A foam control additive is used to reduce or eliminate foam in a coating or coating constituent. The terms ‘defoamer’ and ‘antifoaming’ agent are often used interchangeably. In fact, they are not quite the same.

A defoamer is a surface-active agent that stops the foam and breaks the bubble once it has been formed. It is a bubble breaker.

An antifoaming agent prevents the formation of foam so it never forms.

The term “foam control additive” is a more appropriate term to use.

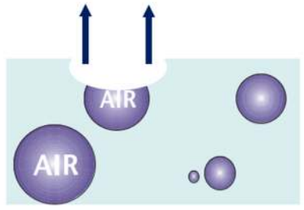
There is a difference between macrofoam and microfoam. Macrofoam is located mostly on the coating surface and is surrounded by a duplex film with two liquid/air interfaces (double layer), whereas microfoam occurs inside of a coating film (air entrapment) and is characterized by a single liquid/air interface. These two types of foam also differentiate defoamers from deaerators.

Defoamers are mostly effective against macrofoam, whereas deaerators suppress microfoam.

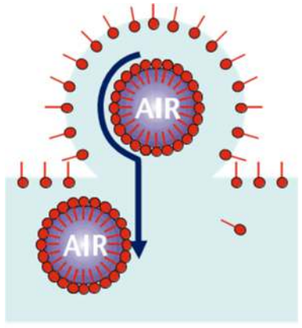
Both kinds of foam impair the surface optics of the coating and cause surface irregularities, as well as reduce gloss and transparency. Microfoam also adversely affects the coating’s protective properties because the effective film thickness is reduced and pinholes can form from the micro bubbles.

The function of defoamers is based on disturbance of the double layer of the macrofoam lamella. Substances with very low surface tension are used as they are not wetted by the foam bubble.

Foam-stabilizing substances move away from the defoamer droplet, which finally causes collapse of the bubble. Surfactants are often used with defoamers to improve the spreading of the defoamer droplet on the bubble surface.



Without surfactant



With surfactant

In surfactant-free solutions, these bubbles will move up to the surface because of their lower density. At the surface, formation of a so-called lamella takes place, the gas bubble still containing a layer of liquid on the outside. The liquid in the lamella flows down and then out. The size of the lamella gets smaller while the thickness of the liquid layer around the gas bubble is reduced. Ordinarily, the lamella will burst at a thickness of approximately 10 nm. This process is called drainage effect and in pure water, will occur instantaneously.

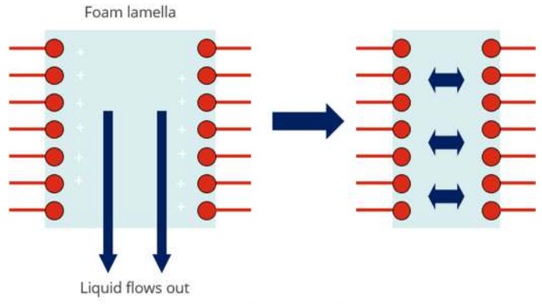
In the case of a system containing a surfactant characterized by the presence of hydrophobic and hydrophilic molecular subgroups, air in bubbles are stabilized by a double layer of surfactants.

Foam builds up due to the fact that the hydrophobic subgroups orient themselves towards the air whereas hydrophilic groups are directed towards the liquid phase thereby reducing surface tension.

Foam Control Additives KAM-FCA®

Foam is stabilized by different mechanisms via action of surfactants:

- The formed lamella is much thinner compared to that in pure liquids. The liquid cannot flow out and drain as quickly.
- The presence of ionic surfactant molecules at the surface creates electrostatic repulsion.
- The foam lamella exhibits a higher elasticity due to a stretching effect caused by the presence of surfactant molecules.

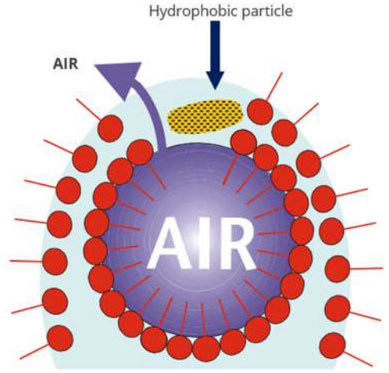


Electrostatic repulsion

Defoaming mechanism:

- Finely dispersed foam control additive droplets penetrate into the foam lamella and spread itself out into the shape of a duplex film. This leads to an increase of surface tension causing the lamella to break.
- The “droplet” penetrates the lamella and forms a mixed monomolecular film there, leading to a lower cohesion compared to the previously existing one and causes lamella to break.
- In case of foam control additives containing hydrophobic particles like silicas: Hydrophobic particles reach the surface of lamella and on the top of the lamella they adsorb surfactant molecules. The lamella is deprived of the surfactants and breaks.

Excellent foam control additives are characterized by high incompatibility, high spreading activity, low surface tension and for further enhancement, the content of hydrophobic particles.



Defoaming mechanism by hydrophobic particles

According to the described defoaming mechanism, a typical foam control additive consists of carrier fluids (A), surfactants (B) and active substances (C).

(A) act to transfer the generally hydrophobic active substance uniformly into the hydrophilic medium. Typical carrier fluids include aliphatic and aromatic mineral oils, solvent blends, water, etc.

(B) bring the active substance to the air interface and into contact with the stabilized foam structure. These substances (Fatty acid esters, amides, polyalkylated glycols, etc.) work by having a general incompatibility with the formulation and disrupt the spreading mechanism for stabilizing foam.

(C) adsorb surfactant ingredients present in the formulation and destabilize foam. Hydrophobic particles like metal soaps, waxes, hydrophobic fumed silica are adsorption compounds for foam destruction.

A foam control additive with a high degree of incompatibility and therefore, high defoaming activity should be introduced into the system under sufficiently high shear to render good mixing. Otherwise, side effects like cratering or haze may appear in the dried films.

A more compatible grade can be added at the letdown process or as a post-addition.

Foam Control Additives KAM-FCA®

Trade name	Description/Composition	Dosage %	Solids %	Features & benefits	Acid curable	Acrylic OH-functional	Acrylic self-crosslinking	Acrylic thermoplastic	Long-oil alkyd	Medium-oil alkyd	Short-oil alkyd	Alkyd & PE OH-functional	Alkyd & PE melamine	Chlorinated rubber	Solvent-based epoxy	Solvent-free epoxy	Nitrocellulose	Unsaturated polyester	Silicon resin	Vinyl copolymer	Acrylic emulsion	Acrylic water-reducible	Alkyd emulsion	Alkyd melamine	Alkyd water-reducible	Epoxy	Polyester melamine	Polyurethane emulsion	2K polyurethane	UV Curable	Packaging inks (Gravure/Flexo/Screen)	Water-based inks	Ambient Curing Systems	SMC/BMC	PVC (Plastisols/Compounds)	Thermoplastics	PUR Foams	Water-based	Solvent-based	Solvent-free & Reactive
					Solvent-based Coating																Water-based Coating									Ink		Composite						A & S*		
KAM-FCA 20	Solution of defoaming substances, silicone-free	0.1-0.7 upon total formulation	-	No negative influence on inter-coat adhesion/Universal for pigmented systems	●	●	●	●		●	●				●		●	●												●		●	●					●	
KAM-FCA 22	Solution of defoaming substances, containing silicone	0.2-1.0 upon total formulation	-	Polyurethane curtain coatings and stoving enamels		●	●			●	●	●	●		●	●																							
KAM-FCA 26	Solution of defoaming substances, containing silicone	0.1-1.0 upon total formulation	-	Printing inks based on acetate-reduced nitrocellulose. PVB and PU inks					●								●														●								
KAM-FCA 40	Solution of defoaming substances, containing silicone	0.1-0.7 upon total formulation	-	Industrial coatings including airless spary applications/highest compatibility		●	●	●	●	●		●	●	●	●		●		●	●											●								
KAM-FCA 521	Foam-destroying polysiloxanes emulsified in water	0.05-1.0 upon total formulation	-	High-gloss and satin-gloss systems. Suitable for resin-free grinds																		●	●	●	●	●	●	●	●			●						●		
KAM-FCA 550	Modified polydimethyl siloxane	0.1-0.5 upon total formulation	-	Grinding stage for pigment concentrates/Long-term stability																		●	●						●									●		
KAM-FCA 561	Foam-destroying polysiloxanes emulsified in water	0.05-1.0 upon total formulation	-	Defoams particularly high-gloss and satin-gloss systems, even in airless application.																		●	●	●	●	●	●	●	●			●						●		
KAM-FCA 564	Polysiloxanes and hydrophobic solids in polyglycol	0.1-1.0 upon total formulation	-	All purpose/Suitable in PVC range of 0 to 25. Suitable for resin-free grinds																		●	●	●	●	●	●	●	●			●						●		
KAM-FCA 568	Polysiloxanes and hydrophobic solids in polyglycol	0.1-1.0 upon total formulation	-	High-gloss systems/Suitable in PVC range of 0 to 25																		●	●	●	●	●	●	●	●			●						●		
KAM-FCA 593	Fine dispersion of foam-destroying hydrophobic solids in mineral oil	0.2-0.5 upon total formulation	-	Prevents air entrainment during manufacture and application of water-based paints and adhesives																		●	●	●	●	●	●	●	●			●						●		
KAM-FCA 720	Solution of defoaming substances, silicone-free	0.1-1.0 upon total formulation	-	Unstaturated polyesters/epoxy and polyurethane coatings											●	●		●													●	●		●	●	●	●			●	●
KAM-FCA 722	Solution of defoaming substances, containing silicone	0.3-1.5 upon total formulation	-	Solvent-free epoxy and polyurethane systems												●																●	●	●					●	●

* Adhesives and Sealants

● Suitable/Recommended

● Potentially suitable