



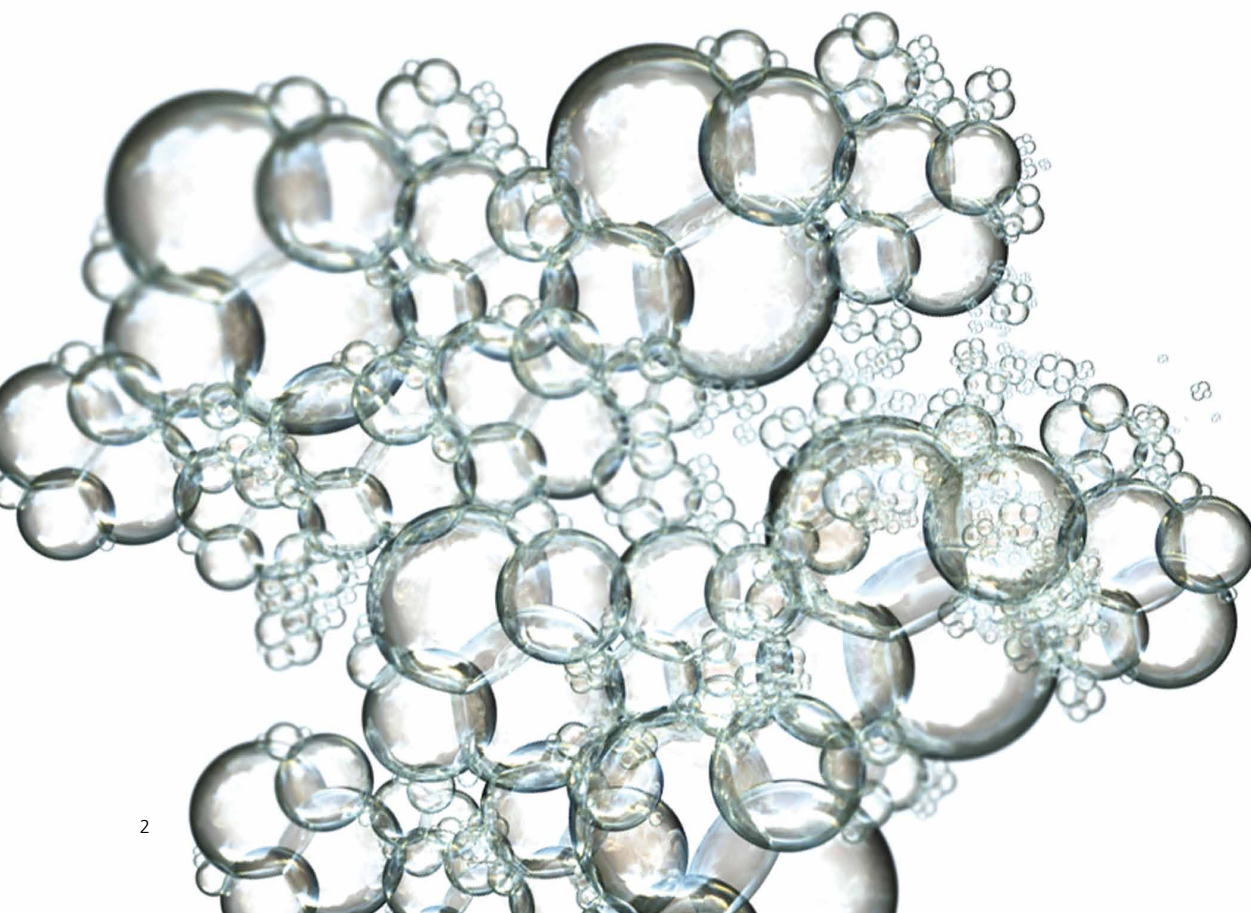
Technical Information AS-TI 1

Defoamers and Air Release Agents for Adhesives and Sealants

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Introduction

The presence of foam is always undesirable in adhesives and sealants (except of course in foam sealant). Foam created during the production process leads to non-optimal utilization of the production equipment and can cause problems in the filling lines. Furthermore, foam that forms during the application of adhesives can result in surface defects that could negatively impact the adhesive properties.

One of the determining factors in stabilizing the foam is the presence of surface-active substances, or surfactants. These bipolar substances can stabilize air bubbles by forming a double layer (figure 1).

BYK has over 30 years of experience in developing defoamers and air release agents for various applications.

Due to the multitude of formulations of adhesives and sealants, there is no particular defoamer that is optimum for all systems. Therefore, it is necessary to offer a wide variety of products in order to provide a suitable product for each specific application purpose.

Defoaming effects cannot be fine-tuned solely by optimizing the dosage: More defoamer also generally provides improved defoaming, but it can cause surface defects. This often means that a combination of defoamers with various compatibilities provides optimum defoaming while also simultaneously minimizing negative side effects.

In the following sections, the defoamers are presented according to their various chemical compositions.

Foam Stabilization through Surfactants

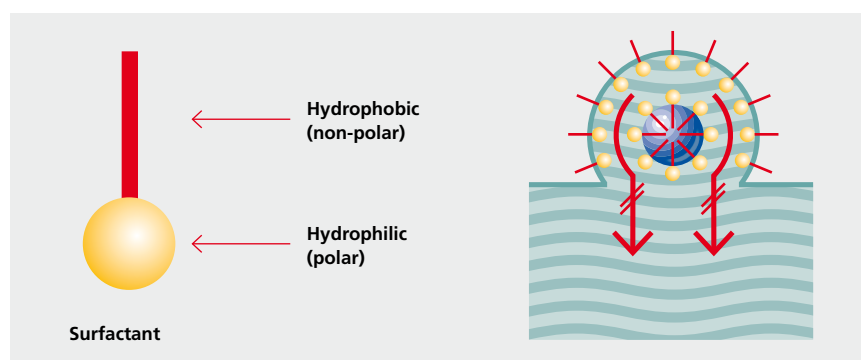


figure 1

Defoamers for Aqueous Systems

Silicone Defoamers

Silicone defoamers contain organically modified polysiloxanes. They are characterized by a particularly low surface tension.

With today's state of knowledge, BYK silicone defoamers show no negative influence on adhesion when used in adhesives. The explanation is that only organically modified silicone defoamers are used instead of unmodified polysiloxanes or silicone oils. Therefore, these additives are very suitable for adhesives.

Silicone Defoamers

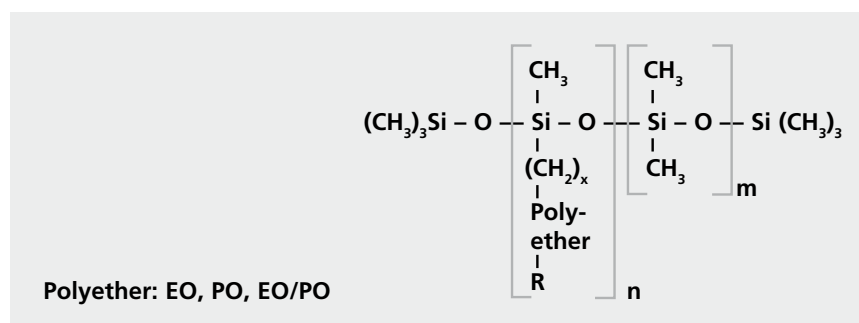


figure 2

Silicone Defoamers for Aqueous Adhesive Systems

Silicone defoamers for aqueous systems are primarily polyether-modified polysiloxanes. The polysiloxanes achieve a certain water compatibility by way of the polyether modification (figure 2).

In addition to silicone, silicone defoamers also contain hydrophobic solids to support the defoaming. Furthermore, the products also contain emulsifiers and polyglycols in order to influence the ease with which the defoamer can be incorporated into the aqueous systems.

In addition to the incorporation conditions, selecting the appropriate product also depends on the sensitivity or respectively the robustness of the system to be defoamed. BYK-093 and BYK-028 are great starting points for selecting an appropriate defoamer (figure 3). Both products have a good defoaming effect and a good compatibility, but BYK-093 is more effective for longer periods of time.

If these products prove too strong, BYK-025 is an available product that is very easy to incorporate and correspondingly causes few side effects.

Silicone Defoamers for Aqueous Adhesive Systems

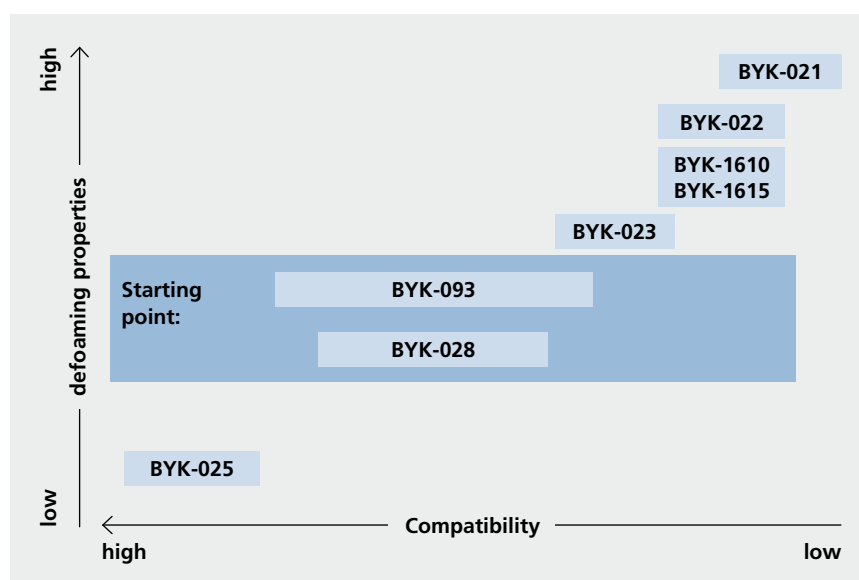


figure 3

If BYK-093 and BYK-028 do not provide a sufficient defoaming effect, try BYK-023, BYK-022 and BYK-021, which are even stronger. However, these products must then be incorporated with higher shear forces.

In applications for which adhesives are applied using a printing process (such as gravure printing), microfoam often causes problems. In these cases, BYK-094 is the first choice.

In order to achieve an optimum result, meaning the best possible defoaming along with extensive reduction of side effects, combinations of defoamers can also be used.

BYK-1610 and BYK-1615 were specifically developed as substitutes for mineral oil defoamers. Both of these products have an excellent cost-benefit ratio. They are also approved for diverse food contact applications.

Mineral Oil and Silicone-free Polymeric Defoamers for Aqueous Adhesive Systems

Useful defoamers are not only polysiloxane-based. Polymeric substances can also have excellent defoaming properties due to their incompatibility in the system. The specific balance between

„incompatible“ and „compatible“ is adjusted by changing the polarity and the molecular weight, or respectively the molecular weight distribution of the polymeric structures. However, to date there is no published data which explains the logical relation between defoaming efficiency and the chemistry of the polymer used. From the range of

polymeric defoamers, BYK-014 is the first choice. The additive shows an excellent defoaming and at the same time good compatibility. If an incompatibility is observed, BYK-016 is particularly suitable. The additive is very easy to incorporate.

Recommendation Chart: Silicone and Polymeric Defoamers for Diverse Adhesive Resins

	PVAc	VAE	Polyacrylate	PU Dispersion	Polychloroprene	Polyvinyl Alcohol
Polymeric Defoamers	BYK-014 BYK-016	BYK-012 BYK-014 BYK-1640	BYK-012 BYK-014	BYK-014 BYK-016 BYK-1640	BYK-014	BYK-014 BYK-016
Modified Silicone Defoamers	BYK-022 BYK-093	BYK-022 BYK-093	BYK-022 BYK-094	BYK-093 BYK-1610	BYK-021 BYK-022	BYK-021 BYK-093

figure 4

Mineral Oil Defoamers

The BYK-030 product line is comprised of mineral oil defoamers. Mineral oil defoamers are generally only utilized in aqueous systems because they are too compatible with solvent-borne systems. A mineral oil defoamer consists of about 85 % carrier oil and about 10 % hydrophobic solids to support the defoaming effect. Emulsifiers, biocides and other performance enhancing ingredients make up the remaining 5 %. Paraffinic mineral oils are used as the carrier oil, however, in certain instances, medical white oil is also used. Criteria for selecting products in the BYK-030 product line include the percentage of additional silicone to improve the defoaming (e.g., BYK-038), the concentration of nonylphenol ethoxylate (e.g., BYK-033) and the differentiation between emulsions (e.g., BYK-037) and 100 % active substance additives (figure 4).

Defoamers for Aqueous Systems

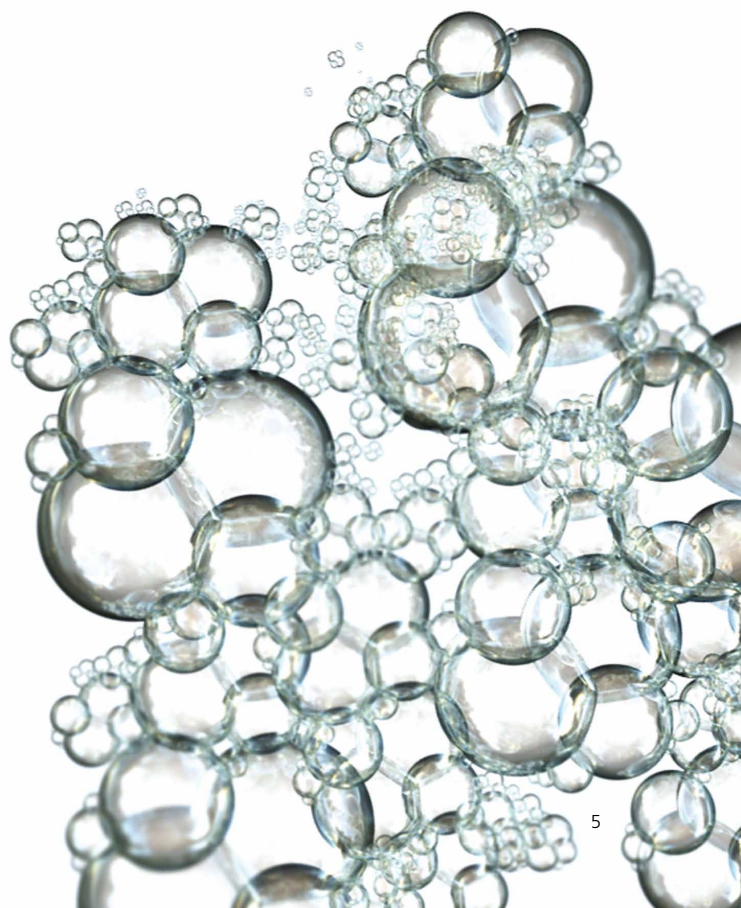
Silicone Defoamers	Polymeric Defoamers	Mineral Oil Defoamers
BYK-093* BYK-094* BYK-022* BYK-028*	BYK-014* BYK-012* BYK-016*	BYK-037 BYK-039

* > 94 % non-volatile matter

First recommendation

Second recommendation

figure 5



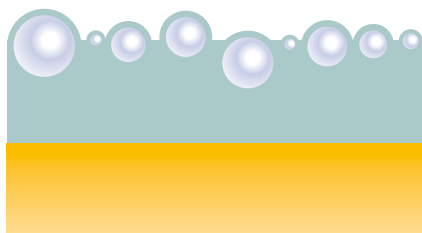
Air Release Agents for Solvent-borne and Solvent-free Systems

The term „defoaming“ is often used as a generalization to denote the process of removing gas bubbles from a layer of adhesive. A distinction is sometimes made between „air release agent“ and „defoamer“ (figure 6). Gas bubbles must first rise to the surface: this is the process of air release. The subsequent destruction of the foam bubbles on the surface is the actual defoaming. Air release agents are used to increase the speed with which foam bubbles rise to the surface. They facilitate the fusion of

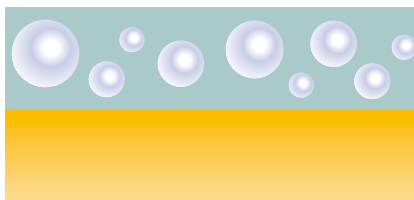
adjacent small bubbles into larger bubbles which then rise more rapidly to the surface (Stokes' law). For this to succeed, air release agents must be active throughout the adhesive layer. Defoamers are only active on the surface of the adhesive, and destabilize the air bubbles which have risen. However, in practice this distinction is not consistently observed. Additionally, it is not always possible to define the activity of an additive as only air release or only defoaming. Therefore, the

following text will usually refer generally to defoamers, even though the term „air release agent“ may be more appropriate in a few cases. Silicone and polymeric defoamers are generally good choices for solvent-borne and solvent-free adhesives. Mineral oils are not suitable for these conditions, because they are too compatible in many of these systems, and their spreading properties are insufficient.

Defoamers – Air Release Agents



Foam on the surface.
Defoamers destabilize these foam bubbles.



Air entrapment in the coating film.
Air release agents accelerate the rising of bubbles to the surface.

figure 6

Silicone Defoamers

Silicone defoamers for solvent-borne systems can contain for instance unmodified silicones (figure 7, dimethylpolysiloxane) or silicones modified with alkyl or fluorine chains. Fluorine modification produces silicones with an exceptionally low surface tension that feature excellent defoaming with a very small percentage of incompatible substances. The products BYK-065, BYK-066 N, and BYK-067 A are included in this group. All three products are primarily recommended for defoaming polyurethane systems.

Dimethylpolysiloxane

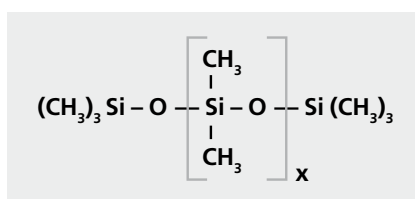


figure 7

Mineral Oil and Silicone-free Polymeric Defoamers

Similar to polymeric defoamers for aqueous systems, the efficiency of the additive is adjusted by the polarity and the molecular weight of the polymer used. BYK-A 515 and BYK-A 535 are recommended out of this group for polyurethane systems. BYK-A 515 is also the first choice for acrylic systems, whereas BYK-A 550 is often used in epoxy systems. Other possible products are indicated in figure 8.

Polymeric and Silicone Defoamers

In addition to the pure silicone defoamers, there are also combination products that contain silicone as well as specific defoaming polymers. This group includes such products as BYK-070 (for acrylic systems), BYK-088 (for polyurethane systems) and BYK-A 530 (for epoxy systems) which are more compatible (figure 8).

Defoamers for Reactive Systems

	Polyurethane	Epoxy	Acrylic	UV Systems
Defoamers	BYK-067 A BYK-088	BYK-A 525 BYK-A 530	BYK-070	BYK-067 A BYK-088
	Silicone-free: BYK-1794* BYK-A 535*	Silicone-free: BYK-A 550* BYK-A 535*	Silicone-free: BYK-A 515	Silicone-free: BYK-1790* BYK-1791* BYK-A 535*

* > 94 % non-volatile matter

First recommendation

Second recommendation

figure 8



For more information about our additives and instruments, as well as our additive sample orders please visit:

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