HOW TO DISPERSE MICRONIZED WAX
Introduction
Micro Powders, Inc. manufactures micronized wax powders based on polymers that have low surface energies. It is important to understand the proper techniques to use when incorporating micronized powders into a coating. In order to successfully “wet” the wax particles, the liquid used requires a lower surface tension than the surface energy of the wax. The term “wet” or “wetting” refers to completely dispersing individual micro-fine particles into a liquid medium.

This guide provides information on dispersing micronized wax powders into a variety of systems, including:

- Solvent based
- Water based
- Energy curable
- 100% solids and reactive systems

General Concept
It is generally recommended to avoid adding micronized wax directly into the final liquid formulation, as this typically will lead to poor wetting, insufficient dispersion, agglomerated wax particles, coating defects, and poor end use performance. It is usually difficult to wet out a small percentage of dry wax in a large batch of liquid material. Ideally, a concentrated dispersion is first prepared using the wax powder and one or more components of the coating formulation. Then the appropriate amount of this pre-dispersion is added to the final coating.

Understanding Wax Density
The density of a wax additive affects how the wax behaves once dispersed into a liquid. If the density of the wax is lower than the density of the liquid, the wax will want to rise to the surface and float. If the density of the wax is higher than the density of the liquid, the wax will want to sink to the bottom. Examples:

<table>
<thead>
<tr>
<th>Wax Type</th>
<th>Density</th>
<th>Formula Type</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polypropylene</td>
<td>0.89</td>
<td>Water-based (density 1.0)</td>
<td>Float</td>
</tr>
<tr>
<td>PTFE</td>
<td>2.20</td>
<td>Water-based (density 1.0)</td>
<td>Sink</td>
</tr>
</tbody>
</table>

Viscosity will affect the rate of this flotation or settling; higher viscosity systems will respond more slowly than lower viscosity systems. Formulators should be aware of this when preparing pre-dispersed wax compounds since the homogeneity of the dispersed wax can change over time.

Our product recommendations take this phenomenon into account in order to recommend the best product for your specific application (where possible).

Dispersion Technique
For best results, it is recommended to use a high speed impeller disk such as a ConnBlade type ITT to provide sufficient shear energy to wet and disperse the wax and to break down any agglomerates that may be generated during the dispersion process. The effective shear energy is dependent on the shear rate and viscosity. Using an impeller disk that provides pumping action will give circulation of the total mass and wet out the particles more thoroughly.

In the laboratory, dispersion of dry wax can be achieved with a disk tip speed of 1,000 – 1,500 feet per minute (FPM), or around 5 – 7 meters per second (m/s). In a production environment, a tip speed of 4,000 – 5,000 FPM, or around 22 – 26 m/s, is a good target.

Solvent Based Systems
Since the surface tension of solvent based liquids is typically low, it is relatively easy to disperse micronized wax powders into these types of formulations. Although it may be more efficient to prepare a concentrated pre-dispersion using one or more of the solvent based formula components, it may also be possible (with efficient mixing) to add micronized waxes directly to the final coating.
It is important to note that when dispersing a micronized wax (especially grades based on lower melting polymers such as synthetic wax or carnauba wax) into a solvent based formulation, the formulator should use caution so as not to soften or dissolve the wax.

Overheating the dispersion can cause the micronized wax to become soluble and possibly recrystallize as it is cooled to room temperature. The dispersion temperature should be kept below 40 °C (104 °F) to prevent it from dissolving. Also, the use of aromatic or other strong solvents can lead to similar issues with dissolution and recrystallization, so avoid these solvents where possible with lower melting waxes. In fact, many solvent based coating formulators prefer to avoid lower melting wax grades because of these potential production issues, instead opting for a more temperature-robust polyethylene wax additive.

The following is a typical procedure for making a stable wax pre-dispersion in a solvent based system:

<table>
<thead>
<tr>
<th>65%</th>
<th>Solvent (such as alcohols, esters, glycols, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Add wax slowly while mixing</td>
</tr>
<tr>
<td>35%</td>
<td>Micro Powders wax additive</td>
</tr>
<tr>
<td></td>
<td>Mix until fully dispersed (~10 minutes)</td>
</tr>
</tbody>
</table>

As the wax is dispersed, the viscosity of the mixture will decrease, and the final dispersed material will have a glossy appearance. Add the appropriate amount of this pre-dispersion to provide the addition level you desire in your coating.

**Water Based Systems**

Since the surface tension of water based liquids is high, it can be difficult to disperse micronized wax powders directly into these types of formulations. It is highly recommended that a concentrated pre-dispersion be prepared using one or more of the water based formula components.

There are several different ways to prepare a wax pre-dispersion for a water based formula:

**METHOD A**
Disperse 40-50% of the micronized wax into a water/surfactant mixture (For example, Micro Powder’s Microspersion EZ is a formulated surfactant package that is ideal for this approach at a 4% addition level)

**METHOD B**
Disperse 20-30% of the micronized wax into a water based resin or vehicle (optionally with defoamer if needed)

The following are two typical procedures for making a stable wax dispersion in a water based system:

**METHOD A - Using Surfactants**

<table>
<thead>
<tr>
<th>45.5% 4.0% 0.5%</th>
<th>Water Microspersion EZ (or other surfactant mixture) Defoamer (Rhodoline 643 – Solvay) or other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mix water and additives before adding in wax (~5 minutes) Add wax slowly while mixing</td>
</tr>
<tr>
<td>50.0%</td>
<td>Micro Powders wax additive Mix until fully dispersed (~20 minutes)</td>
</tr>
</tbody>
</table>

**METHOD B - Using Resins**

<table>
<thead>
<tr>
<th>60.0% 0.5%</th>
<th>Water based vehicle (acrylic, PUD, etc. – typically around 40% solids) Defoamer (Rhodoline 643 – Solvay) or other</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.0%</td>
<td>Micro Powders wax additive Mix until fully dispersed (~20 minutes) and then add</td>
</tr>
<tr>
<td>14.5%</td>
<td>Water</td>
</tr>
</tbody>
</table>

As the wax is dispersed, the viscosity of the mixture will decrease, and the final dispersed material will have a glossy appearance. Add the appropriate amount of this pre-dispersion to provide the addition level you desire in your coating.

For further information on extending shelf stability of a waterbased wax dispersion, please read “How to Stabilize a Waterbased Wax Dispersion” at the end of this document.
Energy Curable Systems

Follow the procedure and formula for solvent based systems, replacing the solvent component with monomer and/or oligomer from the Energy Curable formula. Then add the appropriate amount of this pre-dispersion to provide the addition level you desire in your coating. Use caution during the dispersion process to avoid excessive shear and/or heat development that may cause the energy curable materials to be affected.

100% Solids & Reactive Systems

Follow the procedure and formula for solvent based systems, replacing the solvent component with a low viscosity component from the 100% solids formula. Low reactivity diluents such as polyaldimine or exempt solvents such as propylene carbonate are useful in preparing pre-dispersions. Then add the appropriate amount of this pre-dispersion to provide the addition level you desire in your coating.

How To Verify A Well-Dispersed Wax

It is relatively easy to check a coating or pre-dispersion to ensure that the wax particles have been fully dispersed and wetted out. A grind gauge such as a NPIRI gauge is the easiest way to evaluate the material. Micro Powders wax products have a NPIRI gauge specification that you can use as a reference point. Other gauges such as a Hegman may also be useful in confirming the degree of dispersion. Of course, the best way to check will be to prepare a laboratory scale batch of your coating and evaluate the dried film for surface uniformity, gloss level, COF, or other surface property measurements.

How To Stabilize A Waterbased Wax Dispersion

As discussed earlier, most micronized wax grades will float in a waterbased system because the particle density is lower than that of water (1.0). This flotation process occurs faster in lower viscosity systems. To slow this process, the viscosity of wax dispersion can be increased through the incorporation of a thickening agent. Carbopol ETD 2691 (Lubrizol) is a lightly crosslinked polyacrylic acid polymer that can be used for this purpose. Typically, 0.02% by weight of ETD 2691 is a good starting point to achieve a suitable viscosity. Note that the Carbopol needs to be neutralized with ammonium hydroxide, which swells the particle, raises the viscosity of the dispersion, and prevents the wax particles from floating. Optimum stability against flotation is typically achieved at a viscosity of around 4,000 - 5,000 cP.

Lubrizol provides detailed instructions on how to use Carbopol ETD 2961, but here is some general guidance:

- To thicken a wax dispersion in the lab, first fully disperse the wax and then sprinkle the Carbopol on the surface. Wait ten minutes for the Carbopol to hydrate. Next, add the appropriate amount of ammonium hydroxide to neutralize the Carbopol. Mix with a spatula. Let the dispersion sit for a few hours to allow the Carbopol polymer to uncoil, which will raise the viscosity.

- To thicken a wax dispersion in the plant, first complete the wax dispersion process. Lower the mixer speed to 800 rpm and sprinkle the Carbopol into the vortex. Mix for one minute. Next, add the appropriate amount of ammonium hydroxide and mix at 800 rpm for ten minutes. Over the course of a few hours, the Carbopol uncoils and raises the viscosity.

The Microspersion Option

If your application is waterbased, and you would prefer to purchase pre-dispersed wax in an aqueous liquid form, Micro Powders offers many of our most popular products in “Microspersion” form. These high solids nonionic wax dispersions are easy to add directly to your final waterbased formulation.

Having Problems?

Micro Powder's Technical Support Staff are just a telephone call or e-mail away and are always available to help. If you are still having issues with your application, please contact us.

Watch our video on How to Disperse Micronized Wax at micropowders.com

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