



Technical Information AS-TI 4

Surface Additives for Adhesives and Sealants

Surface Additives for Aqueous Systems

One of the most important purposes of surface additives is to improve substrate wetting.

The substrate wetting primarily depends on the surface tension of the adhesive system and surface energy of the substrate that is to be coated. Generally speaking, for a good wetting, the surface tension of the adhesive should be lower than the surface energy of the substrate.

Poor wetting, i.e. a contraction or even pearling of the adhesive can be expected if the surface tension of the adhesive is above the surface energy of the substrate. Substrates with a generally lower surface energy (e.g. plastic parts) or soiled surfaces (oil residue, release agent) are therefore much more difficult to wet (figure 2). Due to their water content, aqueous adhesive systems have a higher surface

tension than solvent-borne systems, which in turn leads to more wetting problems. Silicone surfactants reduce the surface tension of the adhesive and thus lead to improved wetting of the substrate. This improved wetting is the prerequisite for good adhesion and, therefore, good bonding.

Silicone Surfactants

Figure 1 portrays the generalized structure of a silicone surfactant. Chemically, they are very small non-polar silicone chains consisting of only few Si-O groups, which are modified with one to two polar polyether chains on average. This composition gives the products a distinct surfactant character and reduces their surface tension significantly in aqueous systems (figure 3).

Structure of a Silicone Surfactant

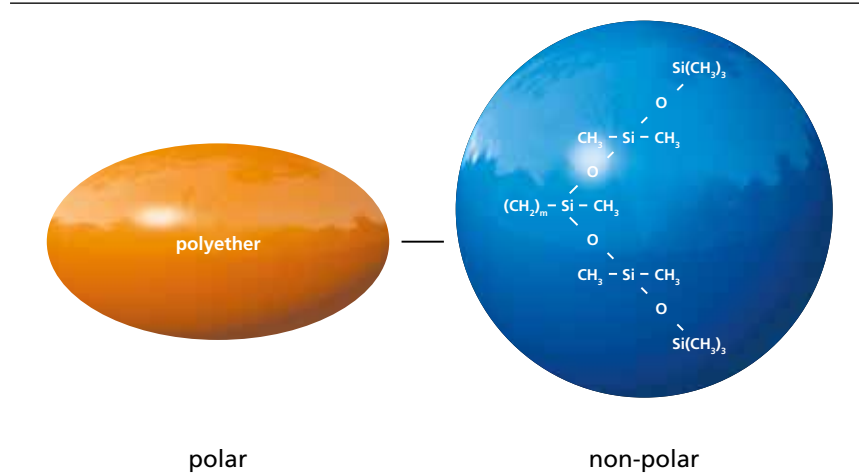


figure 1

Substrate Wetting of an Aqueous Adhesive on Silicone Paper

Poor substrate wetting without surface additive



Improved substrate wetting with surface additive



System: Acrylic dispersion

figure 2

Static Surface Tension: Reduction by Means of Silicone Surfactant

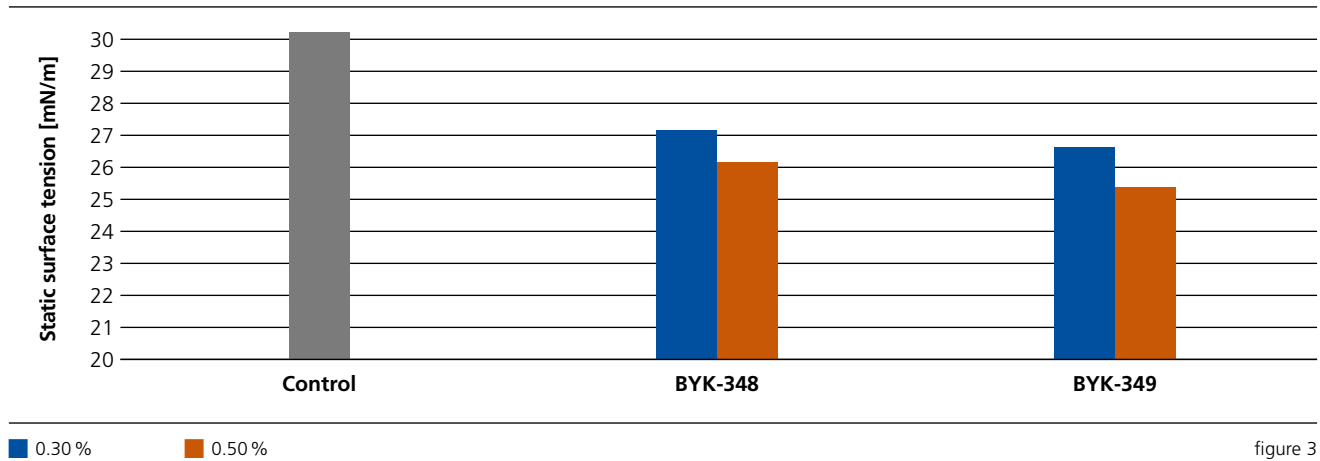


figure 3

Surface Tension in mN/m

Additive Addition	Control	BYK-348	BYK-349
+0.30 %	32.7	27.2	26.7
+0.50 %		26.2	25.4

figure 4

Furthermore, they spread very well, which distinguishes them from most other conventional surfactants (see figure 5). Silicone surfactant BYK-348 and BYK-349 are particularly suitable for aqueous systems. Figure 6 shows when the products require a co-solvent or can be used without one.

BYK-3400 is a silicone surfactant with a reduced silicone content. It concerns a combination of a silicone surfactant with a conventional surfactant. Alongside the static surface tension, BYK-3400 in part also reduces the dynamic surface tension.

Spreading Properties of Silicone Surfactants

Water drops on plastic surface



figure 5

Silicone Surfactants – Fields of Application

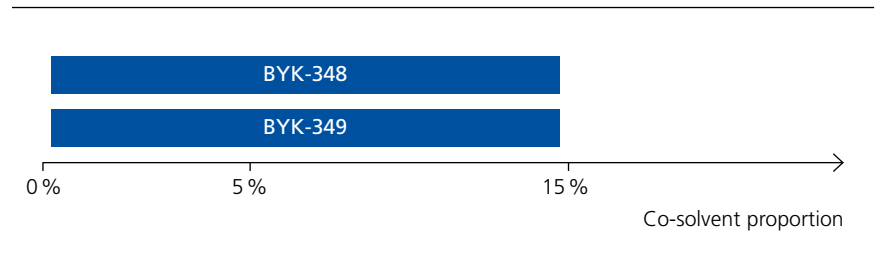


figure 6

Silicone-free Surfactants

BYK-DYNWET 800 N is a silicone-free surfactant developed especially to reduce dynamic surface tension. Reducing dynamic surface tension is useful for rapid application processes (printing, curtain coating applications) which generate new surfaces at high speeds. In figure 7, the surface tension was determined using a bubble pressure tensiometer. Low bubble frequencies signify slow processes, while high

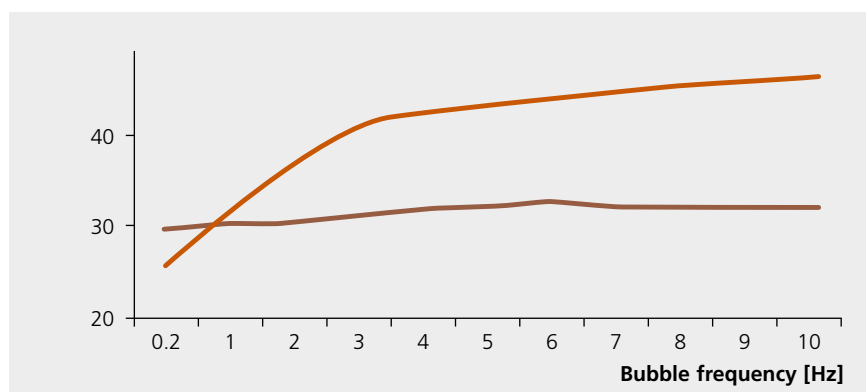
bubble frequencies are a sign of very fast application processes. While silicone surfactants reduce dynamic surface tension for static or slow processes, they are not the first choice for rapid processes. BYK-DYNWET 800 N, on the other hand, reduces surface tension almost equally for all speeds.

BYK-3410 is also a silicone-free surfactant for reducing the static and dynamic surface tension and

possesses a series of approvals for the direct and indirect contact with food.

In the case of negligible differences in the surface tensions of the substrate and adhesive, acrylate leveling additives can also be used. Alongside a better leveling, for example BYK-381 also offers substrate-wetting properties.

Reduction of Dynamic Surface Tension



■ BYK-348 ■ BYK-DYNWET 800 N

figure 7

Recommendation Chart: Surface Additives for Adhesives

Silicone Surfactants	BYK-348*	Strong reduction of the static surface tension, no foam stabilization
	BYK-349*	Strong reduction of the static surface tension, no foam stabilization
	BYK-3455*	Alternative to fluorosurfactants; reduction of static and dynamic surface tension
Silicone surfactant + surfactant	BYK-3400	Reduction of the static/dynamic surface tension, particularly for applications using a flow curtain, it improves the elasticity
Silicone-free surfactants	BYK-3410	Silicone-free version of BYK-3400
	BYK-DYNWET 800 N	Reduction of dynamic surface tension, especially for high application speeds
Polyacrylates	BYK-381	Pure polyacrylate for better leveling, slightly improves substrate wetting
	BYK-3441	Leveling additive additionally with improved substrate wetting, contains a fluorosurfactant

* ≥ 94 % non-volatile matter

figure 8

First recommendation Second recommendation

Surface Additives for Solvent-borne and Solvent-free Systems

The surface tension of the adhesive systems listed is considerably lower than with aqueous systems. Thus, problems wetting the substrate occur less frequently. Optimal wetting occurs when the contact angle between

adhesive and substrate is as low as possible (figure 10). For this reason, various surface additives are also used with these adhesives. The additives especially improve the wetting of low-energy substrates, such as plastic

surfaces, which contributes to improved adhesion. An overview of recommended uses is displayed in the following chart.

Recommendation Chart: Surface Additives for Solvent-borne and Solvent-free Adhesives

Systems	Recommendation
Polyurethane	BYK-333 * BYK-378 * BYK-307 *
Epoxy	BYK-333 * BYK-378 * BYK-307 * BYK-310
Acrylic	BYK-333 * BYK-378 * BYK-307 *
UV systems	BYK-377 * BYK-UV 3500 *

* ≥ 94 % non-volatile matter

figure 9

First recommendation Second recommendation

Contact Angle Measurement of Liquids

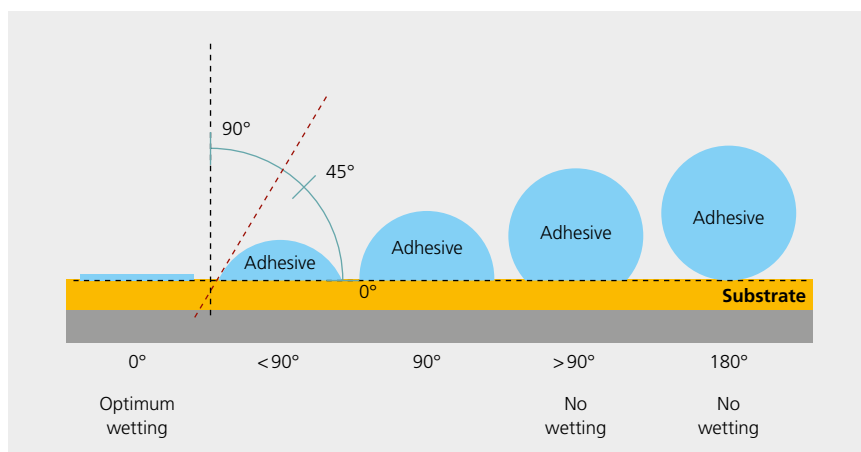


figure 10

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Additive Guide



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