Air Products’ Specialty Additives
To Improve Your Waterborne Wood Coatings Quality with Ease …
Your supplier of choice for water-based speciality additives

Global supplier of high-performance speciality additives

Air Products is a global leading supplier of speciality additives, with over 40 years of experience in materials science and surface chemistry. We are committed to the application development and technological innovation of water-based high-performance surfactants, helping formulators to address continuing challenges and meet increasingly stringent environmental standards. Through close collaboration, we can help you make the transition from solvent to waterborne systems. Our comprehensive range of high-quality and unique solutions and products includes:

- Surfynol® wetting agents - high performance, good dynamic wetting and molecular defoaming
- Dynol™ superwetting surfactants - exceptional dynamic and equilibrium surface tension reduction performance
- Carbowet® nonionic surfactants - with varying degrees of emulsification capability
- ZetaSperse® high performance dispersants and stabilizing surfactants (co-dispersants)
- Airase® unique defoamers and deaerators based on molecular structure and formulation

These products are widely used in automotive waterborne primers and base coat, architectural coatings, industrial coatings, wood coatings, printing inks, inkjet inks, adhesives, paper coatings, construction materials and other products, helping customers to improve product quality and meet certain environmental requirements. We continually strive to be the global supplier of choice of specialty additives by supplying customers with value high-performance solutions.

A team of dedicated professionals provides local service

For decades, Air Products’ professionals have studied the unique challenges facing coatings, inks and adhesives formulators. Our goal is to help you achieve your goals by enabling you to develop and launch successful new products. In addition to our technology center at our company headquarters in the United States, we have highly-skilled applications development teams in our technology centers in Utrecht, Netherlands, Shanghai, China and Tokyo, Japan who are ready to provide you with strong local support, from product development to application testing. With our technical service, we can help you develop the best products, solve problems and grow your business.

Global support

With manufacturing facilities and warehouses in the United States, United Kingdom, Netherlands, Singapore, China and other locations around the world, Air Products has established a worldwide logistics and sales network that enables us to provide our customers with a fast and reliable supply of high-quality products. Our four technology centers can provide customers with value-added formulations support by leveraging the company’s advanced technology and experienced technical personnel. Our deep understanding of customers and their market needs enables us to help you meet the challenges of your markets.

Table of Content

About Air Products ................................................................. 3
Waterborne Wood Coating Market Opportunities and Technical Challenges .......................................................... 5
Products Overview ...................................................................... 6
Wetting Agents ........................................................................ 8
Defoamers / Deaerators ................................................................. 12
Dispersants ............................................................................. 14
Grind Aids ............................................................................. 16
Application Recommendation .................................................. 17
Common Problems and Solutions for Waterborne Wood Coatings .............. 18
Air Products’ high performance specialty additives designed to deliver double advantages — improving product performance and enabling compliance with environmental regulations

Waterborne wood coatings market opportunities and technical challenges

China is the largest wooden furniture exporter in the world, and one of the largest consumers of wood coatings. Recent increasing public and government focus on environmental protection in Europe and other countries has resulted in stricter coating standards in those areas. All these factors underline a strong demand for water-based applications in China for the export of wooden furniture. In China, the government actively encourages the development and application of water-based wood coatings, promoting the transition from solvent-borne to waterborne with a step-by-step approach. With the latest government regulations, additional taxes will be applied for solvent-borne coatings and paints with VOC emission. Driven by these internal and external factors, waterborne wood coatings are poised to become the development trend leading the coating industry.

With low VOC and low odor environmental characteristics, waterborne technology has been rapidly popularized in the flat furniture and furniture assembly markets. However, due to the limitation of coating film appearance and application caused by the waterborne resins, only high quality wetting agents and defoamers can effectively solve pore sealing, substrate wetting, film coating and other production problems. The coating film appearance and fullness can also be improved by reducing pinholes, collapse, edge retraction and other defects, therefore increasing the product pass rate.

High-performance surfactants in waterborne wood coatings

Waterborne wood coatings use water as the solvent. Since the surface tension of water is high, the use of water-based surfactants can be critical to preparing an effective waterborne formulation. These surfactants should provide effective wetting and leveling for the waterborne wood coating and should also be compatible with emulsions, thickeners, dispersants, rheologic aids and other ingredients. At the same time, these surfactants should ideally be as low-foaming as possible to minimize the negative impact on the overall performance of the coatings.

Air Products’ Surfynol and Dynol series of surfactants are high-performance multi-functional surfactants based on Gemini technology. These Gemini-type products can provide fast and efficient wetting as well as unique foam control properties, all of which can greatly improve the performance and quality of waterborne wood coatings.
<table>
<thead>
<tr>
<th>Product Name</th>
<th>Type</th>
<th>Active content %</th>
<th>Appearance</th>
<th>Viscosity p@25°C</th>
<th>Specific gravity @25°C</th>
<th>Flash point °C</th>
<th>Dosage amount %</th>
<th>Typical Properties</th>
<th>Product description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airase 1500</td>
<td>Silicone defoamer</td>
<td>100</td>
<td>Clear, pale yellow liquid</td>
<td>500 000</td>
<td>0.96-1.02</td>
<td>188</td>
<td>0.05-0.15</td>
<td>Strong defoaming, long-term persistent defoaming</td>
<td>Strong defoaming with long term persistence, especially in high shear applications. Not added APEs, HAPs, VOCs (EPA Method 24), improved pH stability compared to traditional siloxanes.</td>
</tr>
<tr>
<td>Airase 1540</td>
<td>Silicone defoamer</td>
<td>100</td>
<td>Clear, pale yellow liquid</td>
<td>450 000</td>
<td>0.96-1.02</td>
<td>191</td>
<td>0.05-0.15</td>
<td>Strong defoaming, long-term persistent defoaming</td>
<td>Strong defoaming with long term persistence, especially in high shear applications. Not added APEs, HAPs, VOCs (EPA Method 24), improved pH stability compared to traditional siloxanes, better film compatibility than Airase 1500 defoamer.</td>
</tr>
<tr>
<td>Airase 1550</td>
<td>Silicone defoamer</td>
<td>100</td>
<td>Clear, pale yellow liquid with white-gray liquid</td>
<td>450 000</td>
<td>0.95-1.10</td>
<td>165</td>
<td>0.05-0.15</td>
<td>Long term persistency and film compatibility</td>
<td>Excellent defoaming and defoaming stability. Not added APEs, HAPs, VOCs (EPA Method 24), improved pH stability compared to traditional siloxanes, can be incorporated in the general use as a defoaming agents.</td>
</tr>
<tr>
<td>Airase 1560</td>
<td>Silicone defoamer</td>
<td>100</td>
<td>Slightly hazy pale yellow liquid</td>
<td>300-500</td>
<td>0.40-1.06</td>
<td>154</td>
<td>0.15-0.55</td>
<td>Effective balance of good defoaming with film compatibility</td>
<td>Effective balance of good defoaming with film compatibility, no added APEs, HAPs and VOCs (EPA Method 24), improved pH stability compared to traditional siloxanes, can be incorporated as a defoamer.</td>
</tr>
<tr>
<td>Airase 1700</td>
<td>Silicone defoamer</td>
<td>100</td>
<td>Clear, pale yellow liquid</td>
<td>400-140</td>
<td>0.40-1.06</td>
<td>166</td>
<td>0.15-0.65</td>
<td>Highly compatibility</td>
<td>Excellent balance of effective defoaming and high film compatibility, no added APEs, HAPs and VOCs (EPA Method 24), improved pH stability compared to traditional siloxanes, can be incorporated in the general use as a defoamer.</td>
</tr>
<tr>
<td>Airase 870</td>
<td>Modified Silicone defoamer</td>
<td>100</td>
<td>Clear, pale yellow liquid</td>
<td>188</td>
<td>0.96</td>
<td>130</td>
<td>0.1-0.15</td>
<td>Equivalent micro foam control and defoaming effect</td>
<td>Proprietary formulated modified silicone defoamer designed to eliminate foam, phobbing and solvent popping problems in water based coatings applied by airless (or air assisted) spray application, excellent for defoaming and de-air entraining agents for a wide variety of aqueous applications without causing defects.</td>
</tr>
<tr>
<td>Surfy-nol 1-1200</td>
<td>Molecular defoamer</td>
<td>12%</td>
<td>Colorless to light yellow liquid</td>
<td>180</td>
<td>0.99</td>
<td>&gt;180</td>
<td>0.15-0.5</td>
<td>Defoaming / air entraining with setting / levelling effect</td>
<td>Surfy-nol 1-1200 is a very effective nonionic polymer-based surfactant of low molecular weight, providing excellent anti-foam effect.</td>
</tr>
<tr>
<td>Surfy-nol 1-2000</td>
<td>Molecular defoamer</td>
<td>10%</td>
<td>Yellow transparent liquid</td>
<td>200</td>
<td>1.00</td>
<td>190</td>
<td>0.15-0.5</td>
<td>Excellent micro foam control and air entraining effect</td>
<td>High performance surfactant with multifunctional properties. Excellent defoaming and anti-foam application. Surfy-nol 1-2000 is a highly effective nonionic surfactant, suitable for a wide variety of aqueous applications.</td>
</tr>
<tr>
<td>Surfy-nol 1-4000</td>
<td>Molecular defoamer</td>
<td>10%</td>
<td>Clear, yellow liquid</td>
<td>280</td>
<td>0.90</td>
<td>&gt;190</td>
<td>0.15-0.5</td>
<td>Excellent micro foam control, levelling and air entraining</td>
<td>Surfy-nol 1-4000 is a very effective nonionic polymer-based surfactant of low molecular weight, providing excellent anti-foam effect.</td>
</tr>
<tr>
<td>Surfy-nol 2-520</td>
<td>Molecular defoamer</td>
<td>10%</td>
<td>Clear, light yellow liquid</td>
<td>250</td>
<td>0.90</td>
<td>140</td>
<td>0.1-0.3</td>
<td>Effective wetting, low compatibility, film / gravity overall performance</td>
<td>Surfy-nol 2-520 is an excellent surfactant for the dispersions of inorganic pigments, ZetaSperse 1700 dispersant is most effective when used as a secondary defoamer.</td>
</tr>
<tr>
<td>Surfy-nol 4-400</td>
<td>Molecular defoamer</td>
<td>10%</td>
<td>Clear, yellow liquid</td>
<td>150</td>
<td>0.98</td>
<td>&gt;110</td>
<td>0.1-0.5</td>
<td>Effective dynamic wetting, low foam, improved flow and levelling</td>
<td>Surfy-nol 4-400 is an excellent surfactant for the dispersions of inorganic pigments, ZetaSperse 1700 dispersant is most effective when used as a secondary defoamer.</td>
</tr>
<tr>
<td>Dipol 300</td>
<td>Non-ionic defoamer</td>
<td>80%</td>
<td>Clear, yellow liquid</td>
<td>90</td>
<td>0.04-1.04</td>
<td>170</td>
<td>0.15-0.5</td>
<td>Effective wetting, low foam, good overall performance</td>
<td>Effective wetting, low foam, good overall performance.</td>
</tr>
<tr>
<td>Dipol 800</td>
<td>Non-ionic defoamer</td>
<td>10%</td>
<td>Clear, yellow liquid</td>
<td>250</td>
<td>0.98</td>
<td>188</td>
<td>0.1-0.5</td>
<td>Effective wetting, levelling, low foam, good overall performance</td>
<td>Effective wetting, levelling, low foam, good overall performance.</td>
</tr>
<tr>
<td>Dipol 610</td>
<td>Non-ionic defoamer</td>
<td>10%</td>
<td>Clear, yellow liquid</td>
<td>250</td>
<td>0.97</td>
<td>171</td>
<td>0.1-0.5</td>
<td>Effective wetting, levelling, low foam, good overall performance</td>
<td>Effective wetting, levelling, low foam, good overall performance.</td>
</tr>
<tr>
<td>Dipol 604</td>
<td>Non-ionic defoamer</td>
<td>10%</td>
<td>Clear, yellow liquid</td>
<td>/</td>
<td>0.97</td>
<td>&gt;164</td>
<td>0.2-0.5</td>
<td>Effective wetting, levelling, low foam, good overall performance</td>
<td>Effective wetting, levelling, low foam, good overall performance.</td>
</tr>
<tr>
<td>Dipol 607</td>
<td>Non-ionic defoamer</td>
<td>10%</td>
<td>Clear, yellow liquid</td>
<td>205</td>
<td>1.00</td>
<td>264</td>
<td>0.2-0.5</td>
<td>Effective wetting, levelling, low foam, good overall performance</td>
<td>Effective wetting, levelling, low foam, good overall performance.</td>
</tr>
<tr>
<td>Dipol 160</td>
<td>Non-ionic defoamer</td>
<td>10%</td>
<td>Clear, yellow liquid</td>
<td>66</td>
<td>1.00</td>
<td>17</td>
<td>0.1-0.15</td>
<td>Superior dynamic and equilibrium surface tension reduction, extremely low film formation.</td>
<td>Dipol 160 is a high performance dispersant designed for the dispersion of inorganic chemistries, ZetaSperse 1700 dispersant is most effective when used as a secondary defoamer.</td>
</tr>
<tr>
<td>Dipol 165</td>
<td>Non-ionic defoamer</td>
<td>10%</td>
<td>Clear, yellow liquid</td>
<td>145</td>
<td>1.00</td>
<td>186</td>
<td>0.1-0.5</td>
<td>Good dynamic and equilibrium surface tension reduction, low foam, excellent compatibility</td>
<td>Dipol 165 is a high performance dispersant designed for the dispersion of inorganic chemistries, ZetaSperse 1700 dispersant is most effective when used as a secondary defoamer.</td>
</tr>
<tr>
<td>Carbopack GA 100</td>
<td>Non-ionic grinding aids</td>
<td>80%</td>
<td>Clear, yellow liquid</td>
<td>90</td>
<td>0.05-1.00</td>
<td>186</td>
<td>0.2-0.5</td>
<td>Optimum melt rheology, deferred color development for enhanced touch up</td>
<td>Optimum melt rheology, deferred color development for enhanced touch up.</td>
</tr>
<tr>
<td>Carbopack GA 210</td>
<td>Non-ionic grinding aids</td>
<td>80%</td>
<td>Clear, yellow liquid</td>
<td>80</td>
<td>0.05-1.00</td>
<td>&gt;98</td>
<td>0.2-0.5</td>
<td>Optimum melt rheology, deferred color development for enhanced touch up</td>
<td>Optimum melt rheology, deferred color development for enhanced touch up.</td>
</tr>
<tr>
<td>ZetaSperse 2170</td>
<td>Non-ionic co-dispersant</td>
<td>100</td>
<td>Clear, amber liquid</td>
<td>50-500</td>
<td>1.01</td>
<td>&gt;900</td>
<td>10-50</td>
<td>Improve wetting, lower viscosity dispersion</td>
<td>Lower in-molecular weight, designed for optimal performance with acidic surface groups such as carbon black. It is a tertiary amine and provides strong affinity with acidic surface groups and is a new generation strong surfactant. ZetaSperse 2170 is most effective when used in a secondary defoamer with anionic polymeric defoamers for organic and inorganic pigments. It provides a broad showed in stabilization and can typically lower dispersion viscosity, allowing the long-term storage and overall improved film formation.</td>
</tr>
<tr>
<td>ZetaSperse 2120</td>
<td>Diterpene</td>
<td>45</td>
<td>Clear, red amber liquid</td>
<td>50</td>
<td>1.28</td>
<td>&gt;75</td>
<td>0.5-2.0</td>
<td>Improved wetting, lower viscosity dispersion</td>
<td>Improved wetting, lower viscosity dispersion.</td>
</tr>
<tr>
<td>ZetaSperse 2130</td>
<td>Diterpene</td>
<td>45</td>
<td>Clear, yellow liquid</td>
<td>50</td>
<td>1.02</td>
<td>&gt;240</td>
<td>0.5-2.0</td>
<td>Universal high solid dispersion</td>
<td>Universal high solid dispersion.</td>
</tr>
<tr>
<td>ZetaSperse 1330</td>
<td>Diterpene</td>
<td>40</td>
<td>Clear, amber liquid</td>
<td>500</td>
<td>1.07</td>
<td>&gt;900</td>
<td>0.5-2.0</td>
<td>Unique wetting performance, suitable for high solid dispersions</td>
<td>Unique wetting performance, suitable for high solid dispersions.</td>
</tr>
<tr>
<td>ZetaSperse 1650</td>
<td>Diterpene</td>
<td>52</td>
<td>Clear, amber liquid</td>
<td>500</td>
<td>1.04</td>
<td>&gt;900</td>
<td>0.5-2.0</td>
<td>Unique wetting performance, suitable for high solid dispersions</td>
<td>Unique wetting performance, suitable for high solid dispersions.</td>
</tr>
</tbody>
</table>
**Unique Gemini-structure designed to provide excellent dynamic wetting and superior defoaming and deaeration ability**

**Wetting agents**

In the coating process, the control of surface tension is very important. Only suitable surface tension can result in suitable wetting, avoiding the defects caused by poor wetting performance. The surface tension of a coating should be thought of in terms of Equilibrium Surface Tension (EST) and Dynamic Surface Tension (DST). EST refers to the surface tension under the conditions of equilibrium or approaching equilibrium, while DST refers to the surface tension measured under dynamic conditions during which new interfaces are rapidly created. During the application of wood coatings, such as via brush, spray or curtain, new air-coating and coating-substrate interfaces are constantly being created, requiring a surfactant that can quickly transfer to the interface to effectively reduce the surface tension and eliminate the film defects caused by poor wetting. Thus EST and DST are both critical for a special surface requirement application.

Gemini surfactants have two amphiphilic moieties connected via a short spacer group (Figure 1). These surfactants generally have higher surface activity, and have significant effect on surface tension reduction. Acrylated diols are examples of Gemini surfactants. Its compact ABA structure allows the active molecule to migrate freely and quickly, therefore, it can quickly reduce the surface tension.

Compared to a typical monomer-type polyether modified siloxane surfactant (Siloxane 1-3) used in the wood coating market, a Gemini surfactant can provide the waterborne wood coating with lower dynamic/equilibrium surface tension, which can enhance substrate wetting and spreading (Figure 2). Because the Gemini surfactant has a compact structure, it has the ability to defoam/inhibit foam compared to the traditional wetting agents. The combination of both wetting and defoaming control can effectively balance the need for both surface tension reduction and foam control to simply the coating formulation and eliminate the negative impact caused by the surfactant, see Figure 3.

![Figure 1: Structure of Gemini surfactants](image1)

![Figure 2: Equilibrium and dynamic surface tension comparison for surfactants](image2)

![Figure 3: Foam height comparison for surfactants](image3)

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**Dy-nol 960 and Dy-nol 980 surfactants**

Dy-nol 960 and Dy-nol 980 surfactants are siloxane-based superwetters designed to be suitable for most aqueous applications. Dy-nol 960 and Dy-nol 980 surfactants have outstanding performance characteristics in the reduction of both DST and EST, and can also improve the flow and leveling of waterborne formulations. These surfactants are designed to provide exceptional wetting of difficult-to-wet substrates. Dy-nol 960 superwetting surfactant can provide extremely low foam properties while Dy-nol 980 superwetting surfactant can provide low foam and excellent compatibility. These unique characteristics enable Dy-nol 960 and Dy-nol 980 surfactants to enhance the performance of waterborne formulation, as shown in Figure 4. The advantages of the newly developed siloxane-based superwetting surfactants include:

- Similar EST reduction to that seen with traditional siloxane wetting agent
- Premium DST control due to unique molecular design
- Excellent compatibility, easy to formulate
- Low foam, eliminate surface defects
- Excellent pH stability

**Dy-nol 604 and Dy-nol 607 surfactants**

Dy-nol 604 and Dy-nol 607 surfactants are based on Gemini technology. They can be excellent alternatives to fluorocarbon surfactants. These Dy-nol surfactants can significantly improve dynamic/static wetting without generating foam. Dy-nol 607 surfactant has better water compatibility than other superwetters and can be more easily incorporated into aqueous formulations.

Dy-nol 604 and Dy-nol 607 surfactants have the following characteristics:

- Effective surface tension reduction under high-speed application conditions
- Superior wetting performance on low surface energy substrates
- No impact on water sensitivity, recatability performance and intercoat adhesion
- No foam generation, no foam stabilizing
- Halogen-free and silicone free

An equilibrium/dynamic surface tension comparison between Dy-nol 604 and Dy-nol 607 surfactants and common commercial fluorocarbon and silicone surfactants is shown in Figure 5.

![Figure 5: Equilibrium/dynamic surface tension comparison between Dy-nol 604 and Dy-nol 607 wetting surfactants and fluorocarbon and silicone surfactants](image5)

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**Figure 4: Dy-nol 980 surfactant can effectively improve the waterborne acrylic wood coating performance (emulsion: Alberdingk® AC2714)**

- Effective surface tension reduction under high-speed application conditions
- Superior wetting performance on low surface energy substrates
- No impact on water sensitivity, recatability performance and intercoat adhesion
- No foam generation, no foam stabilizing
- Halogen-free and silicone free

An equilibrium/dynamic surface tension comparison between Dy-nol 604 and Dy-nol 607 surfactants and common commercial fluorocarbon and silicone surfactants is shown in Figure 5.
Dy-nol 800 and Dy-nol 810 Gemini-type superwetting surfactants

Dy-nol 800 and Dy-nol 810 surfactants are high efficient wetting surfactants based on Gemini technology. They can provide excellent stability and exceptional performance in water-based coatings compared to traditional fluoro-containing surfactants and organo-silicone surfactants. Dy-nol 800 and Dy-nol 810 surfactants have the ability to reduce both equilibrium and dynamic surface tension effectively without using fluoro- or silicone-based chemistries. These excellent balanced properties make Dy-nol 800 and Dy-nol 810 surfactants excellent alternatives for difficult-to-wet substrates requiring good flow and leveling under diverse application conditions, see Figure 6.

Dy-nol 360 surfactant

Dy-nol 360 wetting surfactant is a novel product that contains no-added VOC, solvent, hazardous air pollutants (HAPs) or alkylphenol ethoxylate (APE), and is equipped with excellent dynamic wetting, foam control performance and good compatibility. In addition, Dy-nol 360 wetting surfactant can migrate to the interface rapidly with faster, effective surface tension reduction, which is especially important for dark wood substrates. It can rapidly wet the capillary before the coating surface dries to thoroughly wet the wood grain, enhance the wetting/spreading effects and provide film leveling performance.

* Excellent dynamic wetting
* Aids in film forming, reducing the use of coalescent
* Suitable over a broad pH range (pH 3-13)
* No added APE, or VOCs

Dy-nol 360 surfactant can also reduce the minimum film forming temperature of the emulsion to improve the low temperature film forming ability, enabling the formulator to reduce the use of volatile coalescing solvents (see Figure 7).

Dy-nol 360 surfactant has the following advantages:

Surfy-nol series of multifunctional wetting agents

The Surfy-nol wetting agents are a series of products designed to provide wetting, defoaming, and many other functions. When coating porous substrates, the use of Surfy-nol wetting agents can aid in providing fast penetration and good spreading, and can improve the adhesion of the coating on the substrate to avoid the formation of craters, pinholes and other wetting defects. Surfy-nol 104 wetting agent has a lower HLB value and a strong hydrophobicity. Products using Surfy-nol 104 wetting agent can demonstrate excellent water resistance.

Refer to Figure 8 for the summary of different surfactants’s effect (prevention of edge thickening and retraction, improving flow and leveling, as well as hole filling).
Air Products’ defoamer products are easy to use, with a long-lasting defoaming effect that can effectively perfect film appearance and improve coating quality

Defoamers

With the continuous development of waterborne wood coating technology, the requirements for high-quality visual effects on waterborne wood coating are also increasing. The compatibility between the coating system and traditional defoamer is poor. Improper selection of the defoamer can negatively affect the compatibility and stability of the whole coating system; cratering can easily occur; and the defoamer may exude when the film is dried, reducing surface gloss and affecting the intercoat adhesion. Microfoam is a common issue in coating applications. The microfoam size generally is about 0.1mm, which is very difficult to eliminate. While there are many reasons for the generation of microfoam, the presence of microfoam will cause pinholes and other defects, reducing gloss and affecting film appearance and coating quality.

Molecular defoamers

Traditional mineral oil and silicone defoamer achieve defoaming because they contain small incompatible particles or microdroplets. In contrast, molecular defoamers utilize compatibility at the molecular level for defoaming and foam inhibition. Molecular defoamers do not contain silicone and mineral oil, and are easy to use. Additionally, they provide long-lasting defoaming and do not generate surface defects caused by incompatibility, as illustrated in Figure 9.

Silicone defoamers and deaerators

Air Products provides molecular defoamers based on Gemini technology as well as traditional defoamers (silicone and organic oil defoamers). Silicone defoamers are efficient and can provide rapid defoaming effects; silicone deaerators can effectively eliminate defects like pinholes that are caused by microfoam. Silicone defoamers and deaerators have been widely used in waterborne wood coatings, as shown in Figure 10.

Airase® SSDL™ series defoamers

Airase 5000 series of defoamers are “Structured Siloxane Defoamer Line” (SSDL) defoamers. Organic silicone defoamers can provide strong defoaming strength and good compatibility depending on the silicone defoamer structure and formulation. Siloxane defoamers can span the range between strong defoaming and good compatibility depending on the structure of the siloxane molecules and formulating components. Each product in this line has a different balance of defoaming strength and formulation compatibility for optimal defoaming performance in different formulations. This system is designed to provide a faster, easier way to choose a defoamer for water-based applications. It is the first line of defoamers offering a structural selection process, providing a range of defoamers that can allow you to select the most effective defoamer/compatibility balance with minimal trial and error. See Figure 11.

Defoaming mechanism of molecular defoamer and traditional defoamer

Figure 9: Defoaming mechanism of molecular defoamer and traditional defoamer

Figure 10: Deaerator mechanism of molecular defoamer and traditional defoamer

Airase 8070 deaerator

Airase 8070 deaerator is a proprietary, formulated, modified siloxane deaerator designed to eliminate foam, pinhole and solvent-popping problems in water-based coatings applied by airless (or air-assisted) spray technologies without generating surface defects. Airase 8070 deaerator is especially effective against microfoam because it is designed to achieve a defect-free surface, even when thick layers are applied or highly viscous coatings are sprayed. Airase 8070 deaerator contains no added VOC, alkyphenol ethoxylates (APEs) or hazardous air pollutants (HAPs).
Air Products’ dispersants and grinding aids — designed to provide excellent performance in pigment dispersion

The dispersion of solids in water involves three processes: wetting of the dry solid, milling to the desired particle size, and stabilizing for application. To maximize the value for the end user, it is important to recognize the impact these processes have on application performance. Air Products has spent decades researching the technical requirements for surface active materials in the various steps of aqueous dispersion and has developed a number of products that can optimize performance at each step, including the final application. These products can be grouped into two categories based on their attributes:

(i) Dispersants that provide the fundamental stabilization to prepare a dispersion and(ii) performance additives, such as surfactants, wetting agents, defoamers, and grind aids, that are used to improve dispersion properties.

### Dispersants

ZetaSperse dispersants comprise 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, the ZetaSperse dispersants require minimal or no additional formulation with other surface active agents to achieve optimal performance. Many of the ZetaSperse dispersants are designed for a range of uses and performance requirements, and many are specifically designed to overcome typical problems with common pigment types.

Choosing a correct dispersant can be a challenge for a formulator because of the wide range of properties and dispersion characteristics of the various pigment grades on the market. To help our customers to quickly identify a proper dispersant for their pigment formulations, Air Products has developed the Formulators Assistant ZetaSperse 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.

#### 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 dioxide, 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 52% active solution in water, Zetasperse 2300 dispersant is based on a unique comb-shaped polymer. It can offer electrosteric stabilization for a wide range of solids and has been found to be particularly effective with small particle-size pigments such as carbon black and transparent inorganic pigments.

#### Zetasperse 3600 dispersant

A 40% active solution in water, Zetasperse 3600 dispersant is based on a synergistic combination of surface active agents and is designed to provide robust and easy-to-use performance across most pigment and particle chemistries. It can also provide a very effective solution for overcoming variation in pigment supply and quality. Although designed as a primary dispersant for use in resin-free and resin-minimal systems, ZetaSperse 3600 dispersant’s properties can also provide favorable stabilization benefits when used as a secondary dispersant in conjunction with other dispersants.

#### 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.
Grind aids
Grind aids surfactants are utilized to provide improved milling efficiency. Functioning through dynamic wetting and a form of dynamic stabilization, these products are used to overcome deficiencies in the dispersant or grind resin. From improved hiding power, greater color development, 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.

Carbowet GA100 and Carbowet GA210 surfactants
A grind aid specifically designed for optimal performance in architectural paint grinds, Carbowet GA-100 surfactant can help to optimize milling efficiency and offer 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.

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 can provide excellent attributes in many other dispersion formulations.

Application recommendation

<table>
<thead>
<tr>
<th>Product</th>
<th>General Performance</th>
<th>Defects</th>
<th>Application Method</th>
<th>Resin Type</th>
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<td>Surfy-nol MD20</td>
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<td>Surfy-nol DF110D</td>
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<td>ZetaSpense 5600</td>
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</table>

- highly recommended
- recommended
## Common problems and solutions for waterborne wood coatings

<table>
<thead>
<tr>
<th>Common problems</th>
<th>Preferred recommendation</th>
<th>Solutions</th>
<th>Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor wetting and hole filling performance on substrate (Figure 12)</td>
<td>Dy-nol 607, Dy-nol 604,</td>
<td>Dy-nol 810, Dy-nol 960,</td>
<td>Effective dynamic and equilibrium wetting, can quickly migrate to the interface to provide substrate wetting and leveling to increase the adhesion</td>
</tr>
<tr>
<td></td>
<td>Dy-nol 980</td>
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<tr>
<td>Poor flow / leveling</td>
<td>Dy-nol 980, Dy-nol 607,</td>
<td>Dy-nol 604, Dy-nol 960</td>
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<tr>
<td></td>
<td>Dy-nol 604, Dy-nol 960</td>
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<tr>
<td>Poor adhesion</td>
<td>Dy-nol 607, Surfynol AD01,</td>
<td>Dy-nol 360, Surfynol 104, Surfynol 104, Surfynol 104, Surfynol 980</td>
<td>Compact and active molecular structure, with little impact on coating interface and surface viscoelasticity, reducing the tendency of edge retraction or thickening</td>
</tr>
<tr>
<td></td>
<td>Dy-nol 800, Dy-nol 980</td>
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<tr>
<td>Edge retraction or thickening</td>
<td>Dy-nol 360, Dy-nol 607,</td>
<td>Surfynol AD01, Dy-nol 604, Surfynol 104, Surfynol 104, Surfynol 980</td>
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<tr>
<td></td>
<td>Dy-nol 800, Dy-nol 980</td>
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<tr>
<td>Poor water resistance</td>
<td>Dy-nol 604, Surfynol AD01,</td>
<td>Surfynol 104, Dy-nol 800, Dy-nol 980</td>
<td>All products are non-ionic surfactants with low HLB values, which is helpful to improve the water resistance.</td>
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<tr>
<td></td>
<td>Dy-nol 360, Dy-nol 607,</td>
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<td>Dy-nol 980</td>
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<tr>
<td>Pinhole / microfoam</td>
<td>Surfynol MD20, Surfynol AD01,</td>
<td>Surfynol DFT10, Surfynol 104</td>
<td>Unique foam inhibition and defoaming effects provided by molecular defoamers</td>
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<tr>
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<td>Airase 8070</td>
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<tr>
<td>Foam</td>
<td>Airase SSDL defoamer line</td>
<td>Surfynol MD20</td>
<td>Formulated silicone defoamer, efficient foam control</td>
</tr>
<tr>
<td>Cratering, fish-eyes and recoatability</td>
<td>Dy-nol 604, Dy-nol 607,</td>
<td>Surfynol AD01, Surfynol 104</td>
<td>Effectively dynamic and equilibrium surface tension reduction, reach rapid spreading &amp; wetting</td>
</tr>
<tr>
<td></td>
<td>Dy-nol 360, Dy-nol 800,</td>
<td></td>
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<tr>
<td></td>
<td>Dy-nol 810</td>
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</tbody>
</table>

**Figure 12:** Hole filling ability for wood coating (commercial silicone surfactant Siloxane 2 and Dy-nol 607 surfactant, Fraxinus mandshurica substrate)

Compared to the traditional silicone surfactants, Dy-nol 607 surfactant can significantly improve the hole filling properties.
tell me more

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