EASILY DISPERSIBLE ORGANIC PIGMENTS:
AN INNOVATIVE APPROACH FOR FLEXIBLE, ECONOMIC AND SUSTAINABLE
PAINT PRODUCTION

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ABSTRACT

In the paint manufacturing process, one of the most important steps is the dispersion of pigments. A new range of organic pigments: the “Easily Dispersible pigments” abbreviated “ED pigments” has been developed by Clariant to simplify this process.

ED pigments are surface modified organic pigments which can be dispersed with a high speed dissolver, eliminating the need of the traditional bead milling step. The additives on the ED pigment surfaces are incorporated in the standard pigment production process during the pigment finish; therefore no additional step is added to this process. These additives, highly efficient and widely compatible, facilitate wetting and separation of pigment particles during the dispersion process. As a result, ED pigments can be dispersed only by the use of a high speed dissolver. No additional milling step is necessary.

Furthermore, optimum amount of additive is present on each ED pigment surface to achieve the necessary dispersion properties, thus reducing or even eliminating the need for additional dispersant in the mill base formulation.

By simplifying the dispersion step, ED pigments can improve significantly the eco footprint in paint manufacture. The processing time is shortened leading to increased production capacity while simultaneously realizing savings in electricity consumption and generation of waste water.

Previously only available for solvent based industrial coatings systems, the ED pigment range now covers all coatings systems and applications:

- EDS pigments for solvent based industrial coating systems,
- EDU pigments for water and solvent based industrial coating systems
- EDW pigments for water based pigment dispersions for decorative paints
INTRODUCTION

The most important and complex step in the coloration of paints is the homogenous distribution of pigment particles in the paint system. Organic pigment particles in powder form exist as agglomerates. During the grinding process, the pigment particles are first premixed in the presence of costly dispersing agents in solvent by means of a dissolver (wetting step) and then transferred to a bead mill (milling step) where the pigment particle size is reduced to achieve the optimum color properties in the paint system. Ideally, this means reduction of agglomerates to primary particles.

This process is expensive due to the high cost of machines, production time and workforce. Moreover, this working step also affects the environment because of the electrical energy required by the bead mill and the intensive cleaning that needs to be done after every operating cycle. Therefore Clariant offers now to customers the possibility to simplify this process and to reduce the cleaning step by using the easily dispersible pigments also called ED pigments.

WHAT ARE ED PIGMENTS?

ED pigments are surface modified organic pigments which can be dispersed with a high speed dissolver, eliminating the need of the traditional bead milling step. They are not solid pigment preparations in which the pigment is already dispersed; they are pigment powder (cf. Figure 1).

<table>
<thead>
<tr>
<th>Colorant</th>
<th>Pigments</th>
<th>Pigment dispersions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inorganic</td>
<td>Organic</td>
</tr>
<tr>
<td>Difference</td>
<td>Iron oxide etc.</td>
<td>Hostaperm®, Novoperm®, etc.</td>
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<tr>
<td>Product example</td>
<td></td>
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<tr>
<td>Dispersing effort</td>
<td>Dispersing effort = low to middle (dissolver only is possible)</td>
<td>Dispersing effort = middle to high (dissolver only is not possible)</td>
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Figure 1: Definition of ED pigments
HOW ARE ED PIGMENTS PRODUCED?

The manufacturing process of ED pigments is similar to the production process of the standard pigments. The pigment additivation is integrated in the pigment finish and no additional process step is necessary (cf. Figure 2).

Based on this efficient manufacturing technology, the ED pigments can be offered at prices comparable to their standard counterparts from Clariant.

IN WHICH APPLICATIONS CAN ED PIGMENTS BE USED?

The ED pigments range includes three different product types (cf. Figure 3):
- EDS pigments for solvent-based industrial coating systems
- EDU pigments for water- and solvent-based industrial coating systems
- EDW pigments for water based pigment dispersions for decorative paints
NO NEED TO USE A BEAD MILL EQUIPMENT

The ED pigments carry on their surface highly efficient and widely compatible additives. Which facilitate the separation and wetting of the pigment particles during the dispersion process. As a result, ED pigments can be fully dispersed just by means of a high speed dissolver. No additional milling with a bead mill is necessary.

This increases the flexibility in production and results in additional production capacity without further investment.
HANDLING OF EDS AND EDU PIGMENTS

EDS and EDU pigments can be directly incorporated into the paint system with a dissolver and the desired color properties can be achieved in approximately 30 min (cf. Figure 4). The key parameter to get the “easily dispersible” effect is to bring the right shear forces into the system when using the dissolver. The highest efficiency is reached when the typical “Donut” effect is observed. This effect can only be observed at the right viscosity therefore the viscosity of the mill base needs to be adjusted for example by increasing the pigment loading and/or decreasing the amount of solvent.

Furthermore, due to the special properties of the EDS and EDU pigments, the amount of additives in the mill base formulation can be substantially reduced with the effect of further cost savings.

Finally, all our EDS and EDU pigments have been successfully tested against standard pigments in numerous coating systems such as alkyd (air drying and baking enamels), polyurethane, polyester (saturated and unsaturated polyester, polyester CAB), acrylic (UV curing, e.g. epoxy acrylate resins) and epoxy systems.

HANDLING OF EDW PIGMENTS

EDW pigments will be dispersed in binder-free systems to get pigment dispersions also known as tinters which will then be incorporated into either water based decorative paint systems or solvent based decorative paint systems (cf. Figure 5). Like for EDS and EDU pigments, EDW pigments can be dispersed by using only a dissolver. The optimum shear forces need to be applied during the dispersion step to achieve the desired color properties.
THE BENEFITS OF USING ED PIGMENTS

SHORTER DISPERSION TIME BY USING ONLY A DISSOLVER

After the pre-dispersion in a dissolver the standard pigment needs to be ground in a bead mill. Depending on the pigment, the milling process can vary from several hours up to one week. With ED pigments the grinding step is eliminated. The desired color properties can be achieved in approximately 30 minutes by using the dissolver step only.

POSSIBLE CO-DISPERSING OF EDS PIGMENTS WITH INORGANIC PIGMENTS

In general, ED pigments can be combined in a mill base formulation or co-dispersed with inorganic pigments to achieve a specific shade. The simplified process reduces the manufacturing costs, improves productivity and offers lower cost options for high performance coatings. Examples of formulations for RAL, safety colors and lead replacement by co-dispersing EDS pigments with inorganic pigments are given in Figure 7.
BENEFITS IN PRODUCTION

EXAMPLE FROM A SOLVENT PIGMENT PREPARATION

In a production trial using Pigment Red 254-EDS to make a solvent based pigment preparation we could show that primary production costs as well as secondary production costs can be reduced significantly in comparison to the standard bead mill process (cf. Figure 8).

Figure 7: Formulations for RAL, Safety colors and lead free replacement are possible

Scale up of a solvent based pigment dispersion using: Pigment Red 254-EDS (1 ton)

<table>
<thead>
<tr>
<th>Standard pigments</th>
<th>ED pigments</th>
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<tbody>
<tr>
<td>20 min Dissolver</td>
<td>30 min Dissolver only</td>
</tr>
<tr>
<td>more than 24hrs. Bead mill</td>
<td>No bead mill</td>
</tr>
<tr>
<td>Total energy cost</td>
<td>6% Total energy cost compare to standard</td>
</tr>
<tr>
<td>Cleaning time</td>
<td>13% Cleaning time compare to standard</td>
</tr>
</tbody>
</table>

Figure 8: Production trial using Pigment Red 254-EDS
From all data obtained we could estimate the cost saving potential when implementing ED pigment in production (cf. Figure 9). By avoiding the use of the bead mill, conversion cost could be reduced up to 30%. Furthermore, it is well known that the bead mill step consumes large amount of energy (kW) and requires long cleaning processes leading to substantial quantities of waste water. By using the ED pigments, these expensive energy consuming processes are dramatically reduced or can be completely eliminated. Finally, the strongly reduced energy consumption during the pigment dispersion step leads to a positive contribution to the carbon foot print of the pant manufacturing chain.

![Figure 9: Benefits of ED pigments on production scale](image)

**SUMMARY**

ED Pigments offer the following advantages:
- shorter processing time for the dispersion,
- higher production capacity without further investment,
- reduced energy consumption,
- positive contribution to the carbon foot print of the paint manufacturing chain.