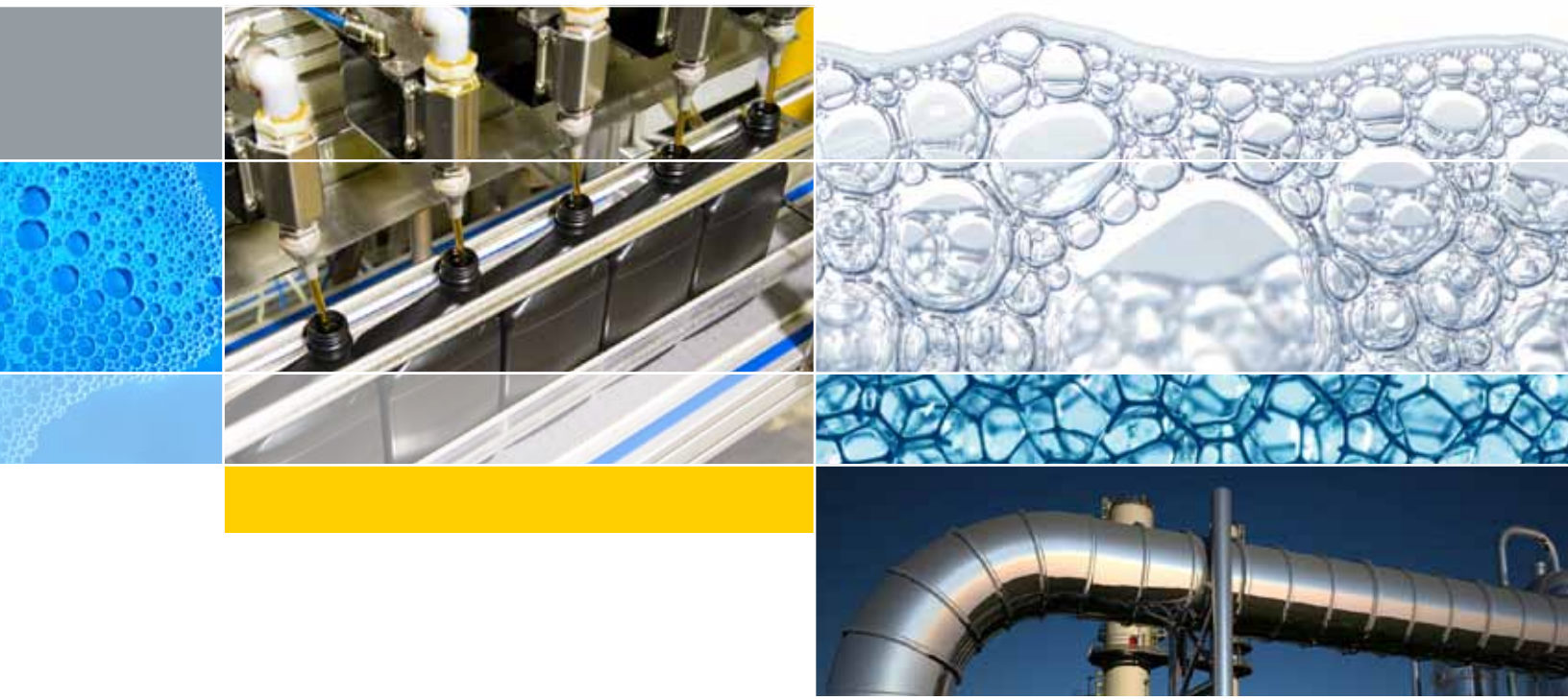
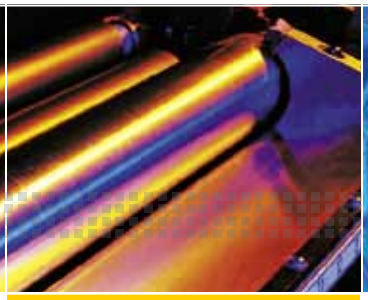
MOMENTIVE™

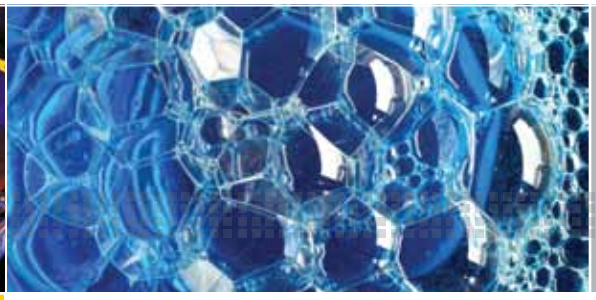
Antifoam Solutions



Why Use Antifoams and Defoamers?

Foam is a mass of bubbles created when gas is dispersed into a liquid and the dispersion is stabilized. High-strength films of liquid surround the bubbles, forming large volumes of foam (Figure 1). While the cause of foam is a complicated study in physical chemistry, its existence presents serious problems in the operation of industrial processes, the filling, transportation and the quality of finished products. If not properly controlled, foam can reduce equipment capacity and increase processing time and expense. Typically foam occurs in blending or mixing, reflux and distillation steps, filtration and filling.





Applications

- food & beverage
- chemical & plastics
- pulp & paper
- water treatment
- coatings
- mechanical fluids
- construction
- oil & mining

An effective chemical defoaming agent generally meets the following requirements:

- Possess lower surface tension than the system to which it is added.
- Disperse readily in the system.
- Possess poor or low solubility (incompatibility) in the system.
- Be inert.
- Leave no substantial residue or odor.
- Meet regulatory requirements, e.g. FDA and USDA where applicable.
- Be certified kosher and parve, where applicable.

For many applications silicone foam control agents match all these requirements effectively. Due to their efficient foam destruction even at extremely low dose rates, they can be very cost competitive.

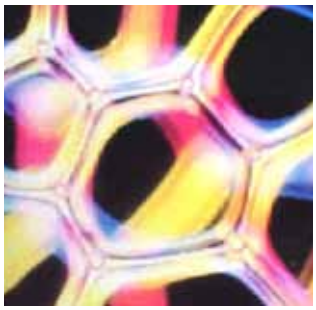


Figure 1: Image of a foam with oil droplets in it.

Foam can be controlled by making basic changes in the process itself or by using mechanical defoaming equipment. However, chemical foam control agents have proven to be the most versatile, effective and economical solution to the problem.

Performance Measurement

The performance of antifoams is not easy to measure, since various factors, like the nature of the foaming medium, the temperature or shear rate – among many others – have a strong impact and may be difficult to foresee.

A good test should mimic as close as possible the specific application conditions (type of mixing, temperature etc..). The most widely used test is the shake test, in which the antifoam is added to a foaming medium in a closed container and is shaken either by hand or – more reliably – by automated shaking machine equipment for a defined time period or number of shakes. The time for the foam to collapse and the amount of foam remaining are typical comparison results.

Another way to measure the defoaming performance is the recirculation test. A cylindrical glass container with a bottom outlet is filled to approximately a quarter of its volume with the foaming medium. The outlet is connected to a pump, which pumps the liquid at defined speed out of the container and re-injects it from the top. This test is more challenging as it entrains a lot of air and stresses the antifoam with shear. Optionally the liquid can be heated to mimic process conditions.

After starting the pump the stream of falling liquid leads to a quick buildup of foam. When the foam reaches the top of the container, the antifoam is added. As the foam collapses, the time and level at which the foam collapses is monitored. This reflects the knockdown ability of the antifoam. Continuing recirculation means the foam will start to rise again. The more time passes until the foam builds, the more persistent is the antifoam.

Selecting the best antifoam is ultimately a delicate balance between the performance and cost requirements of each specific application. Basic silicone antifoams are very cost-effective solutions for many applications where foam knockdown is the main performance objective. High performance silicone antifoams (such as SagTex* PhD antifoam, SagTex DSA antifoam, and Y-14991) are more complex formulations offering better solutions in extreme conditions, with strong foam where both foam knockdown and durability (persistence to re-foaming) are required. Since antifoams are used in many diverse markets and applications, Momentive has developed a broad antifoam product line that covers a wide range of performance and cost requirements.

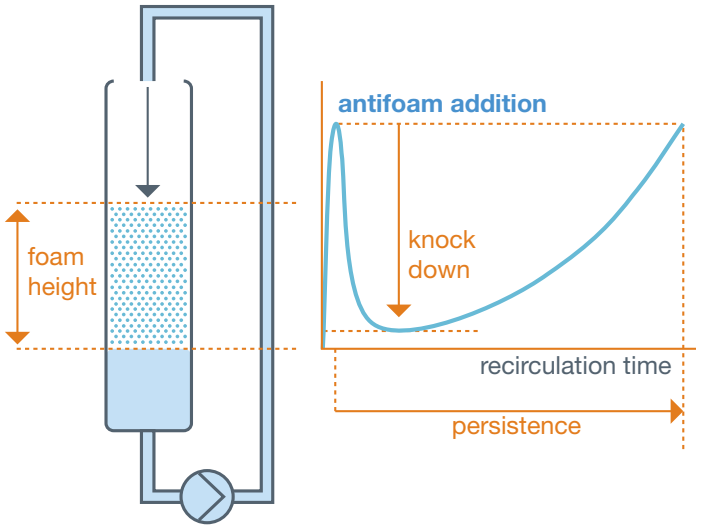


Figure 2

Scheme of recirculary pumping rig: The measurement yields knock-down height, which is the ability of the defoamer to destroy existing foam an also persistence, which is the time the foam takes to rebuild to the original height.



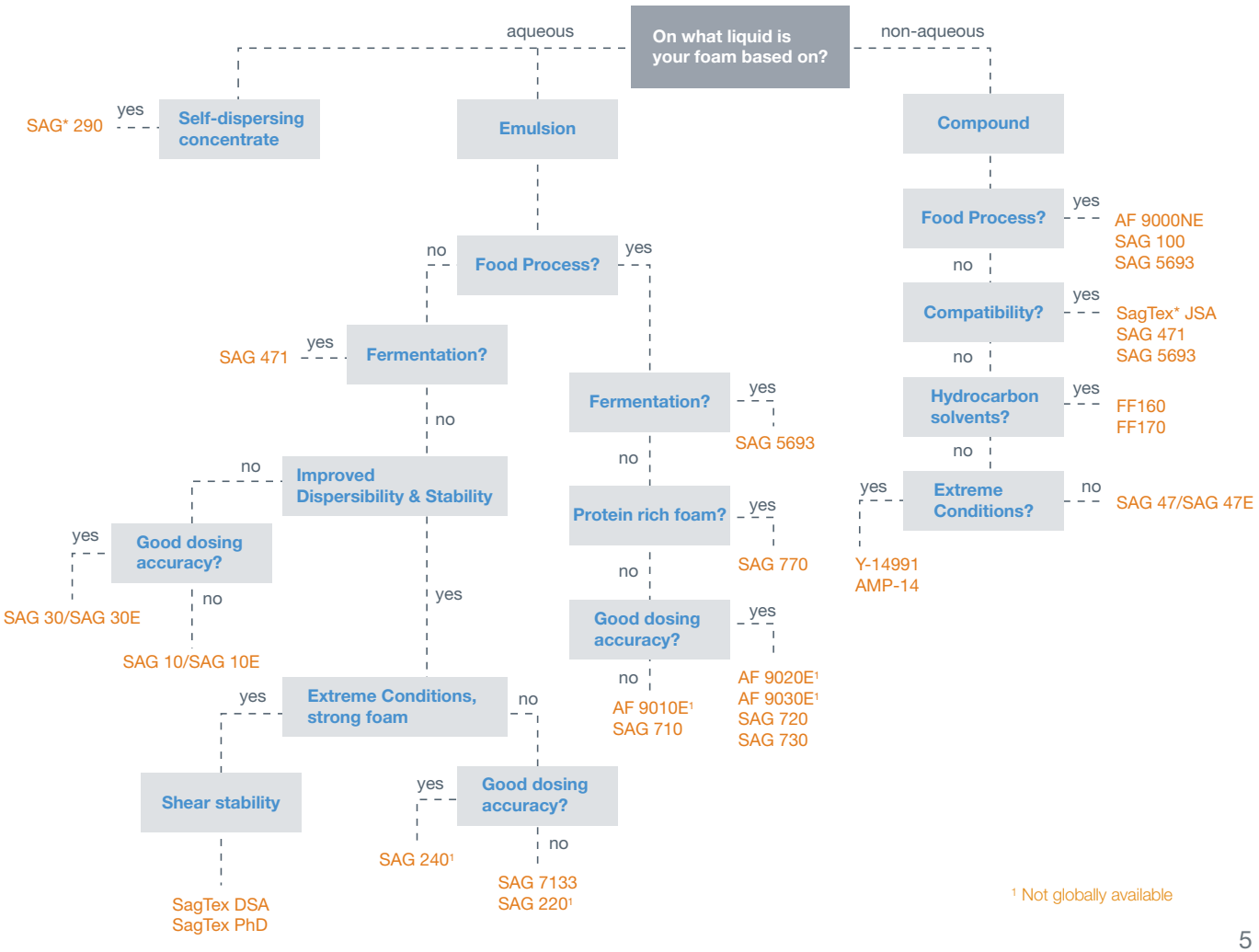
Silicone Antifoam Selection

This selector guide (Figure 3) describes those Momentive antifoams, that have been found particularly useful in many applications. In selecting the best type and quantity of silicone defoamer, each application must be assessed separately. It is therefore best to evaluate several antifoams in each system to determine the type and concentration needed to assure optimum results.

Factor	Options
Chemical nature of the foam-forming agent	Aqueous / non-aqueous.
Temperature	High / low
pH-value	High / neutral / low
Compatibility	Clear appearance / turbid formulation
Dosing accuracy	Concentration of antifoam
Processing equipment	Low shear / high shear
End use of product containing the antifoam	Food contact / sensitive to de-wetting

Figure 3

Antifoam Selection Tree



[1] Not globally available

Aqueous Antifoams

Aqueous antifoams are formulated emulsions or concentrates that allow easy dilution in systems based on water or polar solvents. Various concentrations are available to aid dosing accuracy and handling.

Concentrates	Water dispersible systems of high active content developed for formulators or processes with high dosing accuracy.
Emulsions	Ready-to-use water-based products of various active contents, which provide easy disperse-ability for maximum defoaming efficiency.

The impact of dosing and handling are often underestimated when chemical antifoams are used:

Dosing	Silicone antifoams are often sufficient at a level 10 to 100ppm of the active material. This equals 50 to 500 g of a 20% Emulsion for one metric ton of defoaming media, whereas only 10 to 100 g would be needed of a 100% active material. Thus, in cases where the dosing equipment is not very accurate or very low dose rates are sufficient, we recommend use of antifoam emulsions with a 10 or 20% active content. The higher dosing volume will reduce any error from inaccurate dosing equipment. With precise dosing equipment, we recommend the use of higher concentrated antifoam emulsions, since they need less storage space and offer a better cost performance.
Handling	Compounds are used undiluted or pre-dispersed in organic solvents for non-aqueous applications and need emulsification prior usage in aqueous media. In addition, viscosities of Compounds and Concentrates are typically in the range of 1,500 to 2,000,000 cSt. The handling of such high viscosities requires appropriate equipment. Aqueous emulsions typically have viscosities of 40 to 3,000 cSt depending on active content and formulation. They are therefore much easier to handle and can be diluted with simple stirring equipment.

Non-Aqueous Antifoams

Compounds

100% active fluid products and formulations of fluids containing special active ingredients that boost the defoaming performance.

Non-aqueous antifoams can be considered for defoaming in non-water based systems like organic solvents and mineral oils. They are 100% active materials, so they do not introduce water into these systems.

Non-aqueous antifoams can be chosen from four categories:

- Polydimethylsiloxane (PDMS) fluids of our Element14* PDMS series (predominantly higher viscosities)
- Silicone compounds
- Polyetherfunctional silicone fluid copolymers of our Silwet* product portfolio
- Fluorosilicone fluids

In many cases a dilution of the silicone compound in a suitable organic solvent is advisable to reduce the actives content for a more accurate dosing and decrease the viscosity for an easier handling. Formulators can also use these grades to manufacture their own antifoam emulsions.

Polydimethylsiloxane (PDMS) fluids and silicone compounds:

Some foaming problems can be solved applying high viscosity PDMS fluids, like Element14 PDMS 12.5K silicone fluid and Element14 PDMS 60K silicone fluid. If higher defoaming performance is required silicone compounds can often provide improved defoaming performance compounds.

Polyester functional silicone fluids:

In some applications PDMS fluids are too incompatible and separate out or are too soluble in the foaming medium (e.g. toluene or Diesel fuel) and thus may even stabilize foam. Here polyether-functional silicone copolymers of our Silwet portfolio can help. Our separate Silwet brochure provides a complete overview.

Fluorosilicone fluids:

In certain applications fluorosilicone fluids are the last resort, as they can provide effective oil/gas separation and foam control in solvents like aromatic-rich, fluorinated or chlorinated hydrocarbons at extremely low dose levels, providing foam control and degassing e.g. in offshore oil wells and solvent distillation and recovery units.



Dilution Instructions

Once you have selected the right antifoam for your application, you should determine the appropriate concentration level for your use: using excess antifoam could cause undesirable effects such as decarbonation of carbonated beverages, of formation of residues on cooking vats. To test the effectiveness of a product, a good starting concentration is 100 parts per millon (ppm) of active ingredient from basic silicone antifoams and 10 ppm from the high performance products (SagTex DSA antifoam, SagTex PhD antifoam, & Y-14991).

Table 1

Please follow the instructions below to dilute the antifoam to the desired end use concentration required for each specific application.

For an approximate dilution to 100 ppm actives blend:

1 drop in 1 pint **OR**
8 drops in 1 gallon **OR**
1 tablespoon in 20 gallons **OR**
1 fluid ounce in 75 gallons

For an accurate dilution to 100 ppm antifoam actives blend:

% Actives	Dilution of Antifoam			
100	1.00	37.8	1.28	0.80
30	3.33	126.2	4.27	2.66
20	5.0	189.3	6.40	4.00
10	10	378	12.80	8.00
	parts In	mL in	fl. ounces in	pints in
	10,000	100	100	1000
	parts	gallons	gallons	gallons

If you need X ppm actives from a product with Y% actives content you have to dilute X/Y parts of product in 10,000 parts of liquids.

For example if you want 30 ppm actives dilution from 30% active Antifoam you have to dilute 30/30= 1.0 part of the 30% antifoam with 10,000 parts of liquid.

Product Overview

Table 2

Product	Type	Active Content [%]	Viscosity [cSt]	pH	Potential Applications	Commercially Available		
						AMR	EUR	PAC
Element14 PDMS-XXX	Fluid	100%	350-60000	-	food process, non-aqueous	•	•	•
AF9000NE	Compound	100%	1550	-	food process, non-aqueous	•	•	•
AF9010E	Emulsion	10%	1250	4.5 - 5.5	food process, aqueous		•	
AF9020E	Emulsion	20%	1750	4.5 - 5.5	food process, aqueous		•	
AF9030E	Emulsion	30%	3500	4.5 - 5.5	food process, aqueous		•	
SAG 710	Emulsion	10%	1500	3.5 - 4.5	food process, aqueous	•	•	•
SAG 720	Emulsion	20%	1500	3.5 - 4.5	food process, aqueous	•		•
SAG 730	Emulsion	30%	1500	3.5 - 4.5	food process, aqueous	•	•	•
SAG 770	Emulsion	30%	1500	3.5 - 5.0	food process, protein & starch foams	•	•	
SAG 47	Compound	100%	1400	-	general, non-aqueous	•	•	
Y-14991	Compound	100%	60000	-	general, pulp & paper	•	•	•
SAG 471	Concentrate	100%	2200	7.0 - 8.5	fermentation	•	•	
SAG 5693	Concentrate	100%	350	7.0 - 8.5	food process, fermentation	•	•	
SAG 7133	Emulsion	10%	700	7.0 - 8.5	general, aqueous, oil & mining	•	•	•
SAG 2001	Emulsion	10%	700	3.0 - 12	general, aqueous	•		•
SAG 10	Emulsion	10%	2000	7.0 - 8.5	general, aqueous	•	•	•
SAG 30	Emulsion	30%	2000	7.0 - 8.5	general, aqueous	•	•	•
SAG 220	Emulsion	20%	700	7.0 - 8.5	general, aqueous		•	
SAG 240	Emulsion	40%	900	7.0 - 8.5	general, aqueous		•	
SAG 290	Concentrate	90%	3000	-	general, aqueous	•	•	•
SagTex DSA	Emulsion	20%	1500	7.0 - 10.0	general, aqueous	•	•	•
SagTex PHD	Emulsion	50%	2900	7.0 - 10.0	general, aqueous	•	•	•
SagTex JSA	Compound	100%	250	-	general, coating	•	•	•
FF160	Fluorosilicone	100%	20000	-	chemical, non-aqueous	•	•	•
FF170	Fluorosilicone	100%	4000	-	chemical, non-aqueous	•	•	•
AMP-14	Compound	100%	gel like	-	chemical, pulp & paper	•	•	•

Typical data are average. The average values may vary.

These typical data values of Momentive antifoam products should not be used as specifications. Please consult our Technical Data Sheets and material Safety Datasheets as changes might occur. Assistance and specifications are available by contacting Momentive or your Momentive Distributor.

* Other Momentive Antifoam Products not listed here are also available in Asia-Pacific. See the Momentive web-site.

Antifoam Selector

Table 3

Market	Segment	Potential Applications	Products To Consider
Food & Beverage		Food Process Aid Carbonated Beverages	SAG 710[2], SAG 720[2], SAG 730[2], SAG 770[2], AF9000NE[2], AF9010E, AF9020E, AF9030E, Element14 350[2], SAG 100[2], SAG 5693, SAG 471
		Protein/Starch Foam	SAG 770[2]
		Fermentation	SAG 5693, SAG 471
Chemical & Plastics	Distillation	Aqueous	SAG 7133, SAG 220, SAG 290, SAG 2001
		Semi-polar	SAG 471, SAG 5693, SAG 290
		Non-polar	Element14 PDMS 60K, SAG 47, Y-14991, FF160, FF170
	Vacuum Distillation	Hydrocarbon	SAG 47, FF160, FF170
		Solvent & Alcohol	Element14 PDMS 12.5K, Element 14 PDMS 60K SAG 471, FF160, FF170
		Aqueous	SAG 5693, SAG 7133
	Polymerization	Latex	SAG 7133, SAG 220, SAG 240, SAG 290
		Nylon	SAG 220, SAG 240, SagTex PhD
		Aqueous	SAG 7133, SAG 220, SAG 290
		Semi-Polar	SAG 471, SAG 5693, SAG 290
		Non-Polar	Element14 PDMS 60K, SAG 47, Y-14991
	Minerals & Pigments	Phosphates	SAG 7133, Silwet L-7605
		TiO2	SAG 7133, SAG 220, SAG 240, SagTex DSA
	Oil	Gas Sweetening	SAG 7133
		Gas/Oil Separators	Element14 PDMS 60K, FF160, FF170
		Distillation	Element14 PDMS 60K, FF160, FF170
	Emulsions	Emulsion Polymerization	SAG 7133, SAG 220, SAG 240, SagTex DSA, SagTex PhD, Silwet DA-33, Silwet DA-40, Silwet DA-63
		Mechanical Emulsification	SAG 7133, SAG 220, SAG 240, SagTex DSA, SagTex PhD
		Bitumen Emulsification	SAG 7133, SAG 220, SAG 240, SagTex DSA, SagTex PhD
	Surfactants	Surfactant Solutions	SAG 7133, SAG 220, SAG 240, SagTex DSA, SagTex PhD, SAG 2001
		Biodiesel	SAG 47
		Amine & Acid Scrubbing	SAG 7133, SAG 220

Antifoam Selector

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	Segment	Potential Applications	Products To Consider
Pulp & Paper		Formulation Ingredient	Silwet DA-33, Silwet DA-40, Silwet DA-63, SAG 47, Y-14991
		Pulp Process	SagTex DSA, SagTex PhD, Y-14991, AMD-14
Water Treatment		Biological Effluent	SAG 471, SAG 5693, SAG 7133, SAG 220, SAG 240
		Sea Water Distillation	SAG 7133, SAG 220, SAG 240, SagTex DSA
Coatings	Paints, Inks & Varnishes		SagTex JSA, Silwet DA-33, Silwet DA-40, Silwet DA-60
	Adhesives		SAG 471, SagTex JSA, Silwet DA-33, Silwet DA-40, Silwet DA-60
	Sealants		SAG 471, SagTex JSA, Silwet DA-33, Silwet DA-40, Silwet DA-60
Mechanical Fluids	Coolants	Glycol Based	SAG 471, SagTex PhD
	Hydraulic Fluids		Element14 PDMS 5000, SAG 5693
	Engine Oils		Element14 PDMS 350, Element14 PDMS 5000, Element14 PDMS 12.5K
	Transmission Oils	Mineral Based	Element14 PDMS 350, Element14 PDMS 5000, Element14 PDMS12.5K
		Synthetic Oil Based	FF160, FF170
	Aqueous Cutting Fluids	Mineral Based	SAG 471, SAG 290, SagTex DSA
	Non-Aqueous Cutting Fluids	Synthetic Oil Based	SAG 471, SAG 290, SagTex DSA
	Heat Transfer		SAG 471, SAG 5693
Construction	Cement		SAG 240, SagTex DSA, SagTex PhD
	Asphalt		SAG 47, Y-14991
Oil & Mining	Ore Extraction		SAG 7133, SAG 220, SAG 240, SagTex DSA, SagTex PhD
	Ore Flotation		SAG 7133, SAG 220, SAG 240, SagTex DSA, SagTex PhD
	Drilling Muds	Aqueous	SAG 7133, SAG 220, SAG 240, SAG 290
	Drilling Muds	Non-Aqueous	Element14 PDMS 5000, Element14 PDMS 12.5K

[2] Certified Kosher. Please consider that usage and/or dosage restrictions may apply, depending on application or other ingredients of same chemistry. For more details please contact the respective brochure, technical datasheet or your responsible Momentive distributor or sales representative.

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