AMP™ Dispersant is widely recognized as a multifunctional additive for all types of latex emulsion paints. In a formulation, AMP can be used as a powerful co-dispersant to prevent re-agglomeration of pigments. At the same time, AMP will contribute significant benefits to the overall performance of the coating.

The benefits and performance improvements made possible by AMP in different stages of paint manufacture are:

**AMP in the Grind**
- Reduces dispersant demand when used in conjunction with conventional dispersants
- Optimizes pigment dispersion
- Reduces foam (through dispersant reduction)
- Provides effective pH control
- Lowers raw material costs

**AMP in the Letdown**
- Improves thickener performance
- Eliminates need for ammonia, resulting in a lower odor paint
- Improves color acceptance of shading pastes

**AMP and Coating Performance**
- Improves scrub and water resistance
- Reduces in-can corrosion and flash rusting
- Effective in low odor systems
- Minimal contribution to system VOC

When formulating a latex paint, it is important to consider all the effects of dispersants and surfactants on the paint and on its final performance. AMP can be used to reduce the levels of many commonly used paint additives through paint formulation optimization, potentially lowering raw material costs while improving paint performance.

**Typical Properties**

The following are selected formulating properties of AMP. They are not to be considered product specifications.

- Specific gravity @ 25/25°C (77°F) (with ~5% water) ... 0.942
- Weight per gallon @ 25°C (77°F) (with ~5% water) ... 7.85 lb
- APHA color ... <20
- Coefficient of expansion, 20 to 90°C (68 to 194°F) ... 0.00096/°C
- Flash Point, Tag Closed Cup ... 83°C (182°F)
- Flash Point, Setaflash Closed Cup neat ... 76.7°C (170.1°F)
- Vapor pressure@20°C (68°F) mm Hg/Pascal ... 0.34 / 45.33
- Freezing point (with ~5% water) ... -2°C (28°F)
- Surface tension, neat ... ~36-38 dynes/cm
  - in 10% aqueous solution ... ~58 dynes/cm
- pH of 0.1 M aqueous solution @ 20°C (68°F) ... 11.3
- pkα@20°C (77°F), neat ... ~9.82
- Refractive index nD @ 20°C (68°F) ... 1.4568

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AMP™
2-AMINO-2-METHYL-1-PROPANOL SOLUTION
CAS Registry No.124-68-5
Recommended Use Levels

In The Grind
To take full advantage of AMP™ as a co-dispersant, up to 30% of the existing dispersant solids can be replaced by an equal weight of AMP. This generally amounts to 0.05 to 0.1 percent of AMP on the total weight of the formulation.

In The Letdown
Typical formulations require 0.1 to 0.3 percent (on total formulation weight) of AMP for optimum pH stability, for associative thickener neutralization, and to eliminate in-can corrosion. For control of flash rusting, an additional 0.1 to 0.2 percent (on total formulation weight) of AMP may be required.

Efficient Pigment Dispersion
AMP improves pigment dispersion in the production of latex paints. Combining AMP with a conventional anionic dispersant in a grind paste is more effective than using any dispersant alone.

AMP enhances the performance of anionic dispersants so that dispersant demand is reduced. Six commonly-used dispersants were tested in a typical dispersion. As shown in the table below, small quantities of AMP in a TiO2, calcined clay, and calcium carbonate blend significantly reduced dispersant demand. Specific dispersant requirements vary with the pigment grade, type and lot.

Using AMP in the grind produces a paint with maximum hiding power, color acceptance, and stability at considerably lower anionic dispersant levels than are normally required to achieve similar results. AMP also stabilizes the grind at a mildly alkaline pH. This reduces the tendency for pigment reagglomeration or “shock” when the grind is added to a moderately alkaline letdown.

Dispersant Demand for 70% NVM TiO2, Calcined Clay, and Calcium Carbonate Blend

<table>
<thead>
<tr>
<th>Dispersant</th>
<th>Without AMP</th>
<th>With AMP*</th>
<th>% Dispersant Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamol 731 [A]</td>
<td>0.118</td>
<td>0.085</td>
<td>28</td>
</tr>
<tr>
<td>Nopcosperse 44 [B]</td>
<td>0.113</td>
<td>0.087</td>
<td>23</td>
</tr>
<tr>
<td>Tamol 963 [A]</td>
<td>0.100</td>
<td>0.075</td>
<td>25</td>
</tr>
<tr>
<td>KTPP [D]</td>
<td>0.165</td>
<td>0.123</td>
<td>25</td>
</tr>
<tr>
<td>Colloids 226 [C]</td>
<td>0.142</td>
<td>0.100</td>
<td>29</td>
</tr>
<tr>
<td>Tamol 1124 [A]</td>
<td>0.133</td>
<td>0.100</td>
<td>25</td>
</tr>
</tbody>
</table>

*AMP added at 0.05% by wt. of pigment.

Key to Suppliers:
[A] Rohm & Haas
[B] Cognis
[C] Rhodia
[D] Astaris LLC
AMP™ Dispersant functions as a powerful co-dispersant and then evaporates from the paint film upon drying. In gloss systems, the gloss is improved by the more efficient dispersion of the pigment through the use of AMP. Therefore, gloss can be enhanced as demonstrated in the following graph.

**Gloss Enhancement**

Exterior Semi-Gloss Paint
With and Without AMP

Reactive Pigment Stabilization

AMP helps to stabilize paint systems containing reactive pigments such as zinc oxide. Typical improvements are demonstrated in the following photo; the addition of AMP inhibited gelling even for paint subjected to heat aging.
AMP™ Dispersant evaporates from the paint film and is virtually gone from a film in two to six days, depending upon atmospheric conditions (Graph 1).

Graph 1
Percent by Wt. of AMP Remaining in Film

Most dispersants and surfactants contain 25 to 50% non-volatile, hygroscopic components, which remain in the dried paint film and contribute to poor scrub resistance and water spotting. Therefore, it is important to keep these additives to a minimum. AMP used in conjunction with reduced levels of conventional dispersants accomplishes this objective. The results are improved scrub resistance, water resistance, and reduced water spotting of the paint film (Graph 2).

AMP exhibits its superior scrub resistance properties in this interior flat formulation.
AMP™ Dispersant is an outstanding replacement for ammonia when neutralizing alkali swellable associative thickeners. Not only does AMP eliminate the problems associated with the handling of ammonia, but pH control and subsequent stability of the associative thickener is greatly enhanced.

Thickeners are often added at the dispersion stage to provide the required milling viscosity. As shown in Figure 1, AMP provides greater pH stability than ammonia during the dispersion, thus contributing to improved performance of the associative thickener.

In associative thickener-containing systems, effective neutralization and pH control are important to the long term stability of the coating. Accelerated aging studies demonstrate that AMP provides optimum pH stability in these finished coatings. In one comparison study, semi-gloss paints containing associative thickener and AMP or ammonia were aged 14 days at 130°F (54.5°C). The AMP system exhibited improved pH stability in comparison to the ammonia-based system as shown in Figure 2.
AMP™ Dispersant imparts excellent pH stability to latex paints. Ammonia is a weaker amine and is much more fugitive than AMP; therefore, ammonia-based paint has poorer pH stability and a stronger odor than does paint based on AMP. Controlling pH is very important because most paint formulations require a stable alkaline pH to control:

- Pigment dispersion
- Vehicle stability
- Package corrosion
- Viscosity stability

The control of pH with AMP also provides coatings with virtually no yellowing compared to many other commonly-used amines and amino alcohols, which is important for many types of quality paints being produced for the marketplace.

A comparison of the pH control performance of AMP and ammonia in a vinyl-acrylic semi-gloss paint (Graph 3) shows AMP is clearly superior to ammonia. After aging one month at elevated, and then two months at ambient temperature, the pH of the ammonia formulation had dropped from 9.2 to 7.4 while the pH of the paint with AMP did not go below 8.5.
Reduced Corrosion

AMP™ Dispersant reduces corrosion problems in two areas because AMP reduces pH drift in latex paints. It effectively stops in-can rusting in areas such as seams and edges. In addition, flash rusting over steel and iron is reduced. This is important for paints used over exposed nailheads, casements and other ferrous surfaces.

Effective in Low Odor/Low VOC Systems

With the ever-tightening VOC regulations and the consumer preference for low odor paints, AMP is an excellent alternative to ammonia. To demonstrate that point, two low VOC/low odor paint formulations were prepared with ammonia and AMP. The data in Graph 4 clearly show that AMP does not incrementally increase VOC, with the added benefit of eliminating the offensive odor of ammonia.

Graph 4

AMP Outperforms Ammonia and has a Comparable System VOC

The maximum theoretical VOC contribution of AMP at a typical use level of 0.2% on total weight of the formulation is 2.4 g/L. This contribution is extremely low and well within the experimental error associated with the test method. In addition, the use of AMP allows for the overall reduction of other additives and glycols, which further reduces VOC and provides for significant improvements to low odor systems. The use of AMP in low VOC paint formulations allows for the manufacture of paints well within current and proposed VOC targets.

Product Stewardship

ANGUS encourages its customers to review their applications of ANGUS products from the standpoint of human health and environmental quality. To help ensure that ANGUS products are not used in ways for which they are not intended, ANGUS personnel will assist customers in dealing with environmental and product safety considerations. For assistance, Safety Data Sheets, or other information, please contact your ANGUS representative at the numbers provided in this document. When considering the use of any ANGUS product in a particular application, review the latest Safety Data Sheet to ensure that the intended use is within the scope of approved uses and can be accomplished safely. Before handling any of the products, obtain available product safety information including the Safety Data Sheet(s) and take the necessary steps to ensure safety of use.
AEPD™ VOX 1000 Neutralizing Amine

AEPD™ VOX 1000 Neutralizing Amine can help you formulate Zero VOC (< 5g/L) paints without compromising product quality. AEPD VOX 1000 Neutralizing Amine from ANGUS delivers all the functionality of industry standard AMP™, has virtually no odor, and is more efficient than other low VOC alkanolamines.

Addition of AEPD VOX 1000 Neutralizing Amine to the grind improves pigment dispersion efficiency resulting in lower primary dispersant levels. Its high boiling point and low vapor pressure make it a great fit when formulating either low VOC or VOC-free paint while virtually eliminating amine or ammonia type odors.

AEPD VOX 1000 Neutralizing Amine is a distinct ANGUS amino alcohol that is chemically similar to AMP (2-amino-2-methyl-1-propanol), boasting an additional hydroxyl functional group that allows for improved open time and wet-edge improvements.

Typical Properties

The typical physical characteristics of AEPD VOX 1000 Neutralizing Amine are shown below; they are not to be considered product specifications.

- Virtually no odor
- Vapor pressure 0.01 mm Hg
- Boiling Point 259°C
- Pale Liquid
- Molecular weight 119
- pH 10.8 (0.1M solution @20°C)
- pKa@ 20°C 8.8
- Specific gravity approx 1.05
- Primary amine
- Di-ol functionality

Recommended Uses

AEPD VOX 1000 Neutralizing Amine is recommended to be used in the grind and may also be used in the let down to neutralize alkali swellable associative thickeners. For assistance with formulation optimization guidelines please consult an ANGUS Chemical Company technical specialist.
Efficient Pigment Dispersion

AEPD™ VOX 1000 Neutralizing Amine improves pigment dispersion in latex paints. Combining AEPD VOX 1000 Neutralizing Amine with a conventional anionic dispersant in a grind paste is more effective than using any single dispersant alone.

Just as AMP™ has been widely used as an effective co-dispersant for pigments, AEPD VOX 1000 Neutralizing Amine provides similar results. The kaolin clay dispersion efficiency and rheology of AEPD VOX 1000 Neutralizing Amine is shown in Figure 1 below.

Another performance benefit with utilizing the co-dispersant functionality of AEPD VOX 1000 Neutralizing Amine with pigments is enhanced gloss. Compared to Ammonia, Figure 2 below shows a >4 units increase in gloss with AEPD VOX 1000 Neutralizing Amine in an Interior Low VOC Semi-Gloss Latex Formula.

AEPD VOX 1000 Neutralizing Amine Allows for Formula Optimization

In a low VOC semi-gloss formula VOC contribution of AEPD VOX 1000 Neutralizing Amine is minimal when compared to ammonia. The multifunctional nature of AEPD VOX 1000 Neutralizing Amine allows for significant reduction in primary dispersant, glycols and coalescing agents further reducing VOC’s. This also provides cost optimization while enhancing the dry film properties such as scrub and water spotting.
**Improved Paint Application/Freeze-Thaw Stability**

Low VOC paint formulations have some shortcomings with freeze-thaw, open-time, block and dirt pick-up resistance. While certain characteristics such as dirt pick-up resistance is more dependent on the low Tg latex composition and ratio, additives such as neutralizing agents can influence properties including freeze-thaw resistance and open-time. Addition of AEPD™ VOX 1000 Neutralizing Amine marginally improved the open time compared to Ammonia.

The formula in Table 1 below showed an improvement in the freeze-thaw resistance as compared to the Ammonia formula at -8°C after 1 cycle. In low VOC formulations, adding hydroxyl functionality can optimize glycols to achieve better film integrity with lower odor.

**Table 1**

**Interior Low VOC Semi-Gloss Formulation**

<table>
<thead>
<tr>
<th></th>
<th>SG1 Ammonia</th>
<th>SG2 AEPD™ VOX-1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRIND (lbs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>120.00</td>
<td>120.00</td>
</tr>
<tr>
<td>CELLOSIZE™ QP-300</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>CANGUARD™ BIT 20-AS</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Potassium Tripolyphosphate</td>
<td>1.50</td>
<td>1.50</td>
</tr>
<tr>
<td>ECOSURFTM SA-9</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Propylene Glycol</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Drewplus Y-381</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>TAMOLT™ 731A</td>
<td>7.00</td>
<td>7.00</td>
</tr>
<tr>
<td><strong>AEPD™ VOX 1000</strong></td>
<td>-</td>
<td><strong>1.88</strong></td>
</tr>
<tr>
<td><strong>Ammonia (28%)</strong></td>
<td><strong>1.30</strong></td>
<td></td>
</tr>
<tr>
<td>Ti-Pure R902+</td>
<td>225.00</td>
<td>225.00</td>
</tr>
<tr>
<td>Polygloss 90</td>
<td>35.00</td>
<td>35.00</td>
</tr>
<tr>
<td>Water</td>
<td>45.00</td>
<td>45.00</td>
</tr>
<tr>
<td><strong>LETDOWN</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UCAR™ Latex 634</td>
<td>425.00</td>
<td>425.00</td>
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<tr>
<td>Water</td>
<td>120.00</td>
<td>120.00</td>
</tr>
<tr>
<td>ACRYSOL™ RM 5000</td>
<td>30.00</td>
<td>30.00</td>
</tr>
<tr>
<td>Water</td>
<td>24.85</td>
<td>24.24</td>
</tr>
<tr>
<td>Drewplus Y-381</td>
<td>1.50</td>
<td>1.50</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1051.64</strong></td>
<td><strong>1051.62</strong></td>
</tr>
<tr>
<td>% Solids by wt</td>
<td>46.5</td>
<td>46.4</td>
</tr>
<tr>
<td>% Solids by vol.</td>
<td>32.5</td>
<td>32.5</td>
</tr>
<tr>
<td>PVC, %</td>
<td>27.2</td>
<td>27.2</td>
</tr>
<tr>
<td>% Solids by wt</td>
<td>46.5</td>
<td>46.4</td>
</tr>
<tr>
<td>% Solids by vol.</td>
<td>32.5</td>
<td>32.5</td>
</tr>
<tr>
<td>PVC, %</td>
<td>27.2</td>
<td>27.2</td>
</tr>
<tr>
<td>pH .1 day, 25°C</td>
<td>9.45</td>
<td>9.26</td>
</tr>
<tr>
<td>KU Viscosity 1 day, 25°C</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>ICI Viscosity 1 day, 25°C</td>
<td>0.9</td>
<td>0.9</td>
</tr>
</tbody>
</table>
Improved Package Stability

Neutralizing agents affect pigment dispersion stability and this effect is especially more significant in flat paint formulations. In a vinyl acrylic flat formulation with PVC 64%, AEPD VOX 1000 Neutralizing Amine demonstrates very stable sheen over aging at 60°C when compared to ammonia as is shown in Figure 3 below.

![Figure 3 Improved Sheen Stability with AEPD VOX 1000](image)

Performance Summary

AEPD VOX 1000 Neutralizing Amine provides exceptional formulation flexibility so that the performance of both a Zero-VOC and Low-VOC paint achieves the highest quality standards. Improvements to freeze-thaw, open time, gloss and package stability are just a few of the benefits that AEPD VOX 1000 Neutralizing Amine offer while having virtually no odor.

Compared to other low VOC alkanolamines, AEPD VOX 1000 Neutralizing Amine offers superior performance at lower use rates, making it the most cost-effective choice for your formulation.

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