HYPERDISPERSENTS AND COUPLING AGENTS FOR THERMOPLASTICS AND THERMOSETS

Solplus™ and Solsperse™ hyperdispersants and coupling agents have been developed to meet the needs of the plastic industry, for both thermoplastic and thermostet polymers, as well as polyurethanes.

THERMOPLASTIC MASTERBATCH AND COMPOUNDING

Solplus™ DP310, Solplus™ DP320 and Solplus™ DP330 hyperdispersants are recommended for the dispersion of pigments and fillers in thermoplastic masterbatch and compound applications. They can be used in a wide variety of thermoplastic polymers including polyethylene, polystyrene, ABS, polypropylene and PVC.

PLASTICIZER AND POLYOL DISPERSIONS

The recommended Solplus™ hyperdispersant for the production of plasticizer and polyol dispersions is dependent upon the pigment:

**Solplus™ K500**
- Inorganic pigments and fillers

**Solplus™ DP700**
- Inorganic pigment fillers and carbon black

**Solplus™ K200**
- Organic pigment (phthalate free dispersions)

**Solplus™ K210**
- Organic pigments (phthalate based dispersions)

**Solplus™ R700**
- Organic pigments (polyether polyols)

**Solplus™ R710**
- Organic pigments (polyether polyols)

BENEFITS

In both phthalate and non-phthalate plasticizer systems and in polyether and polyester polyols for conversion to polyurethanes, Solplus hyperdispersants improve dispersion of:

- Organic and inorganic pigments
- Fillers
- Flame retardants
- Stabilizers
- Blowing agents

As a result, manufacturers achieve:

- Higher solid loadings/increased pigment concentration
- Reduced viscosities (more Newtonian rheology)
- Improved color strength development
- Better dispersion of color in finished polymer
- Cost reductions (increased productivity and fewer passes on the mill)

COUPLING AGENTS IN THERMOPLASTIC COMPOUNDING AND CABLE APPLICATIONS

Solplus™ C800 hyperdispersant is the recommended agent for coupling with a variety of fillers in thermoplastic compounding and cable production. These novel coupling agents for filled polymers offer:

- Improved mechanical properties (tensile strength, elongation to break, etc.)
- More cost-effectiveness than maleinized polymers and silanes
- Effectiveness on wide range of fillers and flame retardants and for many polymer types—suitable for peroxide catalyzed processing
- Surface treatment of fillers (including calcium carbonate)—no evolution of alcohols or toxic byproducts during processing

THERMOSET/COMPOSITE APPLICATIONS

Engineered specifically for composite fillers and resins—and based on proprietary polymer chemistry—Solplus™ additives offer major process advantages to the thermoset industry, including the combination of dispersing/wetting and anti-settling benefits in a single additive.

From being 100% active and solvent free, Solplus™ hyperdispersants also help to reduce environmental impact from the styrene content levels that characterize most unsaturated polyester based systems.

Solplus™ dispersants have been developed to improve dispersion of fillers, flame retardants and reinforcements (fibers) in thermoset systems, as well as for organic and inorganic pigments in gel coats.

BENEFITS

- Higher filler/flame retardant loadings
- Decreased viscosities
- Anti-settling
- Improved stability
- Improved color to white compatibility
- Improved processing
HYPERDISPERSANTS AND COUPLING AGENTS FOR THERMOPLASTICS AND THERMOSETS

INFLUENCE OF MEDIA COMPATIBILITY ON PRODUCT SELECTION

For a Solsperse™ or Solplus™ hyperdispersant to be effective in specific applications, it must be compatible with the media in which the solid is being dispersed AND have an affinity with the surface of the material itself. These are the main criteria used in product selection. The main grades offered for a range of plastics applications are mapped out below.

With certain organic pigment dispersions it may be advantageous to include the use of a Solsperse™ synergist in combination with the polymeric Solplus™ or Solsperse™ hyperdispersant.

FORMULATING GUIDELINES

DOSAGE – PLASTIC APPLICATIONS

MASTERBATCH/COMPOUND

To determine the optimum dosage for masterbatch or compound applications, a “ladder series” should be carried out.

PLASTICIZERS AND GEL COATS

For many plasticizer and polyester gel coat applications, it has been established that the theoretical dosage level of the appropriate Solplus™ or Solsperse™ hyperdispersant in a pigment dispersion equates to 2 mg of Solplus™ or Solsperse™ polymeric hyperdispersant/square meter of pigment surface area.

This can be expressed as % Agent On the Weight of Pigment (% AOWP).

\[
% \text{AOWP} = \frac{\text{pigment surface area (m}^2/\text{g)}}{5}
\]

THERMOSET COMPOSITES

For thermoset composite applications, testing has confirmed a loading of between 0.5% and 2% of the appropriate Solplus™ hyperdispersant on the weight of filler is effective.

Minor adjustments may, however, be required depending on the specific grade of filler used.

FILLER COUPLING IN THERMOPLASTIC COMPOUNDS

The recommended dosage level of Solplus™ C800 to use is calculated as follows:

\[
1.2 \times \text{surface area of filler (m}^2/\text{g}) = \text{weight in grams (g) of Solplus C800 required per kg of filler}
\]

Please refer to Lubrizol technical contacts for more details.

METHOD OF USE/ORDER OF ADDITION – PLASTIC APPLICATIONS

MASTERBATCH/COMPOUND

1. Charge polymer to pre-blending equipment.
2. Add Solplus™ or Solsperse™ agent and blend thoroughly with the polymer to coat the surface of the polymer.
3. Add pigments, fillers, processing aids and other essential ingredients and continue pre-blending.
4. Process the resultant blend in normal manner (extrusion, internal mixer, 2-roll mill, etc.).

It is essential to follow this order of addition carefully since it allows for maximum distribution of the Solplus™ or Solsperse™ additive and produces intimate contact between the hyperdispersant and the polymer. This intimate contact gives the best results.

PLASTICIZERS, GEL COATS AND THERMOSET COMPOSITES

1. Dissolve the appropriate Solsperse™ or Solplus™ hyperdispersant in the millbase plasticizer or resin.
2. If required, add a synergist and distribute evenly with stirring (note: the synergist is virtually insoluble).
3. Add the pigment or filler in stages and disperse in normal manner.
## Hyperdispersants and Coupling Agents for Thermoplastics and Thermosets – Product List

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Physical Description</th>
<th>Package Size (g)</th>
<th>% Active Content</th>
<th>Solvent/Carrier</th>
<th>Suitable Application(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Solplus™ C800</em></td>
<td>Colorless liquid</td>
<td>P25/P200</td>
<td>100</td>
<td>—</td>
<td>Filler coupling in thermoplastic compounds</td>
</tr>
<tr>
<td><em>Solplus™ D520</em></td>
<td>Yellow viscous liquid</td>
<td>D20/D80</td>
<td>100</td>
<td>—</td>
<td>Thermoset composites, pigmented gel coats</td>
</tr>
<tr>
<td><em>Solplus™ D520</em></td>
<td>Straw colored viscous liquid</td>
<td>P25/P200</td>
<td>100</td>
<td>—</td>
<td>Thermoset composites</td>
</tr>
<tr>
<td><em>Solplus™ D540</em></td>
<td>Pale amber to brown viscous liquid</td>
<td>P20/P200</td>
<td>100</td>
<td>—</td>
<td>Thermoset composites</td>
</tr>
<tr>
<td><em>Solplus™ D541</em></td>
<td>Amber liquid</td>
<td>D25, D80</td>
<td>100</td>
<td>—</td>
<td>Thermoset composites</td>
</tr>
<tr>
<td><em>Solplus™ D542</em></td>
<td>Pale amber liquid</td>
<td>D20, D80</td>
<td>50</td>
<td>MPA: methoxy propional</td>
<td>Thermoset composites</td>
</tr>
<tr>
<td><em>Solplus™ D545</em></td>
<td>Pale amber to brown viscous liquid</td>
<td>P25, P200, h1000</td>
<td>100</td>
<td>—</td>
<td>Thermoset composites</td>
</tr>
<tr>
<td><em>Solplus™ D560</em></td>
<td>Pale yellow liquid</td>
<td>P20/P80</td>
<td>100</td>
<td>—</td>
<td>Thermoset composites</td>
</tr>
<tr>
<td><em>Solplus™ D570</em></td>
<td>Colorless to brown viscous liquid</td>
<td>P25, P200</td>
<td>100</td>
<td>—</td>
<td>Thermoset composites</td>
</tr>
<tr>
<td><em>Solplus™ D590</em></td>
<td>Yellow to brown liquid</td>
<td>D20/D80</td>
<td>100</td>
<td>—</td>
<td>Compatibilizer for thermoset composites</td>
</tr>
<tr>
<td><em>Solplus™ DP301</em></td>
<td>Off white powder</td>
<td>B825</td>
<td>100</td>
<td>—</td>
<td>Masterbatch/compounding</td>
</tr>
<tr>
<td><em>Solplus™ DP320</em></td>
<td>White powder</td>
<td>Bag 25</td>
<td>100</td>
<td>—</td>
<td>Masterbatch (compounding especially fibers and engineering plastics (not available in Europe))</td>
</tr>
<tr>
<td><em>Solplus™ DP330</em></td>
<td>White powder</td>
<td>P30</td>
<td>100</td>
<td>—</td>
<td>Masterbatch/compounding</td>
</tr>
<tr>
<td><em>Solplus™ DP700</em></td>
<td>Brown liquid</td>
<td>D20, D80, I750</td>
<td>100</td>
<td>—</td>
<td>Plasticizers</td>
</tr>
<tr>
<td><em>Solplus™ DP710</em></td>
<td>Cream powder</td>
<td>B25</td>
<td>100</td>
<td>—</td>
<td>Rigid PVC</td>
</tr>
<tr>
<td><em>Solplus™ ES5000</em></td>
<td>White to off white liquid</td>
<td>D20, D80</td>
<td>10</td>
<td>Hydrocarbon carrier</td>
<td>Thermoset composites (styrene suppressant)</td>
</tr>
<tr>
<td><em>Solplus™ F300</em></td>
<td>Pale yellow liquid</td>
<td>D20, D80</td>
<td>100</td>
<td>—</td>
<td>Thermoset composites</td>
</tr>
<tr>
<td><em>Solplus™ K300</em></td>
<td>Pale yellow to brown viscous liquid</td>
<td>D20/D80</td>
<td>50</td>
<td>DDA (Diocetyladipate)</td>
<td>Plasticizers and liquid colors for plastics</td>
</tr>
<tr>
<td><em>Solplus™ K310</em></td>
<td>Pale yellow to brown viscous liquid</td>
<td>D20/D80</td>
<td>50</td>
<td>DINP (Diononylphthalate)</td>
<td>Plasticizers and liquid colors for plastics</td>
</tr>
<tr>
<td><em>Solplus™ K220</em></td>
<td>Amber to brown viscous liquid</td>
<td>D20/D80/940</td>
<td>100</td>
<td>—</td>
<td>Plastifier and liquid colors for TP and PVC</td>
</tr>
<tr>
<td><em>Solplus™ K240</em></td>
<td>Pale yellow to brown viscous liquid</td>
<td>D20, D80</td>
<td>100</td>
<td>—</td>
<td>Liquid colors for plastics</td>
</tr>
<tr>
<td><em>Solplus™ K241</em></td>
<td>Pale yellow to brown viscous liquid</td>
<td>D20, D80</td>
<td>50</td>
<td>MPA: methoxy propional</td>
<td>Thermoset composites (silica replacement)</td>
</tr>
<tr>
<td><em>Solperse™ 3000</em></td>
<td>Waxy paste/viscous liquid</td>
<td>D20/D720</td>
<td>100</td>
<td>—</td>
<td>Plasticizers</td>
</tr>
<tr>
<td><em>Solperse™ 5000S</em></td>
<td>Blue powder</td>
<td>B25</td>
<td>100</td>
<td>—</td>
<td>Synergist</td>
</tr>
<tr>
<td><em>Solperse™ 8100S</em></td>
<td>Amber liquid</td>
<td>D20/D80</td>
<td>50</td>
<td>Mineral oil</td>
<td>Plasticizers and liquid colors for plastics</td>
</tr>
<tr>
<td><em>Solperse™ 12005S</em></td>
<td>Blue powder</td>
<td>B25</td>
<td>100</td>
<td>—</td>
<td>Synergist</td>
</tr>
<tr>
<td><em>Solperse™ 13650</em></td>
<td>Amber liquid</td>
<td>D20/D80</td>
<td>50</td>
<td>Diundecylphthalate</td>
<td>Plasticizers</td>
</tr>
<tr>
<td><em>Solperse™ 21000S</em></td>
<td>Waxy paste/viscous liquid</td>
<td>D20/D720</td>
<td>100</td>
<td>—</td>
<td>MRX/compound</td>
</tr>
<tr>
<td><em>Solperse™ 22000</em></td>
<td>Yellow powder</td>
<td>B20</td>
<td>100</td>
<td>—</td>
<td>Synergist</td>
</tr>
</tbody>
</table>

**Key:** Packaging: B = box, D = drum, I = IBC, P = plastic drum

*Approved for food contact. Some limitations apply. Please consult your regional Lubrizol sales office.*
WHAT WE ADD MAKES THE DIFFERENCE.”

At Lubrizol, we innovate coatings solutions that help our customers balance the aesthetics, durability and functionality needs of their products for a wide array of surfaces and substrates. Our strength is in collaborating with customers to solve their toughest challenges—such as making coatings safer, enhancing production efficiency and reducing environmental impact—without compromising performance. To learn more, contact your Lubrizol representative or visit www.lubrizol.com/coatings.

The information contained herein is believed to be reliable, but no representations, guarantees or warranties of any kind are made as to its accuracy, suitability for particular applications or the results to be obtained. The information is based on laboratory work with small-scale equipment and does not necessarily indicate end product performance. Because of variations in methods, conditions and equipment used commercially in processing these materials, no warranties or guarantees are made as to the suitability of the products for the applications disclosed. Full-scale testing and end product performance are the responsibility of the user. Lubrizol Advanced Materials, Inc. shall not be liable for and the customer assumes all risk and liability of any use or handling of any material beyond Lubrizol Advanced Materials, Inc.’s direct control. The SELLER MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Nothing contained herein is to be considered as permission, recommendation nor as an inducement to practice any patented invention without permission of the patent owner.

Trademarks owned by The Lubrizol Corporation or its affiliates.
©The Lubrizol Corporation 2018, All Rights Reserved.