Surfynol® MD-20 Molecular Defoamer

Description

Surfynol MD-20 defoamer is a 100% active, solvent-free, nonsilicone, liquid product based on Gemini surfactant technology. This unique multifunctional defoamer provides a combination of foam control and dynamic wetting, with the potential to reduce overall additive levels, while minimizing surface defects. Used alone or in combination with other Surfynol wetting agents, Surfynol MD-20 is exceptionally effective at eliminating microfoam and other foam-related defects in waterborne systems when used as a foam control agent.

Advantages/Benefits

- Defect-free foam control with dynamic wetting
- Long-lasting defoamer efficacy
- Ease of incorporation and good compatibility without separation
- Synergistic with typical wetting agents for formulation simplification
- Eliminates microfoam
- Wide compounding latitude
- 100% active, solvent-free, clear liquid
- Nonsilicone, nonhydrophobic silica
- Temperature and pH stable (pH 1–13)

Applications

Surfynol MD-20 defoamer is recommended for use in waterborne systems in the following applications:

- Coatings
  - Automotive
  - OEM and DIY wood
  - Industrial maintenance
  - Metal and paper
  - Architectural coatings
- Graphic arts
  - Printing inks
  - Overprint varnishes
  - Fountain solutions
- Adhesives
- Dye and pigment synthesis
- Pigment grinding
- Oil and gas processing
- Cleaning products
- Semiconductor cleaning and processing
- Metalworking fluids
- Cements, mortars and grouts
- Personal care

Formulation Guidance

Typical use levels for Surfynol MD-20 defoamer range from 0.1–1.0 wt % (1–10 g/L) in many formulations. For specific use and formulation guidance, please contact us at: 800-345-3148 (in US/Canada), 01-610-481-6799 (outside US/Canada), or +31-30-2857-100 (in Europe).

Foam Control

Foam produced during system mixing and application often produces undesirable surface defects and negatively impacts performance. These new multifunctional products provide excellent foam control and wetting, thus minimizing defects, such as fisheyes and craters, commonly caused by other defoamers.

Handling Precautions

Refer to the Material Safety Data Sheet.

Molecular Defoamers

Molecular defoamers are surface-active agents that break foam at the molecular level rather than through incompatibility. Typically, foam-causing components stabilize foam because of ionic forces, hydrogen bonding and van der Waals forces. In aqueous systems, molecular defoamers function to destabilize the foam lamella by disrupting these forces, thus causing the foam to collapse (see Figure 1).

When absorbed at the foam interface, molecular defoamers reduce surface elasticity of bubbles to prevent stabilization. They also reduce surface viscosity of the foam lamella and increase the liquid drainage rate. These combined effects further enhance the defoaming ability of molecular defoamers.

Since they are surface-active, molecular defoamers offer excellent longevity because their ability to control foam does not depend on incompatibility. Many conventional defoamers have an optimal particle size in order to achieve optimal defoaming. Over time, their particle sizes change due to aggregation or dispersion, resulting in a loss of foam control effectiveness. Contrary to this, molecular defoamers remain active in the system, leading to consistent formulation performance. They also do not cause surface defects, as one would expect from a silicone/silica-based defoamer. Table 1 summarizes the performance comparisons of typical defoamers against Surfynol MD-20 defoamer.

Typical Properties

Appearance	Clear Liquid
Color	Yellow
Activity (%)	100
Viscosity (21 ºC, cP)	200
Viscosity (0 ºC, cP)	1000
Pour Point (ºC)#	–30
Boiling point (ºC)	275*
Flash Point (ºC)	130
Density @ 21 °C (kg/L)	1.00
Vapor Pressure (kPa)	0.8
U.S. EPA Method 24 VOCs (wt %)	3.6

* Decomposition.
# Determined to be the point at which flow was first observed.

Performance Characteristics

Water Solubility (wt %)*	0.003 (0.03 g/L)
Equilibrium Surface Tension at 0.1 wt %, 25 °C (mN/m)	28.5
Dynamic Surface Tension at 0.1 wt %, 6 b/s, 25 °C (mN/m)	50.8
Initial Ross-Miles Foam Height at 0.1 wt %, 25 °C	1.3 cm
Draves Wetting Time (sec)[1]	19 sec at 0.1 wt %

* Can be used above the solubility limit. Typical use levels range from 0.1 to 1.0 wt % (1 to 10 g/L).
[1] ASTM D 2281, 25 ºC, using a cotton skein.

Figure 1

Defoaming Mechanism Comparison

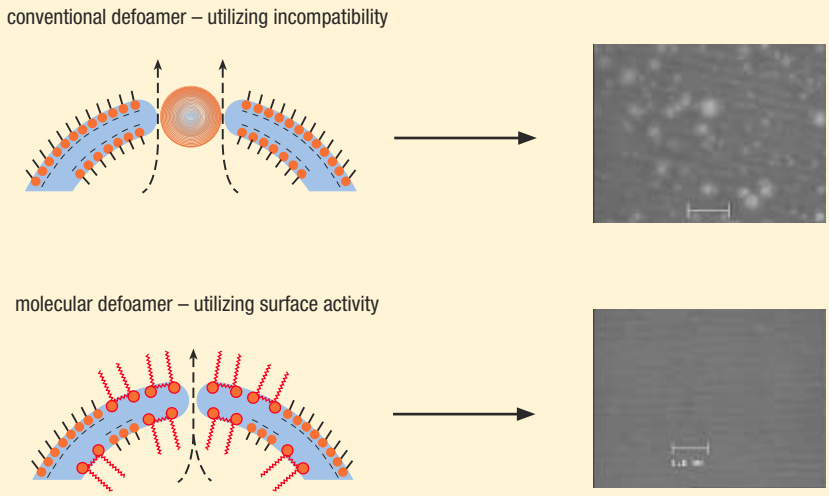


Table 1

General Defoamer Performance Comparison

Defoamer Type	Knockdown Foam Control	Macro Foam Control	Micro Foam Control	Defoamer Longevity	Compatibility and Ease of Handling	Wetting Defect* Reduction
Silica-Based	Excellent	Excellent	Moderate	Poor	Poor	Poor
Silicone	Excellent	Excellent	Good	Moderate	Poor	Poor
Typical Organic	Moderate	Good	Moderate	Moderate	Moderate	Good
Surfynol MD-20	Moderate	Good	Excellent	Excellent	Excellent	Excellent

* Defects such as fisheyes, craters, retractions, etc.

Dynamic Surface Tension

The ability to reduce the surface tension of water enables wetting of water-based systems on low-surface-energy substrates. In many processes, new surfaces are rapidly generated, and the surfactant must quickly migrate to the interface to prevent film retraction and other surface defects. These products reduce surface tension at high surface creation rates. The Krüss BP-2 utilizing the maximum bubble pressure method was used to measure the dynamic surface tension of some typical defoamers and Surfynol MD-20 defoamer as shown here for 0.1 wt % aqueous solutions (Figure 2).

Application Benefits

Packaging Inks

Ink formulators are continuously fighting foam in water-based ink systems either during the manufacturing of the inks or during the printing operation. In both cases, foam is undesirable and can contribute to poor performance. Surfynol MD-20 defoamer provides effective foam control in water-based printing inks as illustrated in Figure 3. The model G/S Cyan blue acrylic ink was designed for film applications. Density was measured after the ink was subjected to high speed mixing using a Cowles at 1000 rpm for 1 minute. Inks were oven aged at 50 °C for 1 week and then the densities were remeasured. The formulation containing Surfynol MD-20 defoamer demonstrated excellent foam control longevity, thus ensuring the performance of the ink over time.

Conventional defoamers cause print defects like fisheyes and craters. Unlike conventional defoamers, Surfynol MD-20 molecular defoamer demonstrates its ability to eliminate microfoam and surface defects as shown in Figure 4. Inks were printed on OPP film using a flexo handproofer. Pictures were taken under a microscope with 10X magnification. Ink without defoamer had print defects caused by microfoam. When a hydrophobic silica-based (or silicone-based) defoamer was used, the print showed pinholes and fisheyes. It was the ink containing Surfynol MD-20 defoamer that was able to produce defect-free prints by eliminating microfoam without craters or fisheyes. It actually enhanced the print by improving the wetting and transfer of the ink. This unusual performance of defoaming, longevity, microfoam control, and wetting make Surfynol MD-20 defoamer a unique product that can solve many ink problems.

Figure 2

Dynamic Surface Tension Comparison

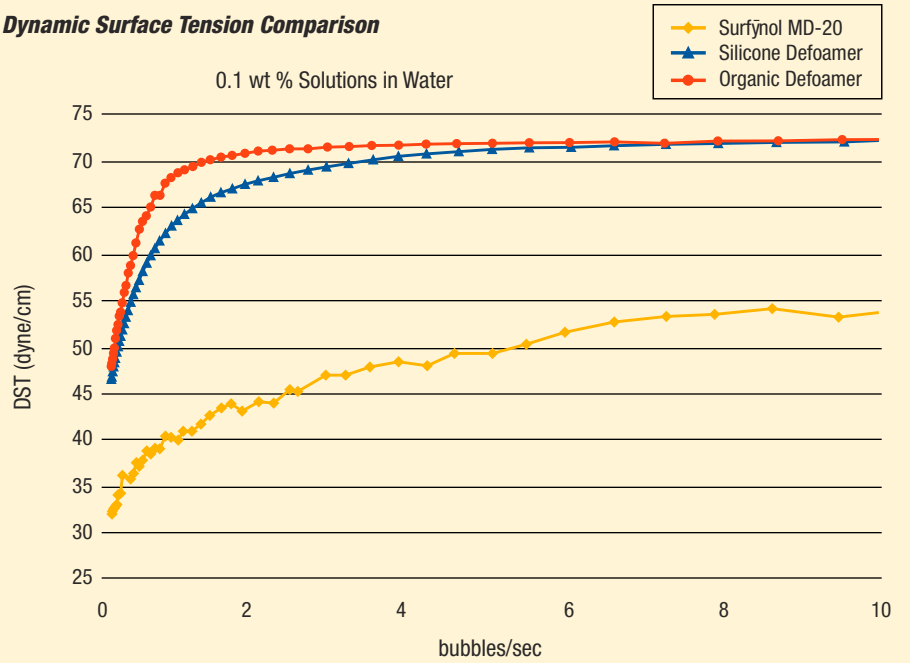


Figure 3

Packaging Ink—Mixer Foam Test
21" Zahn 2 (0.3% Defoamer)

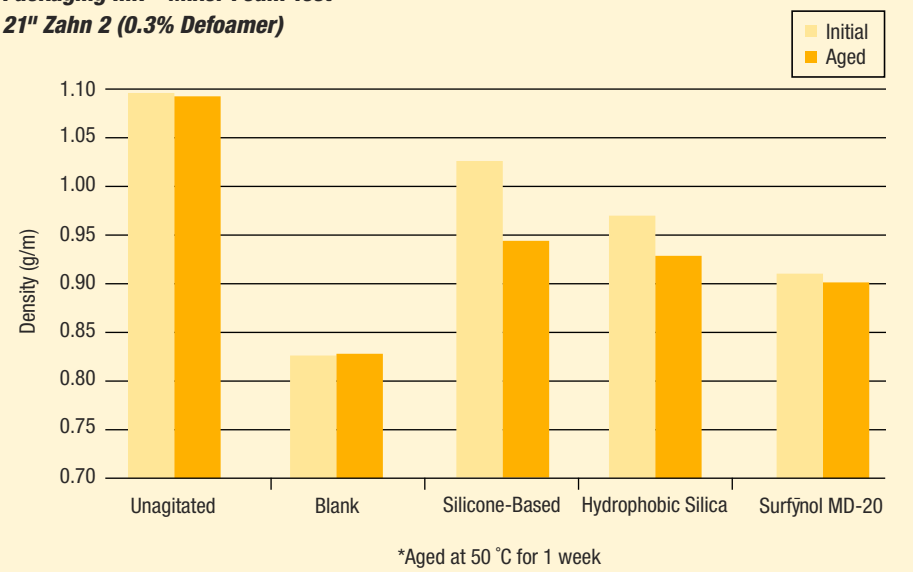
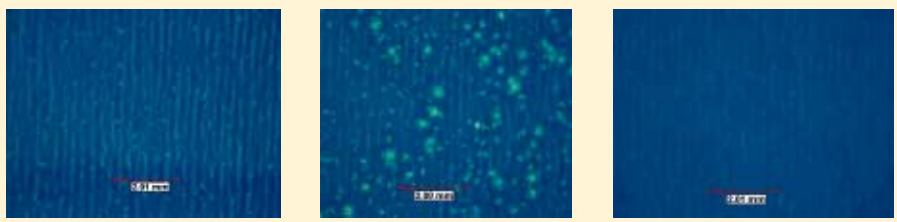


Figure 4

Prints on OPP Film—10X Magnification



Blank Microfoam | Silica-Based Pinholes | Surfynol MD-20

Industrial Maintenance Coatings

The ability to reduce the surface defects in applied coatings is critical. Providing increased formulating latitude allows for more simple control of defects than modification of polymeric binders.

A variety of experimental techniques were brought to bear on evaluating the performance of Surfynol MD-20 defoamer in industrial maintenance paint. A model formula provided by a leading acrylic latex manufacturer was adjusted to be particularly sensitive to microfoam in airless spray, thus providing a screening paint for study. Also evaluated were craters (appearing as dimples), pinholes, and wet paint high shear foam stability. Microscopy was employed as an aid to identifying and recording defects.

Surfynol MD-20 defoamer was found to be exceptional in controlling microfoam, dimples and pinholes when used as both a defoamer and wetting agent. When used as a defoamer in combination with EnviroGem® AD01 surfactant as a wetting agent, even further control of these defects was observed compared to the benchmark additives. Surfynol MD-20 defoamer has been found most effective in controlling foam in a variety of acrylic latexes.

Figure 5

Sprayed Panels

Silicone Defoamers
Surfynol 104 DPM

Surfynol MD-20

Surfynol MD-20
EnviroGem AD01

5X Magnification

Durability testing shows that Surfynol MD-20 defoamer (and EnviroGem AD01 surfactant) do not contribute to performance loss in salt spray, Cleveland Humidity and QUV testing compared to control formula.

Figure 5 displays photomicrographs that depict the performance of Surfynol MD-20 defoamer (and EnviroGem AD01 surfactant) as an aid to minimizing microfoam and craters in spray-applied industrial maintenance coatings.

Table 2 shows subjective ratings (5 = best, 1 = worst) for the performance of Surfynol MD-20 (and EnviroGem AD01) as an aid to minimizing the above defects as seen on 3.6 micron DFT films after airless spray. It is clear that Surfynol MD-20 defoamer not only functions as a defoamer and a wetting agent, but also improves the overall formulation performance.

area to be trimmed off

Table 2

Relative Formulation Performance

Paint #	*Additive*	*Function*	*Where Employed*	*Use Level, % (on wet paint)*	*Subjective Evaluation*		
					Microfoam	*Craters*	*Pinholes*
I	Silicone Defoamer I	Defoamer	Grind	0.25	3.0	1.0	2.0
	Silicone Defoamer II	Defoamer	Letdown	0.35			
II	Surfynol MD-20	Defoamer	Grind	0.25	3.5	5.0	3.0
	SurfynolMD-20	Defoamer	Letdown	0.35			
IIII	Surfynol MD-20	Defoamer	Grind	0.25	4.5	4.5	3.0
	Surfynol MD-20	Defoamer	Letdown	0.35			
	Surfynol MD-20	Wetting Agent	Letdown	1.02			
IV	Surfynol MD-20	Defoamer	Grind	0.25	5.0	5.0	4.0
	Surfynol MD-20	Defoamer	Letdown	0.35			
	EnviroGem AD01	Wetting Agent	Letdown	1.02			

Waterborne Pressure-Sensitive Adhesives (PSAs) and Laminating Adhesives

Surfynol MD-20 defoamer allows the adhesive formulator to design efficient PSA and laminating adhesive formulations. Not only does Surfynol MD-20 defoamer provide outstanding foam control, but it also demonstrates improved defoaming longevity and good wetting on low-energy substrates. This product is compatible with various types of emulsions such as acrylics and vinyl acetate copolymers.

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Table 3 shows that the use of Surfynol MD-20 as both a wetting agent and a defoamer in waterborne PSAs results in excellent foam control and nearly comparable wetting performance to formulations using dioctyl sodium sulfosuccinate (DOSS), a commonly used surfactant. Additional testing has also shown that Surfynol MD-20 defoamer improves shear adhesion property compared to DOSS surfactant and is comparable in peel and tack properties. When tested in a high shear mixer, formulations containing Surfynol MD-20 defoamer also demonstrate improved foam control longevity when compared to either formulations containing just DOSS or DOSS and a typical mineral oil-based defoamer. Figure 6 shows the percentage decrease in foam density when aged at 50 °C relative to the initial formulation foam density.

Figure 7 shows that Surfynol MD-20 defoamer gives excellent foam control, comparable wetting on film substrates and improved defoaming longevity in the laminating adhesive formulation relative to the adhesive that contains a commodity DOSS surfactant and a typical organic defoamer.

Table 3

Wetting and Defoaming in Pressure-Sensitive Adhesives

Properties	*Control*[2]	*DOSS*[3] *(1.3%)*	*Surfynol MD-20 (1%)*
# of Craters[1]	>10	2–3	3–4
% Retraction[1]	>20	<10	<10
Foam Density, g/ml	0.80	0.42	0.71

[1] Measured on a silicone release liner.
[2] Formulated without wetting agents and defoamers.
[3] Dioctyl sodium sulfosuccinate.

Figure 6

Loss of Foam Control Performances Over Time

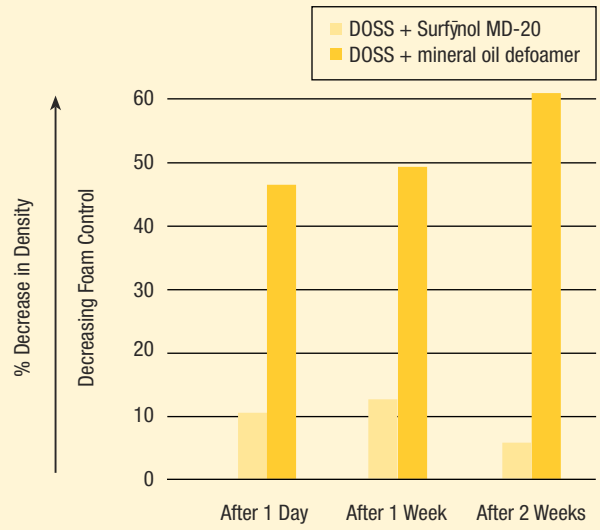
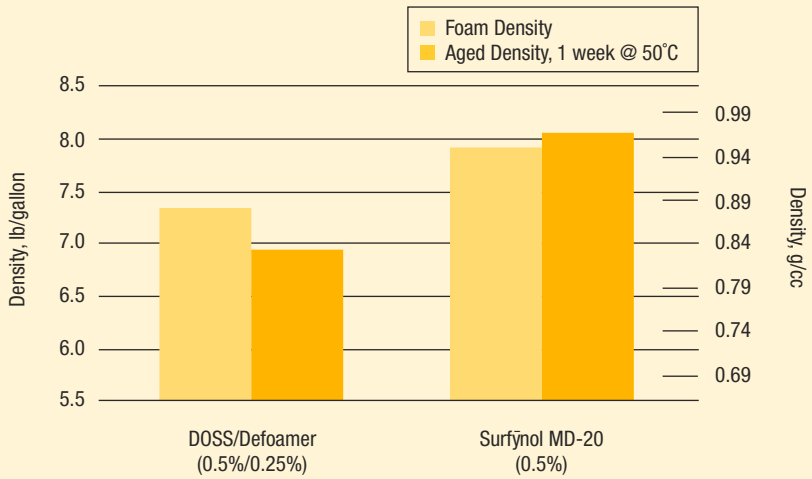


Figure 7

Foam Control Longevity in a Vinyl Acetate Ethylene Laminating Adhesive Formulation



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