaluation of additives for metalworking fluid our innovation center applies the following test procedures:

Foam control agents:

- Recirculation tests
 - CNOMO foam test D 65 5212
 - VSI Haake foam tester
- Stirring test
- Shaking test
- Ultra-Turrax test
- Sintered glass test

Emulsifiers:

- LUMiFuge
- Coulter Particle Counter/Sizer
- Thermogravimetric analysis

Corrosion inhibitors:

- Video enhanced contrast microscopy
- Chip filter test (DIN 51360)
- Electrochemical impedance spectroscopy
- Bimetallic corrosion coupon test

Tribology:

- Mini Traction Machine (MTM)
- Microtap Megatap II-G 8

TEGO® Antifoam

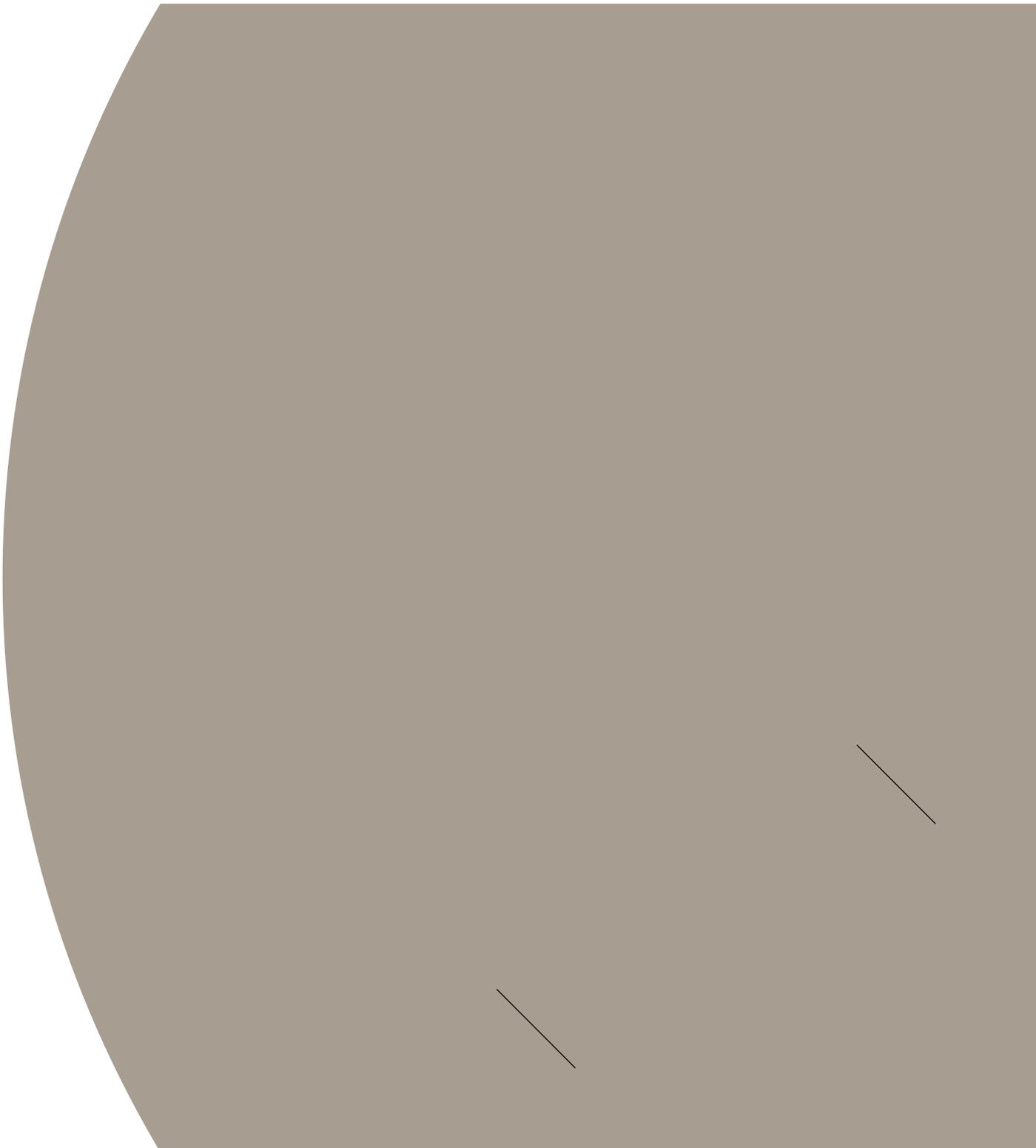
TAGAT®

REWOCOROS®

TEGOPREN®

TEGIN®





www.evonik.com/metalworking-fluids



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