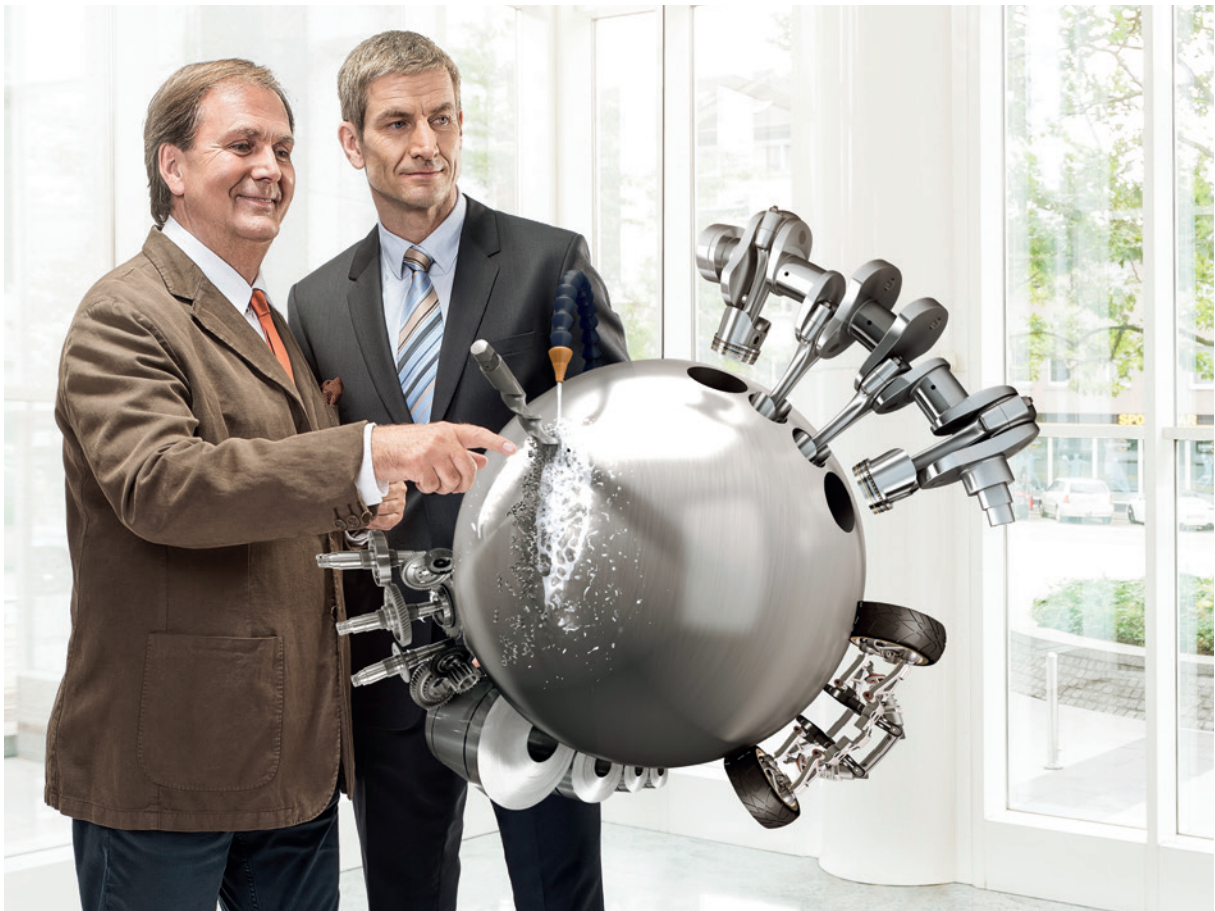


Antifoams for Metalworking Fluids



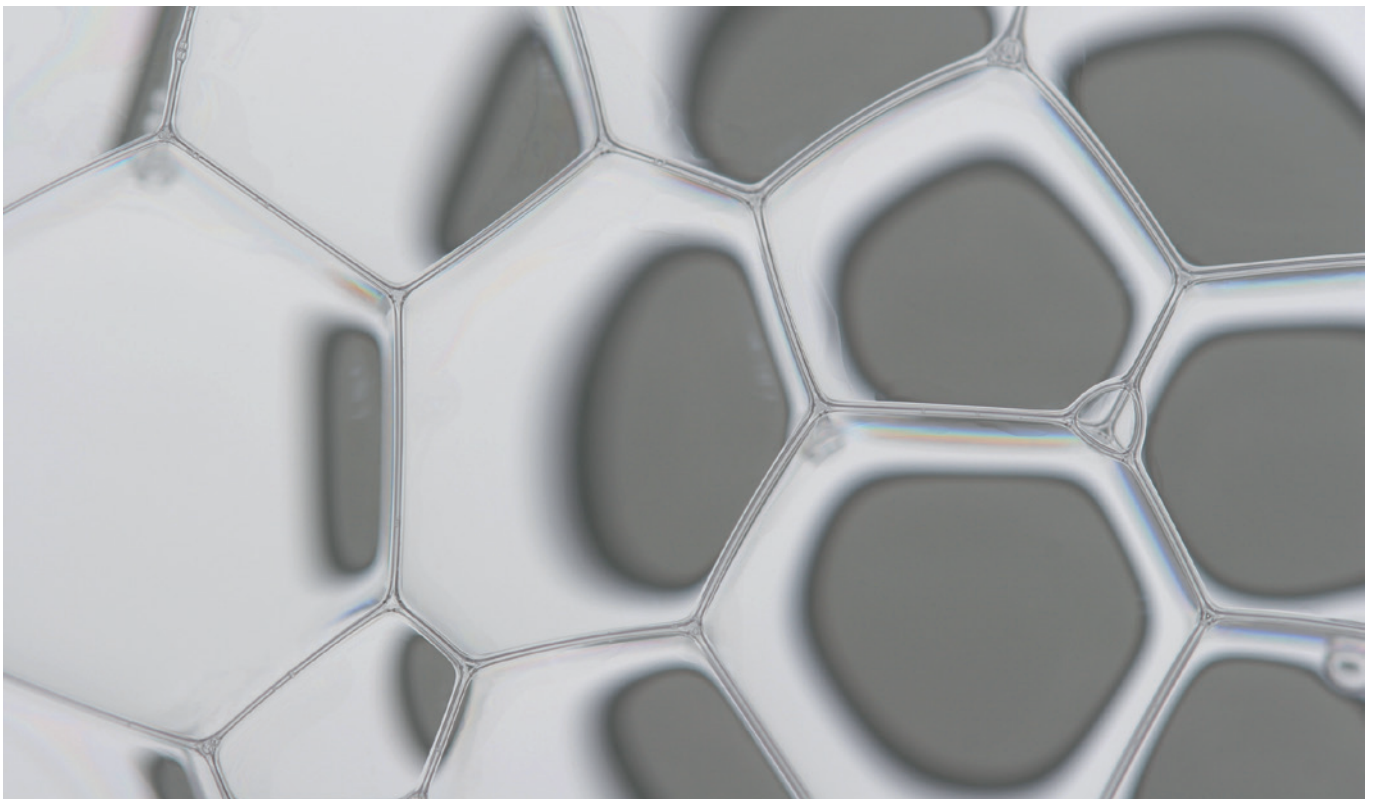
TEGO[®] ANTIFOAM – FOAM CONTROL AGENTS

EFFICIENCY MEETS COMPATIBILITY

Aqueous metalworking fluids contain in addition to base oil, amphiphilic components such as emulsifiers, dispersants or wetting agents. While these components are essential to the metalworking fluid's performance, they often lead to foam formation during production or application.

Foam can negatively influence the cooling efficiency or lubrication properties of the metalworking fluid and limits the visual inspection of the working process. The foam control agents of Evonik are designed to avoid the formation of foam and ensure optimal product performance.

Based on more than 50 years of experience in defoaming technology and in the production of organomodified siloxanes, our defoamers set the benchmark for performance in terms of efficiency, compatibility and durability.



TEGO[®] ANTIFOAM AGENTS FOR METAL WORKING FLUIDS

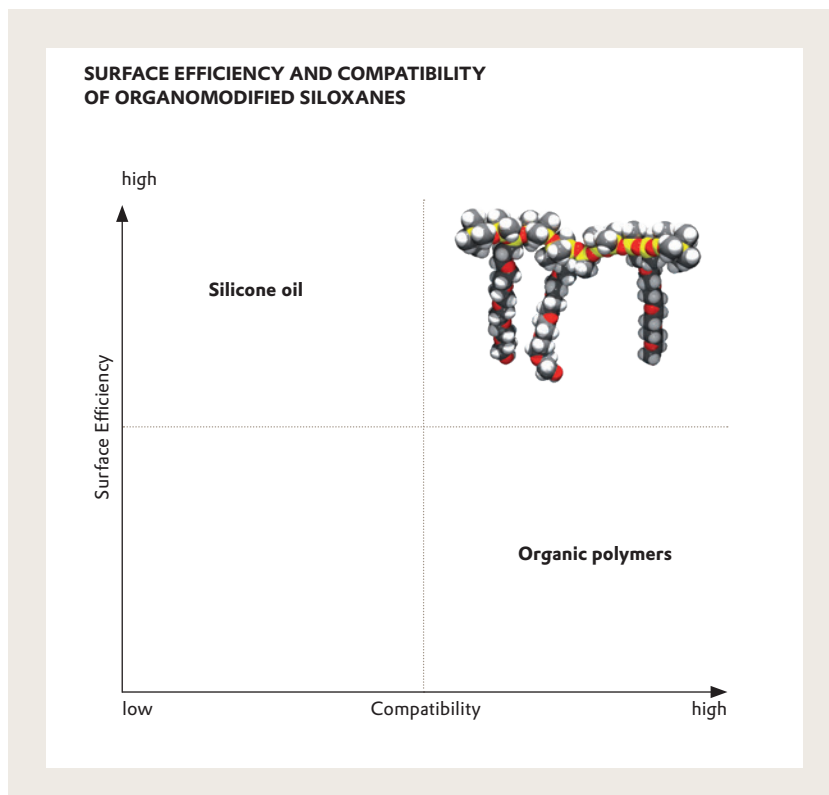
ORGANOMODIFIED SILOXANES MAKE A DIFFERENCE

Generally, organic antifoams combine excellent compatibility with moderate efficiency. On the other hand, silicone oil-based antifoams offer high efficiency with often poor compatibility. Organomodified siloxane based antifoams combine the best properties of

these two worlds. TEGO[®] Antifoam technology is the perfect combination of organomodified siloxane technology with specially designed hydrophobic particles.

BASE MATERIALS OF TEGO[®] ANTIFOAM

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



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
- Excellent performance even after several filtration cycles

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

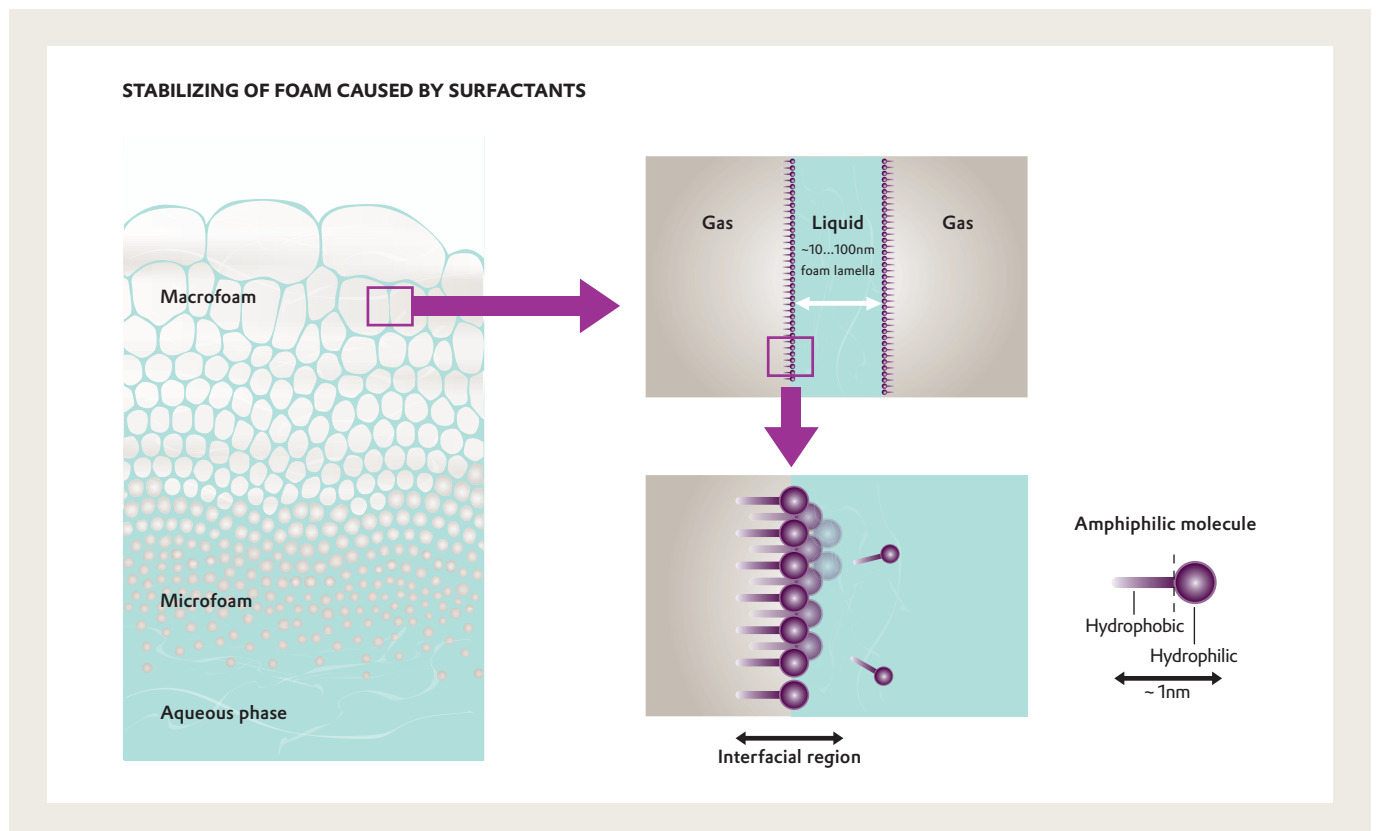
WHAT IS FOAM?

Generally speaking, foam is a dispersion of gas bubbles in a liquid. There is a general distinction between macrofoam, which is stabilized polyhedral foam characterized by thin liquid films and high gas volume, and entrained air of smaller volume in form of roughly spherical bubbles, known as microfoam. Foam is not thermodynamically stable as the formation of the interfaces air/liquid needs energy (surface tension). This makes it intrinsically more favorable to form a minimal surface by completely separating air and liquid. In the case of aqueous foams this separation of

the phases – the breaking of the foam – can be drastically slowed down by the presence of surfactants as emulsifiers, dispersants or wetting agents. These surfactants consist of a hydrophilic and a hydrophobic part. Due to this amphiphilic characteristic they readily adsorb at the water/air interface. When the water between the bubbles has drained to an extent, that a polyhedral foam with low water content and thin lamella has formed, surfactants retard further drainage through several mechanisms. As a consequence foam formation and foam stabilization is enhanced.

WHAT PROBLEMS OCCUR FROM FOAM?

- Reduced lubricity and cooling
- Obstruction of visual inspection of work pieces
- Promotion of oxidation and bacteria growth
- Decreased coolant supply and chip removal

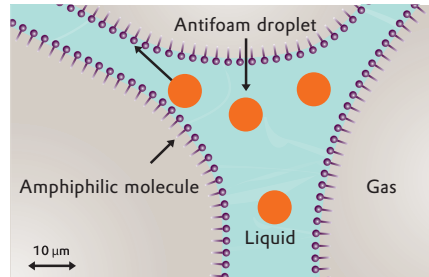


HOW DO TEGO® ANTIFOAM AGENTS WORK?

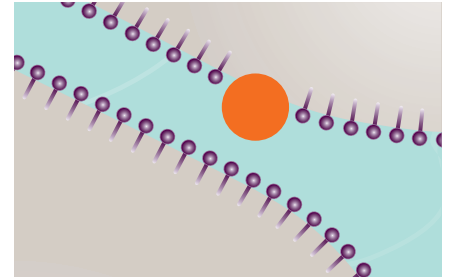
DEFOAMING MECHANISM

There is no single defoamer theory, however, some explanations and prerequisites for effective defoamers for water-miscible metalworking fluids are known. The main component of a TEGO® Antifoam formulation for aqueous systems is a hydrophobic oil which must be insoluble in the foaming medium, thus forming small droplets in the fluid that should be defoamed. This oil must have a low surface tension, particularly lower than that of the foaming medium. Under these conditions the droplet has a tendency to enter the surface of the foam lamella. If its surface tension is low enough it will start spreading within the lamella surface exerting a strong drag on the underlying layers of water, leading to a thinning and subsequent rupture of the foam lamella.

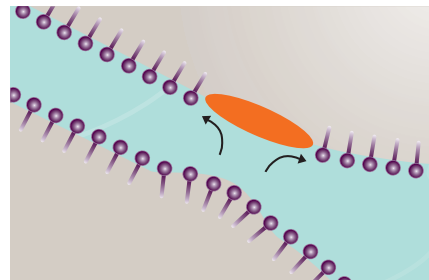
The entering step has an activation barrier as the droplet must push aside the surfactants in the air/water interface. This step often can be accelerated by the addition of finely dispersed hydrophobic particles. The design of the hydrophobic particle is crucial in order to provide for enhanced defoamer efficiency and temperature stability. These small particles are present in the defoamer oil/water interface and can easily enter the air/water interface. The dewetting caused by the hydrophobic particle enable the oil droplet to enter the foam lamella.



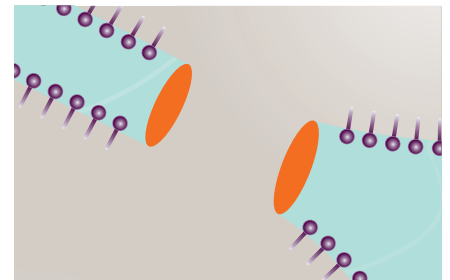
Defoamer oil droplet in foam lamella, which stabilized by surfactants



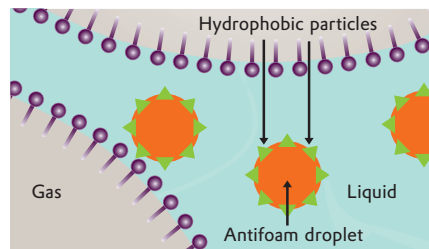
Entering of defoamer oil droplet in air/water interface



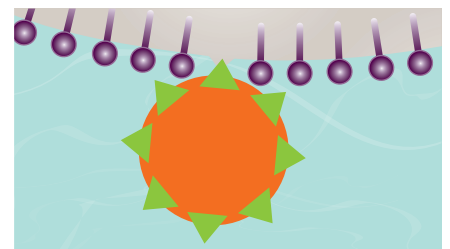
Spreading of defoamer oil droplet on air/water interface



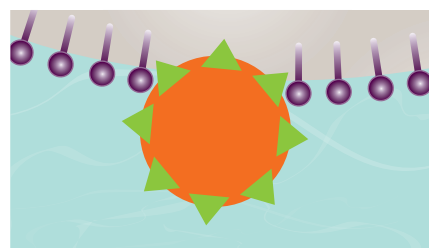
Rupture of foam lamella



Defoamer oil droplet with hydrophobic particles



Dewetting by particle



Entering of defoamer oil droplet in air/water interface

TEST PROCEDURES

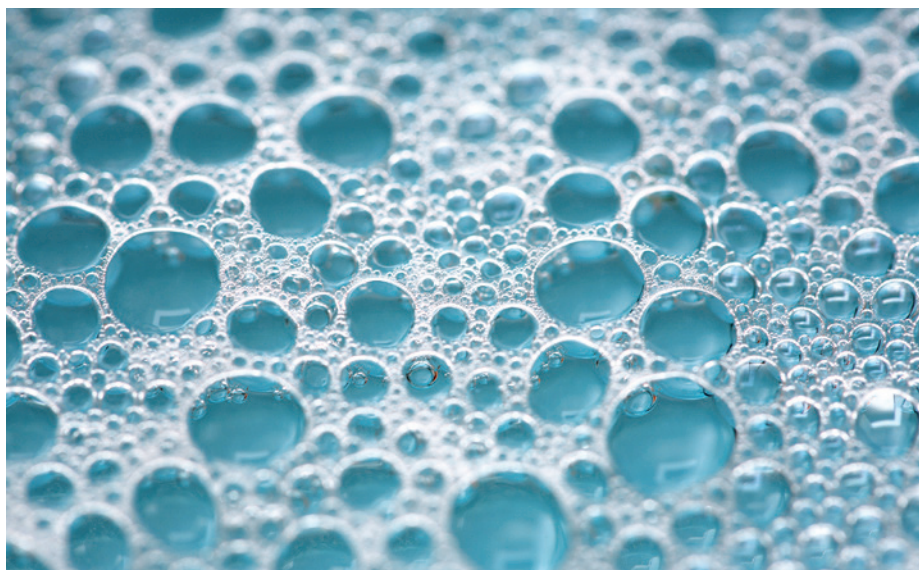
The following test procedures are applied to test our antifoam products in aqueous metal working formulations:

- Recirculation tests:
 - CNOMO foam test D 65 5212
 - VSI Haake foam tester
- Stirring test
- Shaking test
- General Motor's test (sintered glass test)
- Ultra-Turrax test

TEGO® Antifoam Product Table

TRADE NAME	ACTIVE MATTER (%)	PRE-DEFOAMING OF		POST-DEFOAMING OF	
		EMULSIFYABLE FLUIDS	WATER SOLUBLE FLUIDS	EMULSIFYABLE FLUIDS	WATER SOLUBLE FLUIDS
TEGO® Antifoam 793	100	•	•	•	•
TEGO® Antifoam 14	100	•	•	•	•
TEGO® Antifoam MR 2124	100	•		•	
TEGO® Antifoam 2205	100	•			
TEGO® Antifoam MR 1015	70	•		•	•
TEGO® Antifoam 691	100	•	•		
TEGO® Antifoam 692	100	•	•		
TEGO® Antifoam 1488	20			•	

• = recommended



DESCRIPTION OF TEGO® ANTIFOAM PRODUCTS

TEGO® Antifoam agents of our product range can be used for foam control in a broad range of aqueous metal working formulations. Which candidate is the best choice for a given application depends on our customers requirements and on composition of the overall formulation. Initial direction can be taken from the product description.

TEGO® ANTIFOAM 793

Highly efficient and compatible post-defoamer for all types of water miscible metalworking fluids; can also be used in concentrates (pre-defoaming) and particularly in soluble oils. The product provides excellent foam knockdown. Due to its excellent filterability it minimizes the amount of additional tank side defoamer.

TEGO® ANTIFOAM 14

Highly compatible antifoam for the use in water miscible metalworking fluid concentrates – particularly for soluble oils, as tank side defoamer and in metal cleaners.

TEGO® ANTIFOAM MR 2124

Silicon-free defoamer for water miscible metalworking fluids provides improved filterability compared to competitive wax-based antifoams; mainly applicable for tank side addition.

TEGO® ANTIFOAM 2205

Silicon-free antifoam with improved filterability in comparison to competitive wax-based antifoams, recommended for the use in water miscible metalworking fluid concentrates.

TEGO® ANTIFOAM MR 1015

Antifoam containing organomodified siloxane and silicone oil suitable for all types of water miscible metal working fluids; can be used in water miscible metalworking fluid concentrates and as tank side defoamer. It exhibits excellent alkaline stability even at higher temperatures.

TEGO® ANTIFOAM 1488

Antifoam containing 20% actives based on organomodified siloxane. Suitable as a post-defoamer for water miscible metalworking fluids and as a tank side defoamer.

TEGO® ANTIFOAM 691 AND 692

Highly efficient and compatible pre-defoamer for the formulation of stable concentrates of water-miscible lubricants. It provides excellent foam knock down and hold down even at low dosage levels and shows an outstanding long-lasting defoaming persistence.



More information can be found on the global web page: www.evonik.com/metalworking-fluids



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