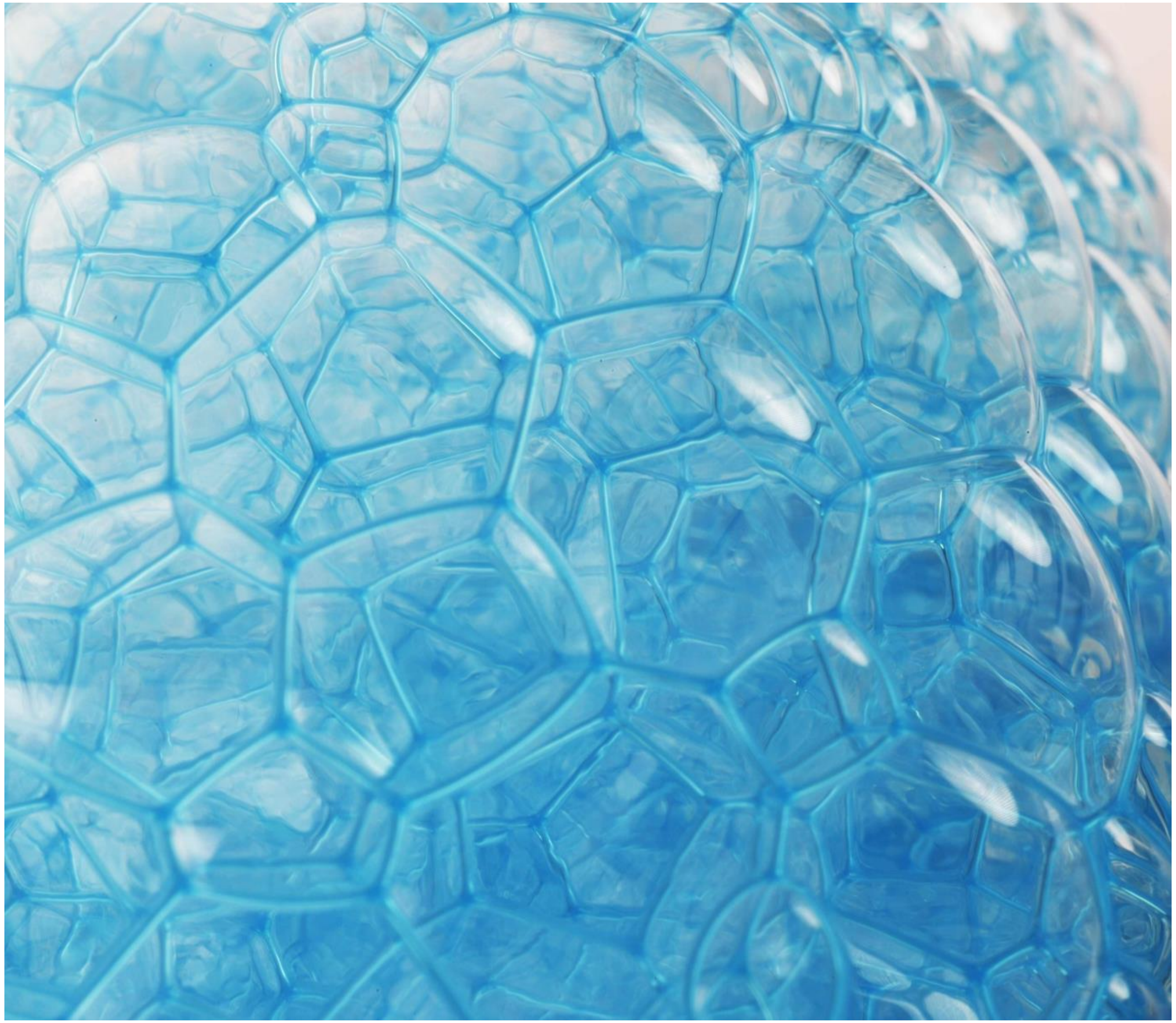
Antifoams based on organo-modified Siloxanes (OMS) for water-miscible Lubricants

Pre- and Post-Defoamers



Evonik Operations GmbH – Specialty Additives
Interface & Performance
August 2023

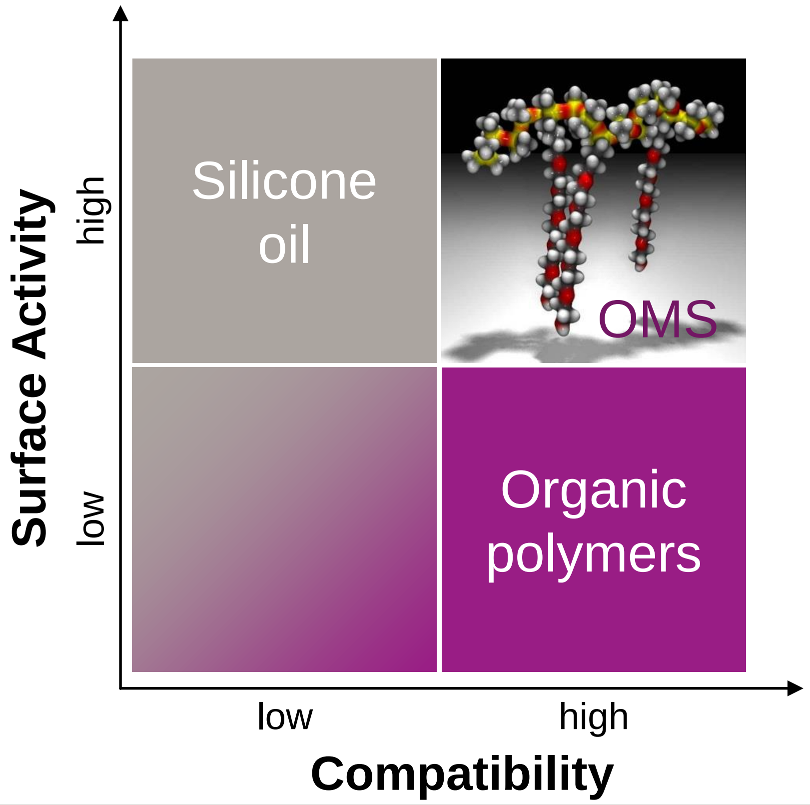
OMS based TEGO® Antifoams from Evonik for water-miscible Lubricants

- Evonik offers a wide range of TEGO® Antifoam products based on organo-modified siloxanes (OMS) that are used in various industrial applications to prevent foam formation in water-borne systems
- In the following, the **focus will be on antifoams** that have already proven to be particularly effective for pre- and/or post-defoaming of water-miscible lubricants (e.g. MWF)

Water-miscible lubricants

- **Pre-defoaming of concentrates**
  - TEGO® Antifoam 793
  - TEGO® Antifoam 14
  - TEGO® Antifoam 691
  - TEGO® Antifoam 692
- **Post-defoaming of emulsions/solutions**
  - TEGO® Antifoam 793
  - TEGO® Antifoam 14
  - TEGO® Antifoam 1488

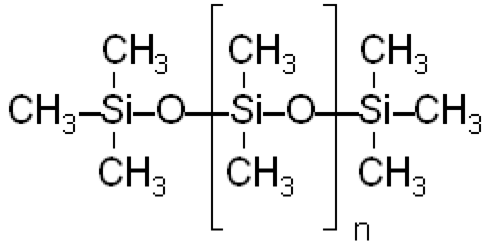
Antifoams based on organo-modified Siloxanes (OMS)



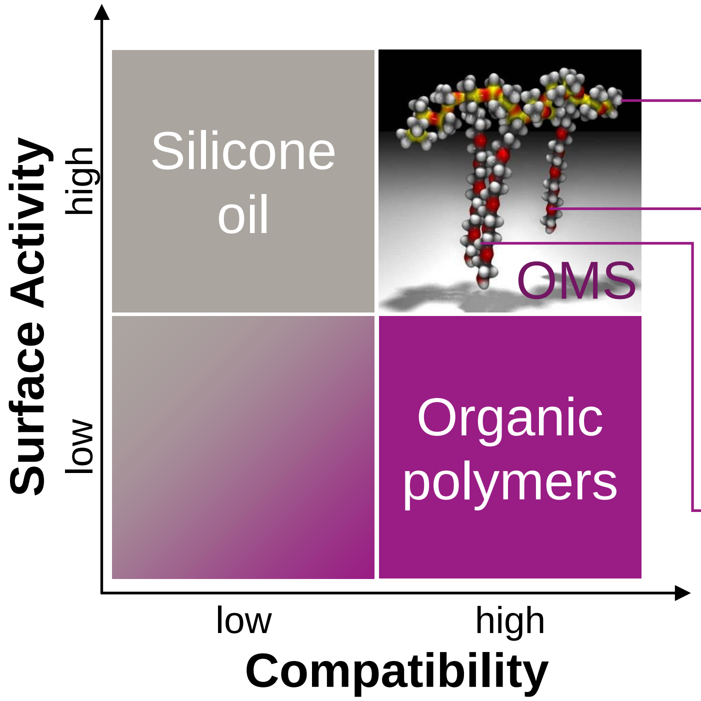
Organo-modified Siloxanes (OMS)

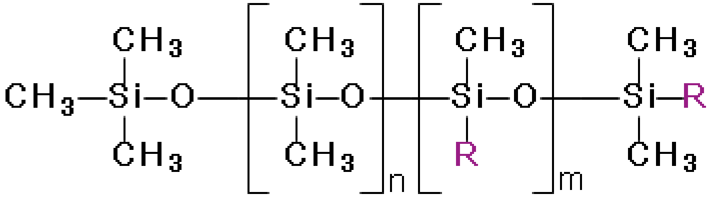
- Combine the high efficiency of silicone oils due to their low surface tension
- With the high compatibility of antifoams based on organic oils
- Highly stable in MWF concentrates
- Minimum influence on the shelf life of water-mixed fluids
- No adverse effects on finishing processes
- Highly cost efficient

No fear of Antifoams based on organo-modified Siloxanes (OMS)



Example for a Polydimethylsiloxane





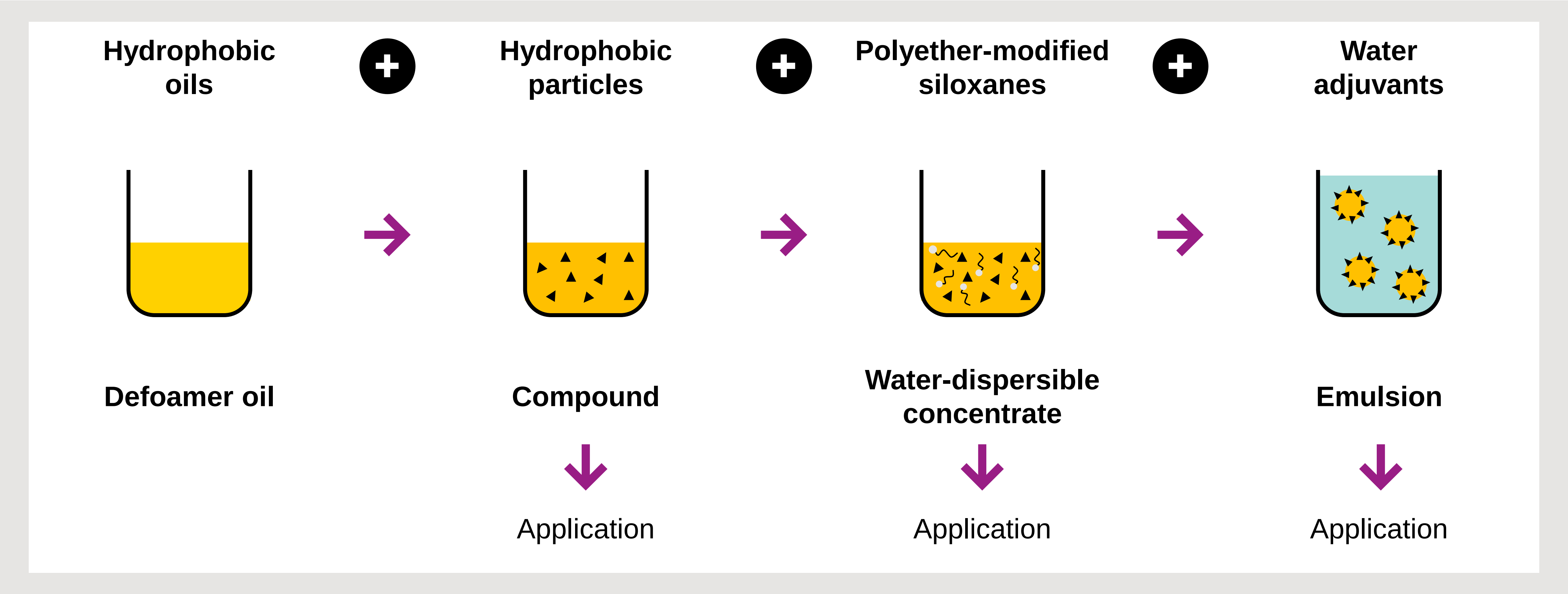
Example for an organo-modified Siloxane

- **Silicone backbone** provides high surface activity
- **Organic side groups** provide compatibility with the matrix

Downstream Effects

Use of antifoams based on…

Composition of Antifoams based on OMS



TEGO® Antifoams for water-miscible Lubricants – proven Products

Product	Based on		Active	Pre-defoaming of		Post-defoaming of	
	defoamer oil	hydrophobic particle	matter [%]	emulsifiable fluids	water soluble fluids	emulsifiable fluids	water soluble fluids
TEGO® Antifoam 793	OMS	Silica	100	●	●	●	●
TEGO® Antifoam 14	OMS	Silica	100	●	●	●	●
TEGO® Antifoam 691	OMS	Silica	100	●	○		
TEGO® Antifoam 692	OMS	Silica	100	●	○		
TEGO® Antifoam 1488	OMS	Silica	20			●	

● recommended ○ depending on fluid composition

TEGO® Antifoam 793 & TEGO® Antifoam 14

Composition

100 % active antifoam compounds based on polyether-modified siloxanes of different hydrophilicity (hydrophobic oils) and different silicas (hydrophobic particles)

TEGO® Antifoam 793 is more hydrophilic and thus more water-dispersible than TEGO® Antifoam 14

Application/Advantages

- Both antifoams are suitable for pre- and post-defoaming of a broad range of different emulsifiable fluids such as soluble oils and semi synthetic fluids as well as full synthetic (water-soluble) fluids
- TEGO® Antifoam 793 in particularly shows its strength as post-defoamer for all kinds of water-mixed emulsions and solutions
- Highly compatible with MWF concentrates, therefore clear MWF concentrates are mainly obtained even at high dosage levels
- Water dispersible, therefore suitable for post-defoaming
  – Can be added as concentrates or in their diluted forms
- Provide an excellent foam knock down and hold down as well as long-lasting defoaming persistence
- Show good filterability properties, which minimizes the amount of additional tank side defoamer
- Does not deteriorate the shelf life of water-mixed emulsions and solutions
- Silicone oil (PDMS) free
  – No adverse effects on finishing processes

TEGO® Antifoam 793 & TEGO® Antifoam 14

Composition

100 % active antifoam compounds based on polyether-modified siloxanes of different hydrophilicity (hydro-phobic oils) and different silicas (hydro-phobic particles)
TEGO® Antifoam 793 is more hydrophilic and thus more water-dispersible than TEGO® Antifoam 14

Presence of unmodified polydimethylsiloxane (PDMS)

- We do not use unmodified polydimethylsiloxane (PDMS) as a raw material during the production of the organo-modified siloxanes that are part of TEGO® Antifoam 793 and TEGO® Antifoam 14

- Based on an analytical method that includes
  - isolation of unmodified PDMS by preparative chromatography
  - quantification of the isolated fraction
  - NMR spectroscopic analysis of the isolated fraction

  it can be stated that both antifoam compounds do not contain unmodified polydimethylsiloxane (PDMS) above the threshold of the analytical detection (detection limit of the applied method is 0.1 m%)

TEGO® Antifoam 691 & TEGO® Antifoam 692

Composition

100 % active antifoam compounds based on a polyether-modified siloxane of brand new structure (hydro-phobic oil) and different silicas (hydrophobic particles)

Application

- Particularly suitable for pre-defoaming of emulsifiable lubricants such as soluble oils and semi synthetic fluids based on mineral oils or ester oils or blends of those base oils
- Depending on the composition of the lubricant both antifoams may also be applicable for pre-defoaming of full synthetic (water-soluble) lubricant concentrates

TEGO® Antifoam 691 & TEGO® Antifoam 692

Composition

100 % active antifoam compounds based on a polyether-modified siloxane of brand new structure (hydrophobic oil) and different silicas (hydrophobic particles)

Advantages

- Both 100 % active antifoam compounds are homogeneous even after one year storage and show no precipitation

TEGO® Antifoam 691

TEGO® Antifoam 692

- Highly efficient pre-defoamers even at low dosage levels of 0.1 – 0.2 %
- Good compatibility with emulsifiable MWF concentrates, therefore stable MWF concentrates are mainly obtained
- Provide an excellent foam knock down and hold down as well as a long-lasting defoaming persistence
- Show excellent filterability properties, which minimizes the amount of additional tank side defoamer
  - Do not deteriorate the shelf life of water-mixed emulsions
  - Have no negative impact on the degree of their dispersity
- Show often even a stabilizing effect
- Can offer beside defoaming in addition a deaerating effect in water-mixed fluids
- Silicone oil (PDMS) free
  - No adverse effects on finishing processes
- No labelling required

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TEGO® Antifoam 691 & TEGO® Antifoam 692

Composition
100 % active antifoam compounds based on a polyether-modified siloxane of brand new structure (hydrophobic oil) and different silicas (hydrophobic particles)

Presence of unmodified polydimethylsiloxane (PDMS)

- We do not use unmodified polydimethylsiloxane (PDMS) as a raw material during the production of the organo-modified siloxanes that are part of TEGO® Antifoam 691 and TEGO® Antifoam 692

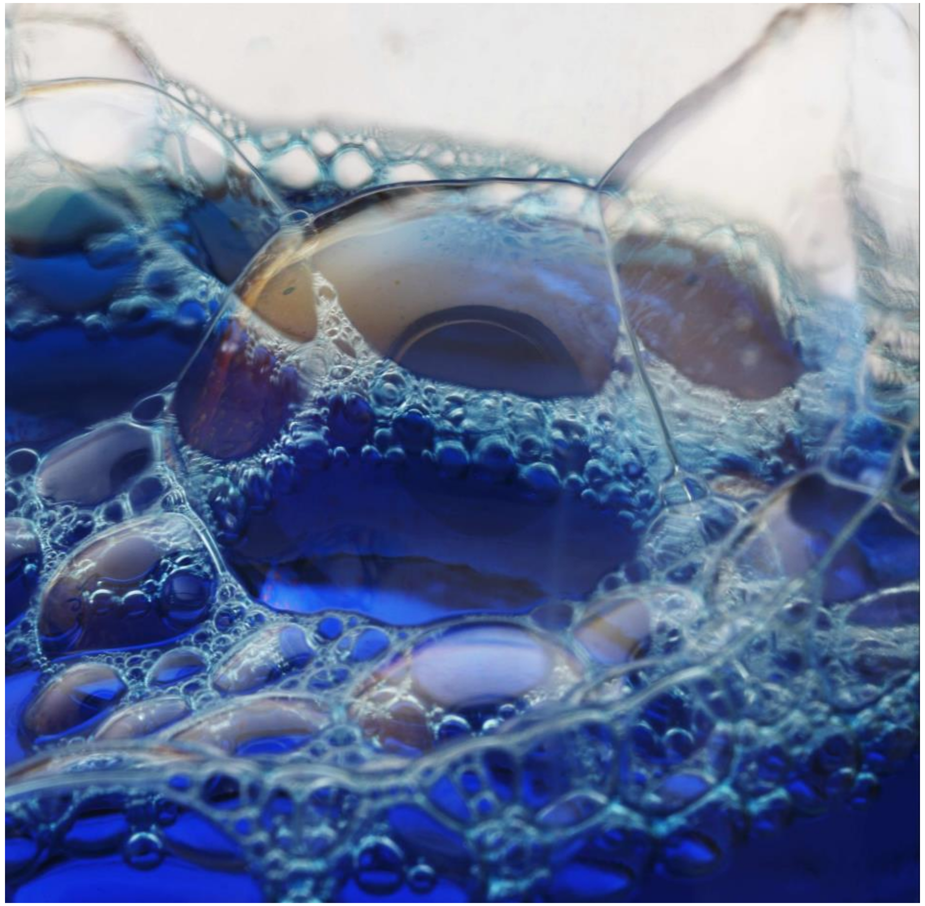
- Based on an analytical method that includes
  - isolation of unmodified PDMS by preparative chromatography
  - quantification of the isolated fraction
  - NMR spectroscopic analysis of the isolated fraction

  it can be stated that both antifoam compounds do not contain unmodified polydimethylsiloxane (PDMS) above the threshold of the analytical detection (detection limit of the applied method is 0.1 m%)

TEGO® Antifoam 691 & 692 compared to Competition

Performance Test Set-up

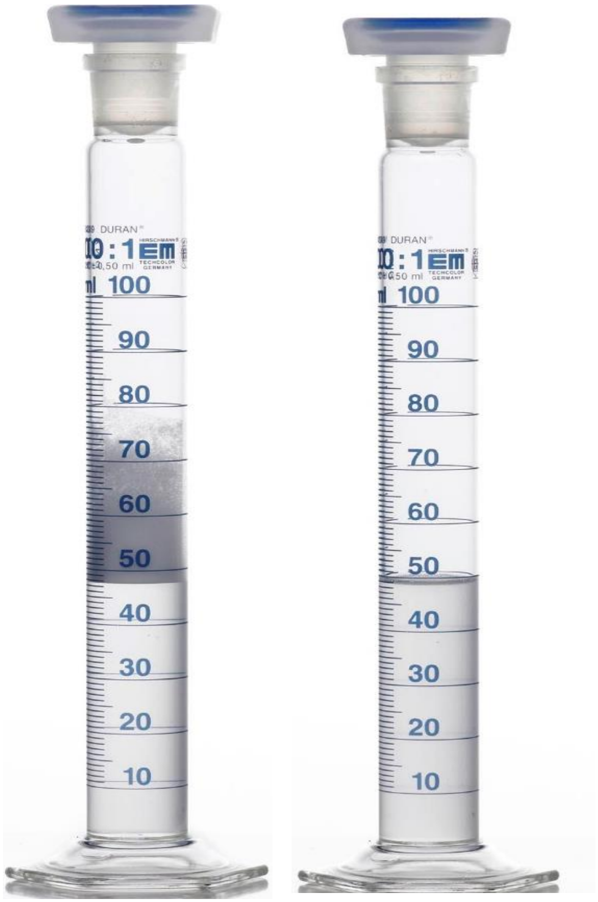
- Comparison of the effectiveness of pre-defoaming was carried out by using an exemplary branded MWF concentrate that was provided without the addition of pre-defoamer
- The boron-/amine free MWF concentrate contained ~40 % mineral oil and ~15 % water
- The MWF concentrate was pre-defoamed with 0.1 % of the respective defoamer
- The MWF concentrates were diluted to 5 % using demineralized water
- The defoaming performance of the respective water-mixed emulsion (translucent) was evaluated by
  – Shaking Test
  – CNOMO Re-circulation Test



Description of Test Methods for evaluating Antifoams

Shaking Test

- 50 ml of a the water-mixed metalworking fluid are filled into a graduated 100 ml shaking cylinder
- A plug is put on top of the cylinder. The cylinder is shaken vigorously with up and down movements for 10 sec (approx. 30 strokes)
- Initially after stopping shaking as well as after 30 sec, 1 min. and 2 min. the foam height (value in ml) is recorded



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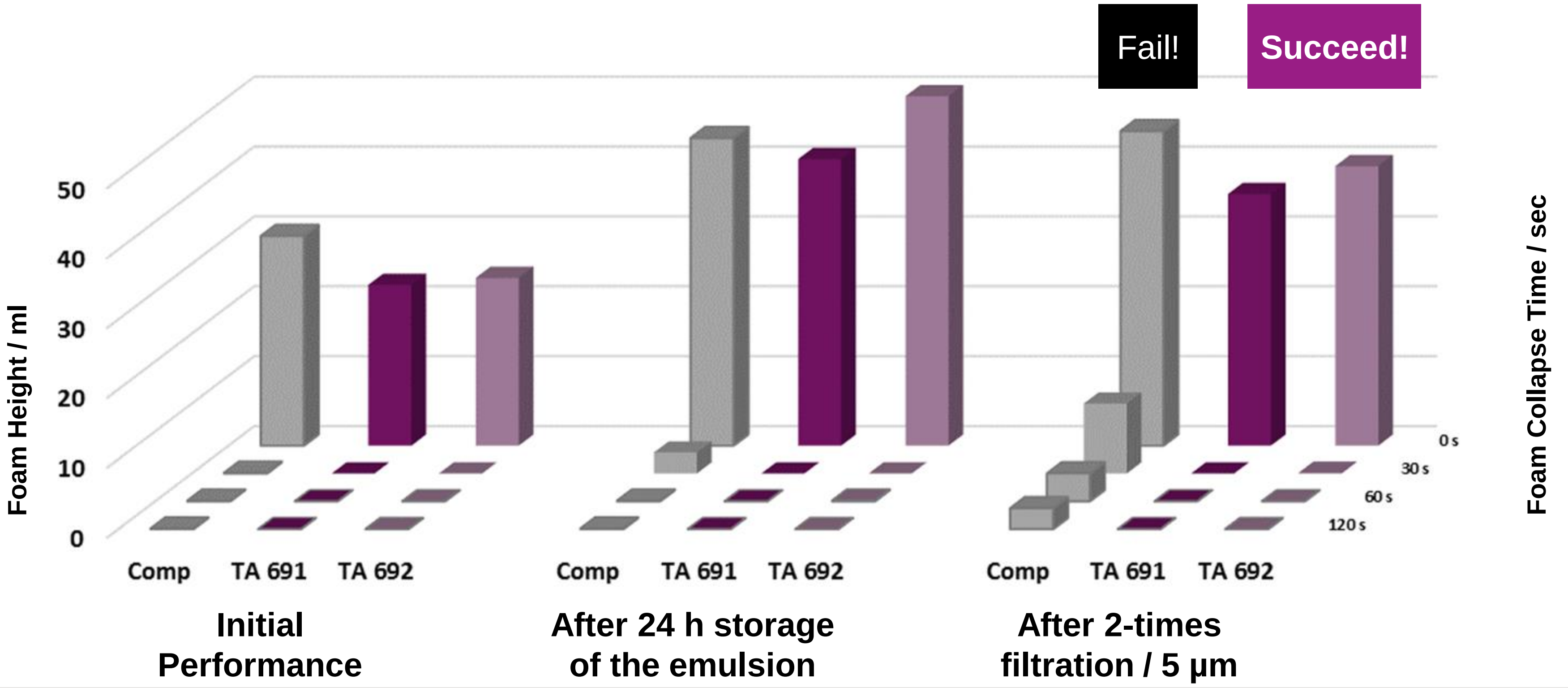
TEGO® Antifoam 691 & 692 compared with Competition

Initial performance (Shaking Test)



Note

Pre-defoamed with 0.1% Antifoam

5 % aqueous emulsion (DI-water) of a semi synthetic MWF (boron-/amine-free)

TA = TEGO® Antifoam | Comp = Competitor

Description of Test Methods for evaluating Antifoams

CNOMO Re-circulation Test

- The water-mixed fluid is filled into the cylinder up to its 1000 ml graduation. It must be taken into account that all hoses as well as the circulation pump are also filled with the water-mixed fluid
- The circulation pump is switched on and the aqueous dilution is re-circulated at a flow rate of 250±10 liters per hour for up to a maximum of 5 hours, or till the foam level reaches the 2000 ml graduation
- During the re-circulation the total height (foam + liquid) is recorded (in ml) every 15 minutes
- If the foam level does not reach the 2000 ml graduation within 5 hours re-circulation time, the pump will be switched off after 5 hours and total height (foam + liquid) is noted

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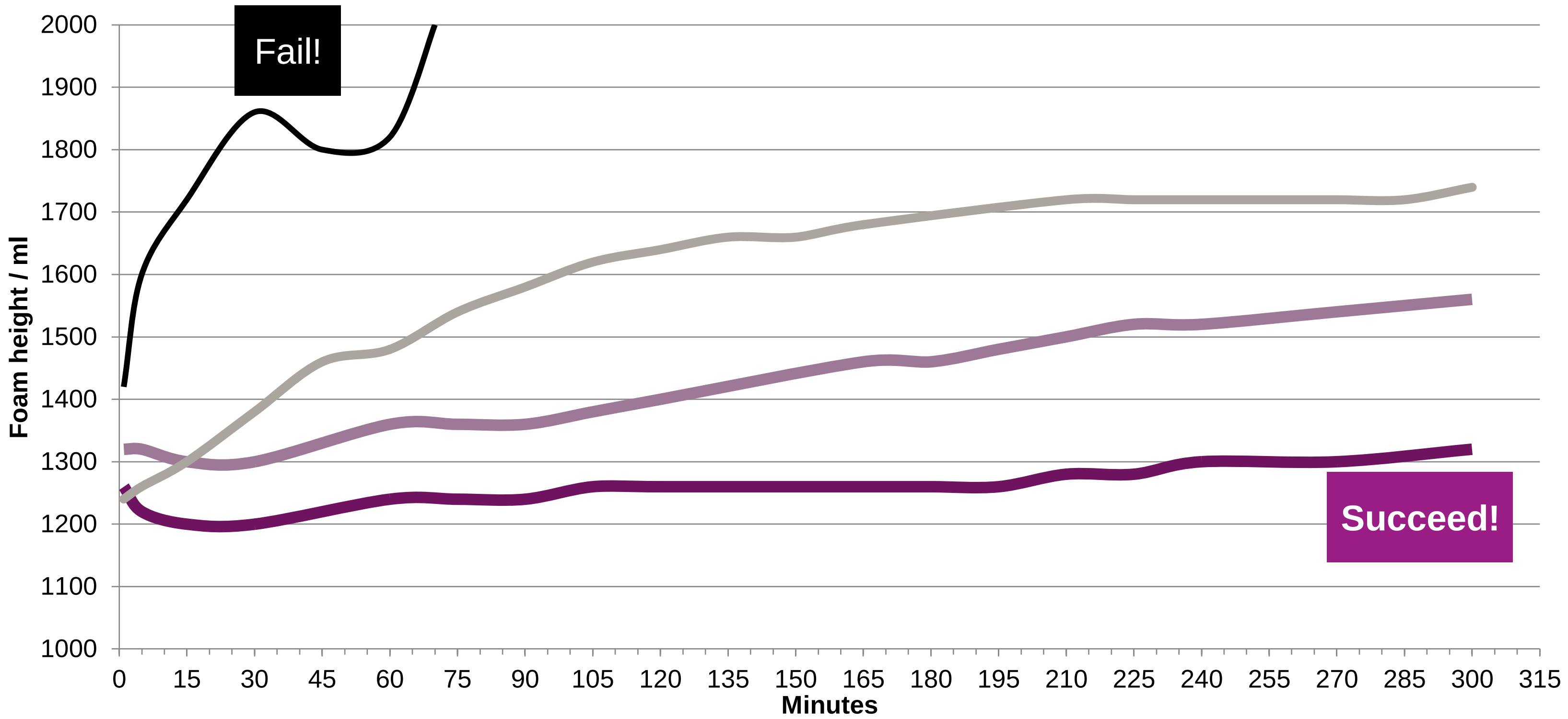
TEGO® Antifoam 691 & TEGO® Antifoam 692 compared with Competition

Initial performance (CNOMO Re-circulation Test)



Note

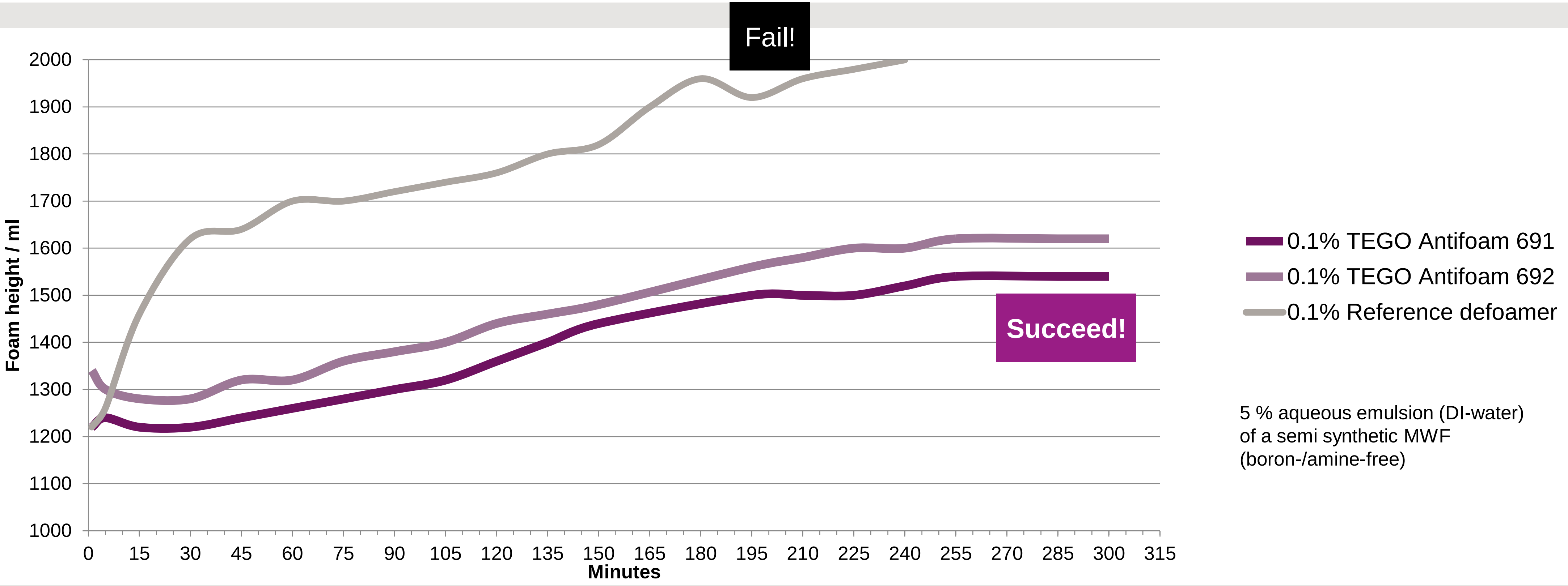
Pre-defoamed with 0.1% Antifoam

- 0.1% TEGO Antifoam 691
- 0,1% TEGO Antifoam 692
- 0.1% Reference defoamer
- Blank

5 % aqueous emulsion (DI-water) of a semi synthetic MWF (boron-/amine-free)

TEGO® Antifoam 691 & TEGO® Antifoam 692 compared with Competition

After 4 weeks storage of the MWF concentrates at RT (CNOMO Re-circulation Test)



5 % aqueous emulsion (DI-water)
of a semi synthetic MWF
(boron-/amine-free)

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TEGO® Antifoam 1488

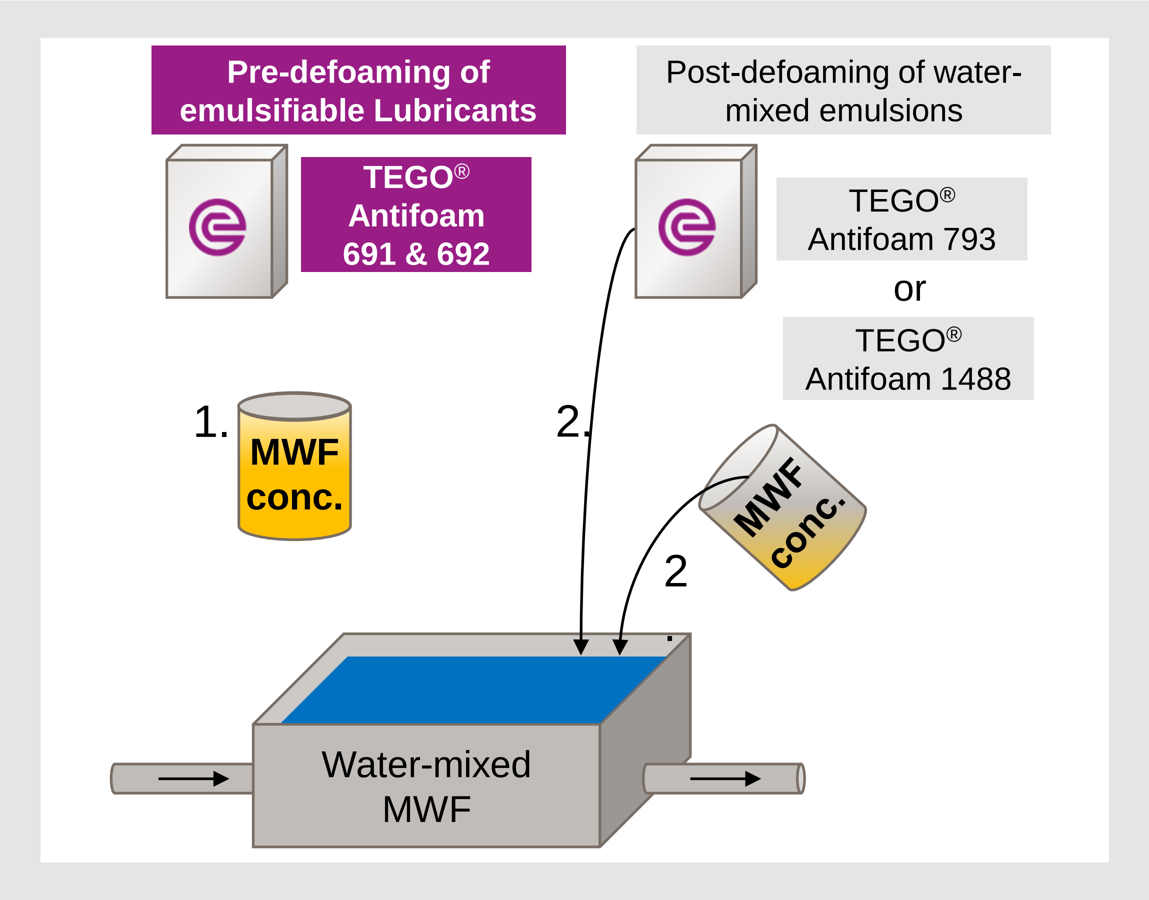
Composition

20 % active defoamer emulsion based on polyether-modified siloxane (hydrophobic oil) and silica (hydrophobic particle)

Application/Advantages

- Highly suitable for post-defoaming of a broad range of emulsifiable lubricants such as soluble oils and semi synthetic fluids
- Is in particular recommended
  - for processes in which water-mixed emulsions show low foaming tendency
  - for preventing overdosing by end-users (as cost-reducing measure)
- Easily dispersible in water, is therefore characterized by ease of handling
  - Can be applied as delivered
- Provides a good foam knock down and hold down as well as a long-lasting defoaming persistence
- Shows excellent filterability properties, which minimizes frequent addition as tank side defoamer
- Does not deteriorate the shelf life of water-mixed emulsions
- Silicone oil (PDMS) free
- No adverse effects on finishing processes
- Highly cost efficient

TEGO® Antifoam 691 & 692 and TEGO® Antifoam 793 & 1488
Complement perfectly for use in emulsifiable MWF



Formulator

1. Formulator incorporates **pre-defoamer** into the emulsifiable MWF concentrate (~0.1 – 0.2 %)

TEGO® Antifoam 691 & 692 are particularly suitable for pre-defoaming of emulsifiable MWF concentrates that are based on mineral and/or ester oil

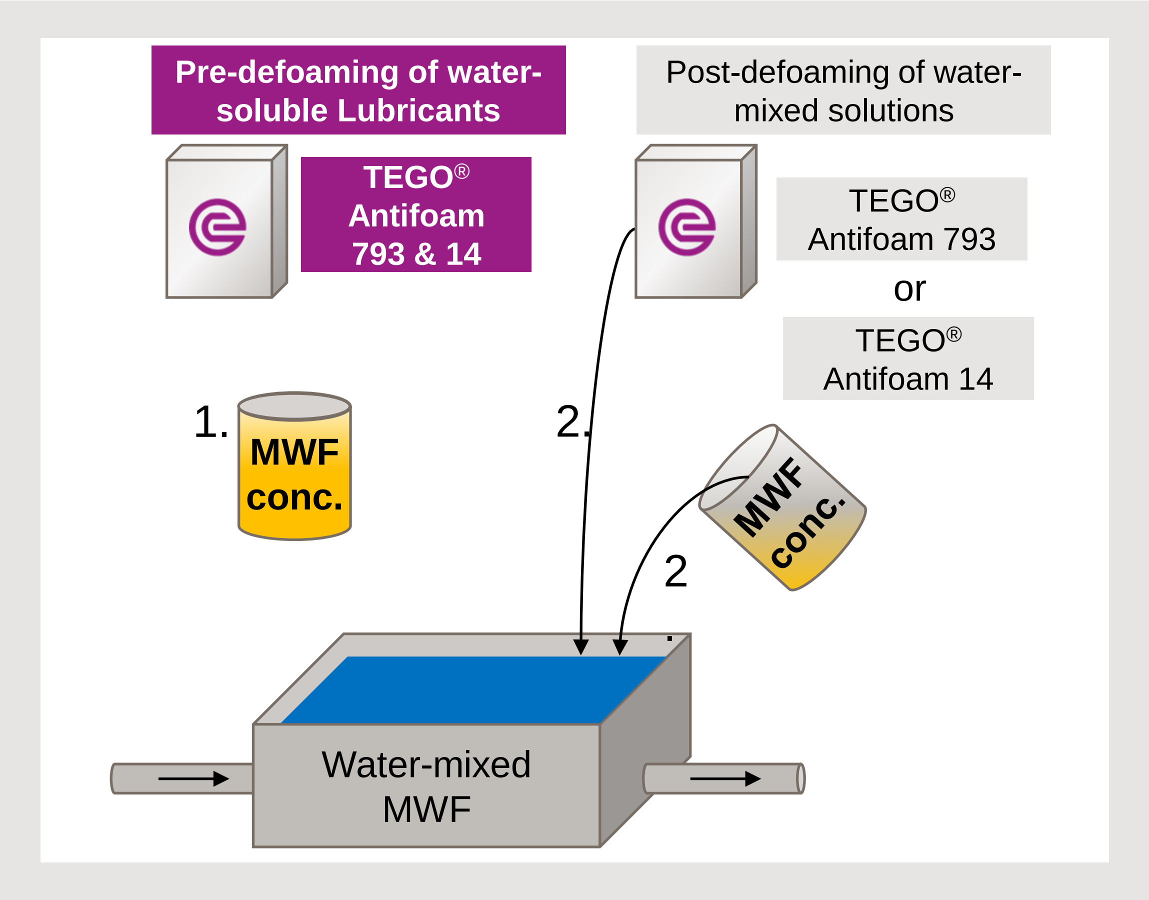
End User

2. End user dilutes MWF concentrate with water for obtaining a water-mixed emulsion

If foam problems occur in the water-mixed emulsion during application, post-defoamer **TEGO® Antifoam 793** (~50 ppm) or **TEGO® Antifoam 1488** (~250 ppm will be added **as tank side additive**

TEGO® Antifoam 793 & 14

Proven successful as Antifoams for use in water-soluble MWF



Formulator

1. Formulator incorporates **pre-defoamer** into the water-soluble MWF concentrate (~0.05 – 0.1 %)

TEGO® Antifoam 793 & 14 are particularly suitable for pre-defoaming of water-soluble MWF concentrates that are based only on water soluble components plus high amounts of water

End User

2. End user dilutes MWF concentrate with water for obtaining a water-mixed solution

If foam problems occur in the water-mixed solution during application, post-defoamers **TEGO® Antifoam 793** or **TEGO® Antifoam 14** (≤50 ppm) will be added **as tank side additive**

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