

ZetaSperser[®] dispersants

AND OTHER ADDITIVES FOR AQUEOUS DISPERSION



Evonik Corporation's family of Surfynol[®], Dynol[™], Airase[®], Carbowet[®], and ZetaSpurse[®] additives are widely used in countless industries, including coatings, inks, adhesives, metalworking, and construction. Our continued commitment to develop new and beneficial surfactant technology promises to be an answer to ongoing challenges facing formulators. We are constantly working to provide unique products and performance solutions for a broad range of applications.





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Dispersants for resin-free systems

ZetaSpense dispersants encompass a range of products developed to provide effective stabilization of pigments and particles in aqueous systems. Designed to orient at the particle surface and establish a repulsive force that inhibits flocculation and aggregation, these dispersants can provide the performance necessary to achieve aqueous dispersions of a wide range of solid chemistries. Optimized for performance in all aspects of the dispersion process, ZetaSpense dispersants require minimal or no additional formulation with other surface active agents to achieve optimal performance. Many of the ZetaSpense dispersants are designed for a range of uses and performance requirements, and many are specifically designed to overcome typical problems with common pigment types. There is significant overlap in the product line, and for most dispersion needs, we can offer multiple, diverse technical solutions that can allow you to achieve maximum value in your dispersions.



ZetaSpense Tool

ZetaSpense dispersants have been tailored to provide optimal performance without additional formulation; therefore, in the initial evaluation, it is best to start by eliminating any other surfactants, wetting agents, or dispersants in your screening formulation. Competitive interactions can be difficult to predict and can mask both good and bad performance issues, thereby lengthening the formulation development process. Sometimes additional additives may boost necessary dispersion attributes, but that should be considered after identifying which dispersant is the most effective.

Choosing the correct dispersant can be a challenging endeavor for a formulator because of the wide range of properties and dispersion characteristics of the various pigment grades on the market. To assist our customers in quickly finding a dispersant for their pigment formulation, Evonik has, based upon its experience with dispersants, developed the Formulators Assistant ZetaSpense Tool (known as "FAZT") to provide product recommendations and starting point formulations for over a thousand different specific pigment grades in our database. FAZT can be found at FAZT.com and is accessible online and from your mobile platform.



ENHANCED FAZT FEATURES

Easy access from your mobile or desktop device

Improved accessibility via the web

An extensive database of global pigments

A broad list of global pigment suppliers

Specific dispersant recommendations for each pigment

Top-performing defoamer recommendations

Download app at www.FAZT.com

Product descriptions

Dispersants

RESIN-FREE SYSTEMS

**ZetaSperse
1200
dispersant**

A high-performance dispersant designed for the dispersion of inorganic chemistries, ZetaSperse 1200 dispersant has been shown to be highly effective with titanium dioxides, iron oxides, other inorganic pigments and particle chemistries. Based on a combination of lower molecular weight dynamic wetting and stabilizing chemistries with an anionic dispersant polymer, ZetaSperse 1200 dispersant can provide excellent performance attributes in application and throughout the dispersion process and is a 45% active solution in water.

**ZetaSperse
2300
dispersant**

A very cost effective, low molecular weight electrosteric dispersant, this product provides robust stabilization for a wide range of particle chemistries. ZetaSperse 2300 is a first choice for cost sensitive applications, low solid dispersions, and large particle size materials.

**ZetaSperse
2500
dispersant**

A low molecular weight electrosteric dispersant, this product was specifically designed to provide strong steric stabilization characteristics to inhibit viscosity build in organic pigments. ZetaSperse 2500 is a first choice with organic pigments.

**ZetaSperse
3100
dispersant**

A moderate molecular weight electrosteric dispersant, ZetaSperse 3100 was designed to provide consistent performance across carbon black pigments, particularly mass tone grades. ZetaSperse 3100 is also excellent with many inorganic pigments and particles and works best when combined with a Carbowet grind aid for optimal wetting and milling efficiency.

**ZetaSperse
3400
dispersant**

A moderate molecular weight electrosteric dispersant, this product was designed to inhibit the viscosity build common with some organic pigment types. ZetaSperse 3400 is a first choice for quinacridone, perylene, and other organic pigments, and has also shown excellent benefits with inorganic particles in industrial specialty applications.

**ZetaSperse
3600
dispersant**

A moderate molecular weight electrosteric dispersant formulated with lower molecular grind aids, this product was designed to provide optimal milling characteristics for organic pigments. ZetaSperse 3600 is a first choice for pigments and particles that are difficult to mill and has shown excellent performance with mid-grade organic pigments, less refined grades, as well as transparent inorganic pigments.

**ZetaSperse
3700
dispersant**

A moderate molecular weight electrosteric dispersant, this product was designed for optimal color stability with some organic pigment types. ZetaSperse 3700 is a first choice for phthalocyanine, DPP, azo, and other organic pigments.

**ZetaSperse
3800
dispersant**

A moderate molecular weight steric dispersant, this product was designed to offer robust stabilization across all particle chemistries. ZetaSperse 3800 is a first choice where one dispersant is desired for many systems and an easy to use option for new formulation development.

Dispersants for resin-containing systems

The ZetaSperse 100 series dispersants were specifically designed to overcome the hurdles of optimizing resin-containing dispersions. These dispersions already contain significant ionic stabilization from the grind resin or binder. In these resin-containing systems, traditional dispersant polymers typically do not provide benefits or adversely interact with the resin. Since they are comprised of nonionic polymers, the ZetaSperse 100 series dispersants can provide steric stabilization characteristics to the largely ionic resins resulting in performance synergies; their use often provides lower dispersion viscosities, improved stability and greater resistance to letdown shock and other incompatibilities. These dispersants are typically added at use levels of 0.5 to 3.0 wt. % because their purpose is secondary stabilization.



Product descriptions

RESIN-CONTAINING SYSTEMS

ZetaSperse 170 dispersant

Lower in molecular weight, ZetaSperse 170 dispersant is designed for optimal performance with acidic surface groups such as carbon black. A tertiary amine provides strong affinity for acidic substrates, and its nonionic character adds strong steric stabilization. ZetaSperse 170 dispersant is most effective when used as a secondary dispersant with anionic polymeric dispersants for organic and inorganic pigments. It can provide a boost in stabilization and typically lower dispersion viscosities, allowing for higher solids loadings and improved overall dispersion stability.

ZetaSperse 179 and 182 dispersants

These dispersants are most effective when used as a secondary dispersant in conjunction with anionic polymeric dispersants and grind resins. Both dispersants can provide significant wetting, milling, and steric stabilization benefits, often improving milling efficiency, color development and dispersion stability, enabling formulators to achieve higher performance. ZetaSperse 179 and 182 dispersants can provide a significant boost to dispersion stability by enhancing steric stabilization and are typically used to control dispersion viscosity, improve resistance to flocculation in letdown, and provide general stability benefits. ZetaSperse 179 dispersant is a highly alkoxyated surfactant designed to provide optimal dispersion benefits in resin-containing formulations or other systems based on an anionic dispersant. ZetaSperse 182 dispersant is a sibling product to ZetaSperse 179 dispersant, differing in the nature of the hydrophobic group.

ZetaSperse 2500 dispersant

Although primarily designed for resin-free and resin-minimal systems, ZetaSperse 2500 dispersant has shown stabilization benefits when used as a secondary dispersant in combination with other polymeric dispersants or grind resins. At low levels of 1 to 3 wt. % on total formulation, ZetaSperse 2500 dispersant can boost the stability of organic dispersions.

ZetaSperse 3600 dispersant

Typically a primary dispersant, ZetaSperse 3600 dispersant has had success improving the letdown stability of dispersions based on grind resins and other anionic dispersing polymers. Due to its strong wetting and milling benefits, the addition of ZetaSperse 3600 dispersant as a dispersion aid can also boost dry powder wetting and improve milling efficiency, much like a grind aid.

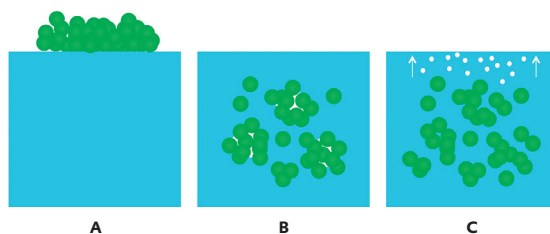
Additives for dispersions: wetting agents, grind aids, and defoamers

While dispersants provide the primary stabilization in a dispersion, additional surface active additives are often used in a formulation to enhance performance. This is particularly true when using commodity dispersants, grind resins, and other low-, mid-, and even some high-performance dispersants, in which the basic stabilization may be adequate but other attributes are not optimal. The addition of a dynamic wetting agent can improve dry powder cut-in time and significantly reduce initial air entrainment prior to milling (**Figure A**). A dynamically stabilizing grind aid can reduce milling energy and time by providing faster particle size reduction and even improved final dispersion properties (**Figure B**). A secondary stabilizing aid can be used to improve long term stability, reduce dispersion viscosities, or reduce shock and incompatibility when the pigment dispersion is let down into a formulation. Molecular defoamers can provide unique foam inhibition during milling, while traditional defoamers can achieve complete foam elimination in even the most difficult systems. Evonik has a range of performance-enhancing additives that can enable formulators to achieve the desired dispersion properties.



FIGURE A

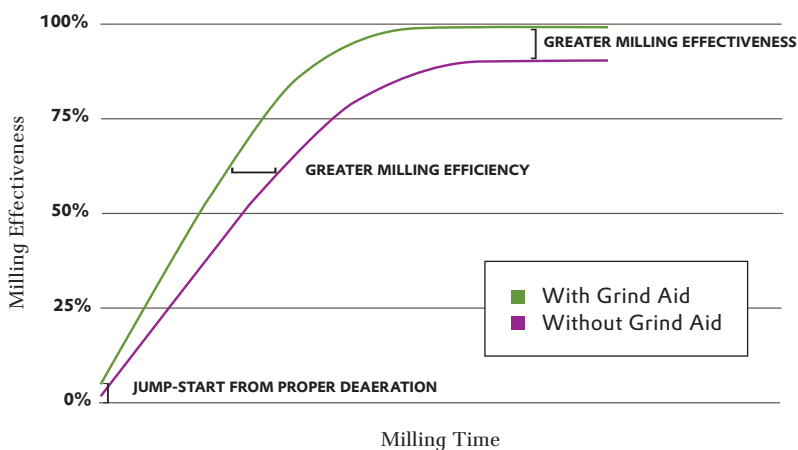
Proper Particle Wetting



- A. Dry solids added to aqueous solution of additives/dispersants require a reduced surface tension to properly wet the surface. Faster wetting = faster process.
- B. After wetting, the particle surface is covered with dispersant and surfactant chemistries, but air can remain trapped inside agglomerates. A low contact angle is required to fully deaerate.
- C. Proper wetting and deaeration will improve the dispersion process resulting in more efficient milling and lower foam.

FIGURE B

Grind Aids Enhance the Milling Process



Dynamic wetting agents

Low-foam dynamic wetting agents can rapidly wet the most hydrophobic powders and provide extensive deaeration prior to milling — a critical complement to the first step of the dispersion process. Our Surfynol® surfactant line has long been recognized as a superior technical solution for wetting and deaeration. These wetting agents are typically effective at 0.1 to 0.5% wt. %, with higher levels necessary in highly filled systems.

Grind aids

These formulated surfactants have been optimized to provide improved milling efficiency. Functioning through dynamic wetting and stabilization, these products are used to overcome deficiencies in the dispersant or grind resin. From improved hiding power, higher gloss, greater color, or faster color development, the Carbowet GA-series surfactants can provide optimal performance and are typically effective at 1.0 to 3.0 wt. %, with high solid surface areas requiring higher additive levels.

Defoamers

- **Molecular**—Many of the Surfynol surfactants used for dynamic wetting can also provide significant antifoaming and defoaming performance. Through disruption of the foam-stabilizing surface active additives, molecular defoamers function within their solubility/compatibility range and can provide foam control without risk of defects or other defoamer-related problems.
- **Traditional**—Surfynol DF-series and Airase 4000 and 5000 series defoamers can provide excellent defoaming during harsh and long grinding operations. With a broad range of defoaming strength, these defoamers can efficiently disrupt the air bubbles in a system while minimizing the potential for defects that are caused by an incompatible material. Traditional defoamers show synergistic behavior with molecular defoamers,

providing formulators with a higher compatibility level and longer-lasting performance.

- **Oil-based**—Airase and Surfynol oil-based defoamers include those containing mineral oil, organic oils, and even vegetable oil. With a broad range of defoaming strength and compatibility, they are suitable for diverse applications such as architectural coatings, inks, and even latex dip applications.
- **Siloxane and SSDL®**—Airase SSDL (Structured Siloxane Defoamer Line) is

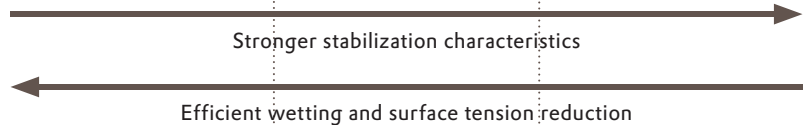
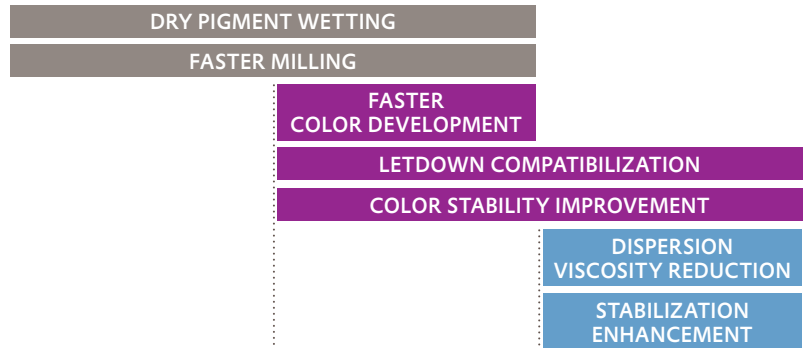
a series of formulated, siloxane-based defoamers that are designed to have predictable performance relative to each other to allow formulators to take a systematic approach to defoamer selection. Each product in this line has a different balance of defoaming strength and formulation compatibility.

Note: Defoamers are typically effective at 0.1 to 1.0 wt. %, although this can vary significantly with the defoamer type. Siloxane defoamers are typically used at 0.1 to 0.5 wt. %, while organic and molecular defoamers can be used at up to 1 wt. %.

TABLE 2

Additives for Dispersion Improvement

BEST CHOICES FOR



PRODUCT RECOMMENDATIONS

Dynamic Wetting Agents	Grind Aids	Co-dispersants
Dynol 360 Surfynol AD01 Surfynol 420	Carbowet GA-100 Carbowet GA-200 Carbowet GA-210 Carbowet GA-211	ZetaSpers 170 ZetaSpers 179 ZetaSpers 182

TABLE 3

Full Spectrum of Defoamer Offerings

	SILOXANES	OIL-BASED	MOLECULAR
↑ STRONGER DEFOAMING ↓ MORE COMPATIBLE	Airase 5100		
	Airase 5200		
	Airase 5300		
	Airase 5355		
	Surfynol DF695	Airase 4500	
	Airase 5400	Airase 4555	
		Surfynol DF220	
	Surfynol DF58		
	Airase 8070*		
	Airase 5500		
	Surfynol DF62	Surfynol DF37*	
	Surfynol DF66		
	Airase 5600		
	Airase 5655		
	Surfynol DF178		
	Airase 5700		Surfynol DF110*
			Surfynol AD01*
		Surfynol 107L*	
		Surfynol MD20*	
		Surfynol 104*	
		Surfynol 420*	
		Surfynol PC*	

* These products are superb deaerators, suitable for eliminating microfoam.

Formulation of an optimal dispersion can be a daunting task, but the addition of an Evonik additive can quickly improve your formulation's performance to enable you to achieve your targets. The Surfynol, Carbowet, and Airase product lines provide a wide range of surface active additives that can offer superior performance benefits in aqueous dispersions; these can be grouped into four basic attribute categories.

Product descriptions

Additives for dispersions

DYNAMIC WETTING AGENTS

Dynol 360 surfactant	A proprietary superwetter chemistry, Dynol 360 surfactant is designed to provide the outstanding surface tension reduction and low contact angles necessary to wet the most difficult solids. Although not a true molecular defoamer, Dynol 360 surfactant stands out against other superwetting surfactants because it does not stabilize foam. Dynol 360 surfactant is a 100% active liquid.
Surfynol AD01 surfactant	A molecular defoamer and nonionic wetting agent that combines strong defoaming performance with efficient substrate wetting and improved film formulation in water-based adhesives, coatings, and inks, as well as good deaeration in construction systems.
Surfynol 104 surfactant	Renowned for its benefits in aqueous systems, Surfynol 104 surfactant offers unique attributes in dispersions. Highly effective at wetting dry powders, Surfynol 104 surfactant can also provide strong molecular defoaming to maximize deaeration and inhibit foam stabilization. Additionally, the Surfynol 104 surfactant molecule has minimal affinity for pigment chemistries, so it will not compete or adversely interact with dispersants. Surfynol 104 surfactant is available in a number of forms and solvent dilutions. Surfynol 104 surfactant acts as a molecular defoamer, helping to deaerate dry powders and provide foam control throughout the dispersion process.
Surfynol 420 surfactant	A minimally ethoxylated acetylenic diol, Surfynol 420 surfactant is designed to provide excellent wetting and deaeration benefits in aqueous dispersions. Compared to the Surfynol 104 surfactant benchmark, Surfynol 420 surfactant can offer better wetting benefits and less molecular defoaming ability. Surfynol 420 surfactant is a 100% active liquid.

GRIND AIDS

Carbowet GA-100 surfactant	A grind aid specifically designed for optimal performance in architectural paint grinds, Carbowet GA-100 surfactant helps to optimize milling efficiency and offers a favorable alternative to modified APE grind aids. When used in the pigment grind, Carbowet GA-100 surfactant can improve the pigment paste acceptance and may eliminate the need for special pigment paste acceptance additives used in the letdown stage of white base paint manufacturing.
Carbowet GA-200 surfactant	A grind aid designed to provide the superior low-foam surfactancy needed in pigmented systems, which includes dynamic wetting, milling, and compatibilization benefits without the adverse impacts on water sensitivity, foam, or rheology typically found with other surfactants. Additionally, Carbowet GA-200 surfactant is suitable for low- or zero-VOC, low emission and EcoLabel compliant formulations.
Carbowet GA-210 surfactant	A broad utility surfactant, Carbowet GA-210 surfactant can deliver excellent grind aid benefits in aqueous dispersions with strong wetting and milling efficiency benefits. It has proven performance as a grind surfactant in coatings dispersions and excellent attributes in many other dispersion formulations.
Carbowet GA-211 surfactant	A combination of surface active agents, Carbowet GA-211 surfactant can provide excellent dry solid wetting with dynamic stabilizing to improve the efficiency of the milling process. Compared to the other grind aid products, Carbowet GA-211 surfactant offers the strongest stabilization benefits with somewhat lesser wetting performance. When used in a dispersion, Carbowet GA-211 surfactant and the other grind aids may provide enough wetting to eliminate the need for additional wetting agents.
Carbowet GA-221 surfactant	A combination of surface active agents, Carbowet GA-221 surfactant offers excellent dry solid wetting with dynamic stabilizing that can improve the efficiency of the milling process. Compared to the other grind aid products, Carbowet GA-221 surfactant offers the strongest stabilization benefits with somewhat lesser wetting performance. When used in a dispersion, Carbowet GA-221 surfactant and the other grind aids provide enough wetting that additional Wetting Agents are not typically needed.

DEFOAMERS

Airase SSDL™ 5000 series defoamers

The Airase 5000 series defoamers are a structured siloxane defoamer line (SSDL) providing a predictable range of products that vary in system compatibility and defoaming strength. This allows a user to quickly identify the best balance of defoamer properties with minimal experimentation, allowing a formulator to quickly identify the high performance defoamer that meets their needs. Table 3 indicates the product most likely to match each application need.

Airase 4655 defoamer

A relatively compatible organic oil-based defoamer designed to control and eliminate foam in a broad range of waterbased systems, with particular advantages in adhesives end-use applications as well as in inks, pigment grinds, overprint varnishes and coatings systems. It is easy to incorporate and provides excellent compatibility with high shear stability. It does not contain added mineral oils, hazardous air pollutants (HAPs), alkyl phenol ethoxylates (APEs) or acetylenic diols. The product has multiple regional food contact compliances.

Airase 4500 defoamer

An organic defoamer for pigment milling operations, Airase 4500 defoamer can be used in any dispersion and is particularly effective in inorganic dispersions. It contains no added mineral oils, hazardous air pollutants or APEs and has various food contact compliances.

Surfynol DF-58 defoamer

Surfynol DF-58 defoamer is a siloxane defoamer with a long and proven track record for eliminating foam in organic and carbon black pigment dispersions.

Airase 8070 deaerator

A formulated deaerator, Airase 8070 deaerator can provide excellent foam control during milling. It has been found to be effective in many dispersions, particularly highly filled systems.

Surfynol DF-110 surfactant

A molecular defoamer, Surfynol DF-110 defoamer can provide strong defect-free defoaming during any step of the dispersion process. Molecular defoamers can be used as the sole defoamer in a formulation or can work synergistically with traditional defoamers for improved control. Surfynol DF-110 defoamer is available in a variety of forms.

Surfynol AD01 surfactant

A chemical alternative to Surfynol 104 surfactant, Surfynol AD01 surfactant shares many of its features and benefits in aqueous dispersions, but can provide stronger molecular defoaming. Surfynol AD01 is a 100% active liquid.

Surfynol 107L surfactant

A molecular defoamer and nonionic wetting agent that combines strong defoaming performance with efficient substrate wetting and improved film formulation in water-based adhesives, coatings, and inks, as well as good deaeration in construction systems.

Surfynol MD-20 defoamer

A molecular defoamer, Surfynol MD-20 defoamer has been found to be particularly effective in sensitive systems for strong yet defect-free foam control. A 100% active liquid, Surfynol MD-20 defoamer is easy to handle and incorporate.



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