

**1. Definition and Characteristics**

Silicone defoamer SILOKSAN A-1 is oil-in-water emulsion of fumed silica dispersion in polydimethylsiloxane oil.

Silicone defoamer SILOKSAN A-2 is fumed silica dispersion in polydimethylsiloxane oil with 100% active ingredient.

Silicone defoamer SILOKSAN A-3 is fumed silica dispersion in polydimethylsiloxane oil with 100% active material, which contains an emulsifier.

Silicone defoamer SILOKSAN A-5 is a thermo-catalytically treated fumed silica dispersion in polydimethylsiloxane oil, with 95% active ingredient, which contains an emulsifier.

Silicone defoamers SILOKSAN A-4 and A-6 are pure polydimethylsiloxane fluids with suitable viscosities. Silicone defoamers of SILOKSAN A series have a unique set of characteristics, owing to a specific organic-inorganic structure containing silicone oil, the choice of solid stabilizers, emulsifiers and catalysts, as well as the application of specific technological processes of production:

- high thermal and oxidative stability,
- high efficiency over a wide range of pH levels,
- good dispersibility in solvents and foaming media,
- low surface tension,
- low vapour pressure,
- anti-adhesiveness,
- lack of smell and taste, and
- non-combustibility, non-toxicity and physiological inertness.

**2. Areas of Application**

Silicone defoamers of SILOKSAN A series are widely used in various industrial processes and products. They are used to prevent, reduce and break down foam in aqueous and non-aqueous media, in neutral, acidic and alkaline media, oxidizing and reducing environments and in cold and hot environments.

The typical industrial processes and products where there are foam problems, and choice of the appropriate defoamer of SILOKSAN A series are specified in Table2.

**3. Technical Characteristics**

Table 1 shows the typical characteristics of silicone defoamers of SILOKSAN A Series.

FEATURES	units of measurement	aqueous media			non-aqueous media				
		EMULSION			COMPOUNDS			LIQUID	
		A-1	A-1	A-1	A-3	A-5	A-2	A-4	A-6
<b>Content of active ingredient</b>	%	10	17	30	100	95	100	100	100
<b>Silicone content</b>	%	8	15	25	90	85	95	100	100
<b>Density at 20° C</b>	kgm-3	990	990	990	990	990	1010	970	970

<b>Consistency/ Viscosity</b>	mm <sup>2</sup> s <sup>-1</sup>	thin			thick			1000	1000 0	
<b>pH - value</b>		6,5	6,5	6,5						
<b>Ignition temperature</b>	°C	-	-	-	320	-	320	310	310	
<b>Type of emulsifier</b>		non-ionic					-	-	-	
<b>Colour</b>		white			grey	brown white	white	transparent		
<b>Working Concentration *</b>	ppm	2 0 0	150	100	10-50	10-50	10-50	10	10	
<b>Suitable solvent</b>		water				amyl acetate, ethyl acetate, toluene, carbon tetrachloride, petroleum ether, trichloroethylene, methyl ethyl ketone, xylene, lacquer petrol, etc.				

\* calculated on the original product (1 ppm = 1mg/kg)

#### 4. The Technical Problem

Foam is a dispersion of air or other gases in the liquid phase. This term usually describes a system in which the gas phase takes a larger portion of the total volume. Difficulties that cause the appearance of foam in processes and operations are numerous, specific and of varying intensity. They are reflected in:

- reduced capacity of production equipment, because the volume of devices is not fully utilized,
- reduced output of finished products,
- reduced rate of technological processes and operations,
- possibility of deterioration of quality or purity of the product
- impossibility of direct (visual) process control,
- increased fire hazards (if the substance is combustible), and
- loss in hydraulic transport (pumping).

Majority of the important commercial and technical problems caused by foaming, occurs in aqueous systems. Water itself, like all other pure liquids, does not produce foam. But if the water contains surfactants (for example, soaps, detergents or emulsifiers), or some high molecular weight substances (for example, natural and synthetic resins, proteins and humic acids), there is the risk of foaming. The degree of foaming depends on the rate of bubble formation in relation to their stability, so that the low rate of formation of stable bubbles can cause a major problem, as the high rate of formation of unstable bubbles may be relatively unimportant. The geometrical structure of foam is also an important factor in foam stability: fine-grained multi-faceted (compact) foams are more stable than spherical ones. In any case, adequate measures should be taken to eliminate foam. Sometimes it is possible to reduce the problem by changing the operating conditions, for example, most foams are less stable at higher than at lower temperatures, or at one pH level than at the other.

The most effective way to remove harmful effects caused by the foam is to add chemicals that prevent foam formation, and suppress and break down foam, the so-called defoamers. They reduce the surface tension in the adjacent layer formed by the bubble membrane, destroying the membrane, and enable the formation of larger

bubbles, their rising to the surface and final rupture. Various organic foam suppressing substances with different efficiency and specificity of action have been already used in traditional industries for a long time (paper and food industries, production of adhesives and other industries involving the processes of wastewater pumping and heating). SILOKSAN A series belongs to a new generation of highly active defoamers based on silicone oil that has achieved a dominant role in many industrial processes. Silicone defoamers of SILOKSAN A series, with proper selection and application method, can solve nearly all of the problems of foaming in the industry.

## 5. The Advantages of Silicone Defoamers

Despite the fact that defoamers operate through a complex mechanism, there are three criteria for their successful application:

1. The surface tension of the defoamer should be lower than the surface tension of the foaming medium; silicone oils have  $s = 22\text{mN/m}$ ,
2. Defoamer should be insoluble in the foaming medium
3. Defoamer should be dispersible in the foaming medium.

Silicone defoamers of SILOKSAN A series have been so formulated as to comply with these conditions and are characterized by their efficiency and stability in the medium, and defoaming action occurs even during storage. Silicone defoamers of SILOKSAN A series have the following advantages over organic defoamers:

- Universal use of only a few types of defoamers for all the problems of foaming. They are adapted to each individual case and, at the same time, are suitable for all types of media and operating conditions.
- They are incompatible with organic matter, so do not spoil the product. Due to lack of smell, they are particularly suitable for applications where the smell is especially important.
- They do not stain the equipment, but rather form a continuous anti-adherent film on its walls, which facilitates cleaning and monitoring through the sight glass.
- They are economical, because they are used in very small doses. In most cases, direct costs are lower, despite the lower nominal price of organic defoamers.

## 6. Instructions for Use

### 6.1. Selection of defoamer

Given the physical and chemical nature of foaming substances, operating parameters and processing equipment operating conditions, the right choice of a defoamer has to be made at the first place. The choice of silicone defoamer of SILOKSAN A series is based on data from Table 2, compared with other (known to a user) defoamers, or on analysis of the general characteristics of the foaming medium and process. The main criteria for selection of silicone defoamers are:

- whether the medium is aqueous, non-aqueous or mixed,
- whether the medium is acidic, alkaline or neutral,
- whether the medium is cold, warm or hot,
- whether the technical or food grade product purity is required,
- whether the use of organic solvents is allowed.

In this regard, silicone defoamers of SILOKSAN A series have been designed for the following application conditions:

- SILOKSAN A-1 for aqueous, slightly alkaline - very sour, hot or cold media, of technical or food grade purity. Diluted with water.
- SILOKSAN A-3, for aqueous, alkaline - very sour, hot or cold media, of technical grade purity. Diluted with organic solvents.
- SILOKSAN A-5, for aqueous, very alkaline - very sour, hot or cold media, of technical grade purity. Diluted with organic solvents.
- SILOKSAN A-2, for non-aqueous, cold or hot media, of technical or food grade purity. Diluted with organic solvents.
- SILOKSAN A-4 and A-6 for non-aqueous, cold or hot media, of technical or food grade purity. Diluted with organic solvents.

Industry	Use	aqueous media					non-aqueous media			
		EMULSION			COMPOUNDS		FLUIDS			
		A-1	A-1	A-1	A-3	A-5	A-2	A-4	A-6	
Chemical industry	Production of adhesives	*	*	*	*		*			
	Production of detergents	*				*				
	Manufacture of printing inks						*			
	Processing						*			
	Processing of latex	*								
	Polymerization of resins	*	*	*			*			
	Manufacture of soaps	*	*	*	*	*				
	Processing of starch	*	*	*						
	Production of synthetic rubber								*	
	Production of chemical fertilizers					*				
	Additive for pesticides / insecticides				*	*				
Food and Pharmaceutical industry	Fermentation of antibiotics	*	*	*			*			
	Fermentation of yeast	*								
	Deodorization of oil						*			
	Esterification of oil						*			
	Dehydration of food	*	*	*						
	Fruit and vegetable processing	*	*	*						
	Production of instant coffee	*	*	*						
	Production of jams and jellies	*	*	*						
	Production of non-alcoholic beverages	*	*	*						
	Manufacture of pickles	*	*	*						
	Refining of sugar	*	*	*						
Petrochemical industry	Production of acrylonitrile	*	*	*						
	Additive for antifreeze	*	*	*						
	Addition for cutting oil	*	*	*						
	Additive for lubricating oils							*		
	Extraction of aromatics in DEX / sulfolane procedures						*			

	Recycling of asphalt						*	*	
	Production of bitumen emulsions	*	*	*					
	Dry distillation of wood oils	*	*	*				*	*
	Production of oxyethylene	*	*	*					
	Production of oxypropylene	*	*	*					
	Regeneration of the glycol	*	*	*			*		
	Visbreaker procedure							*	*
	Oil wells mud				*		*		
	Pipe still furnaces							*	*
	Separation of natural gas							*	
	Rinse of carbon dioxide						*		
	Absorption of carbon dioxide	*	*	*					
	Drying gases				*		*		
<b>Paper and textile industry</b>	Pulp and paper production	*	*	*					
	Preparation of cellulose pulp	*	*	*					
	Thefinal processing of leather	*	*	*	*				
	Textile Processing								
<b>Other Uses</b>	Latexing of flooring	*	*	*					
	Cooling water circulation	*	*	*					
	Extraction of ore	*	*	*					
	Washing of bottles	*	*	*		*			
	Waste water treatment	*	*	*					
	For regulating of emissions	*	*	*					

### 6.2. Preparation and introduction into the system

Because the silicone defoamers of SILOKSAN A series are added in very small quantities, they usually need to be diluted before introduction into the process. It is best to dilute them with the medium they will be applied to, one of its components, or any of the above listed solvents, up to 1-5% solution of active ingredient. In order to avoid possible stratification or deposition, it is recommended that the quantity of prepared diluted defoamer does not exceed the quantity needed for daily use. There are several ways to introduce a defoaming agent into the system. In the continual processes, the most appropriate way to do it is to add diluted defoamer continually (using improvised dosing devices or dosing pumps) at the point of the most intense mixing, in front of the foam formation place. If an operation leads to the mechanical removal of defoamer, and thereafter re-foaming occurs, do not increase the dosage nor do add defoamer at the same point, but add an extra dose in front of the new foam formation place. In batch processes, diluted defoamer is added in one or more doses. Silicone defoamers (especially in batch processes) can also be introduced by coating the walls of devices /vessels at critical points, or through porous materials impregnated by defoamer, that float in the foaming liquid (wood block, aerated concrete, etc.).

### 6.3. The choice of working concentration

Appropriate working concentration of the defoamer is determined by the user, by means of laboratory testing of a sample of foaming fluid and / or, better yet, by testing under operating conditions. Experience found that the optimum efficiency of silicone defoamers of SILOKSAN A series can be obtained at concentrations of 1-100 ppm (1-100 parts by weight of silicone to 1 million parts by weight of foaming liquid). Working concentrations shown in Table 1 can also serve as orientation for the planning of experimental tests. Testing usually begins with a high dose of defoamer, because if the result is positive, it also confirms the accuracy of selecting the type of defoamer.

**7. Regulations on Health Safety**

Silicone defoamers SILOKSAN A 1 and A-2, which are intended for use in food products and in food processing, are consistent with the provisions of the Law on Sanitary Surveillance of Food and Items of General Use, Art. 5, paragraph 2, Sluzbeni glasnik 55/78.

**8. Health Hazards**

Silicone defoamers of SILOKSAN A series are non-toxic. However, avoid contact with eyes and ingestion of the original products and solutions of SILOKSAN A-3 and A-5. These types of defoamers contain emulsifiers that may cause eye irritation and dry skin. Silicone defoamer SILOKSAN A -1 has a mild irritant effect. SILOKSAN A-2, A-4 and A-6 are physiologically inert and do not pose a health risk. In case of contact with eyes or skin, rinse with plenty of clean water.

**9. Packaging and Storage**

Silicone defoamers of SILOKSAN A series are available in in PE-canisters with a net weight of 5, 10, 20, 25 and 50 kg or PE-drums with a net weight of 220 kg.

Silicone defoamer SILOKSAN A-1 has a shelf life of up to 6 months if stored in the sealed original containers between 5o and 30oC. Silicone defoamers SILOKSAN A-2, A-3 and A-5 have an indefinite shelf life under any weather conditions, if stored in the original or other clean sealed containers. Light mixing is required before use. Silicone defoamers SILOKSAN A-4 and A-6 have an indefinite shelf life under any conditions, if stored in the original or other clean sealed containers. With the exception of silicone defoamer SILOKSAN A-1, where it is necessary to avoid re-freezing, all the other silicone defoamers of SILOKSAN A-series do not require special storage conditions during transport.