ROPAQUE™ ULTRA-E Opaque Polymer
For Formulation Cost Savings and Improved Coating Performance

Regional Product Availability

Asia-Pacific

Description

ROPAQUE™ ULTRA-E Opaque Polymer is an advanced polymeric opacifier engineered to improve the efficiency of TiO₂. It offers paint application and performance improvements, lowers the consumption of TiO₂ and reduces the cost of all types of water based paints.

In addition to offering efficient dry-hiding properties, ROPAQUE ULTRA-E Opaque Polymer offers wide range benefits in interior and exterior paint formulations.

Benefits of the Product

- Offers partial replacement of TiO₂
- Lowers TiO₂ demand and formulation cost
- Improves paint application and performance properties
- Wide formulation latitude from low to high PVC paints
- APEO(1) and ammonia(2) free
- Low VOC
- Lower carbon footprint compared to TiO₂

Typical Properties

(These properties are typical but do not constitute specifications).

<table>
<thead>
<tr>
<th>Property</th>
<th>Typical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Opaque, white to off-white liquid</td>
</tr>
<tr>
<td>Solids, by weight, %</td>
<td>30.0</td>
</tr>
<tr>
<td>Solids, by volume, %</td>
<td>52.1</td>
</tr>
<tr>
<td>Density (g/ml), wet</td>
<td>1.025</td>
</tr>
<tr>
<td>Density (g/ml), dry</td>
<td>0.591</td>
</tr>
<tr>
<td>pH</td>
<td>8.4</td>
</tr>
<tr>
<td>Average particle size, µm</td>
<td>0.4</td>
</tr>
<tr>
<td>Void fraction, %</td>
<td>44</td>
</tr>
<tr>
<td>Viscosity (Brookfield LV #2, 60 rpm), cps</td>
<td>&lt; 350 cps</td>
</tr>
<tr>
<td>Storage precautions</td>
<td>Protect from freezing</td>
</tr>
</tbody>
</table>

(1) Manufactured without the use of Alkyl Phenyl Ethoxylate surfactants.
(2) Manufactured without the use of aqueous ammonia
Formulations

Introduction

ROPAQUE™ Opaque Polymers are non-film-forming, emulsion polymers, containing a water filled void. During the drying process of the paint, the water in the void diffuses through the polymer shell and leaves an air void. Due to the difference in refractive index between air and the surrounding polymer, light is effectively scattered, contributing to film opacity.

ROPAQUE Opaque Polymers have a narrow particle size distribution and are similar in size to TiO₂ particles. This allows them to act like ultra fine inorganic extenders, spacing TiO₂ effectively and therefore increasing its efficiency as a primary pigment.

Compared to inorganic small particle size pigment extenders, ROPAQUE Opaque Polymers have a very low specific surface area due to their uniform, spherical shape and non-porous surface. The binder demand of ROPAQUE Opaque Polymer is therefore significantly lower, giving the possibility of formulating at higher pigment volume concentrations.

The combined effect of these three product features can be used by paint formulators to either reduce paint cost without negative effect on paint performance, or alternatively, improve paint performance without increasing costs.

Light scattering theory shows that the two parameters most impacting the hiding efficiency are the particle size of the hollow spheres and the void fraction. The optimum light scattering efficiency is obtained at a particle diameter of roughly 0.40 µm. The innovative process used to manufacture ROPAQUE ULTRA-E Opaque Polymer enables an optimum particle size (0.38 µm) with a maximised void fraction of 44%.

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![Diagram of ROPAQUE Opaque Polymer structure](image)

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**Chart showing particle size distribution**

- CaCO₃ (20 micr.)
- Talc (20 micr.)
- Blanc Fix (2 micr.)
- Ultrafine CaCO₃
- Clay (2.5 micr.)
- CaCO₃ (1 micr.)
- TiO₂ untreated
- TiO₂ treated

**Particle Size 0.4 µ**

**Surface in m²/cm³**

0 20 40 60 80 100 120

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ROPAQUE™ ULTRA-E Opaque Polymer / Dow Coating Materials

03/2014, Rev. 0
How to Introduce ROPAQUE™ ULTRA-E Opaque Polymer in your Paint Formulation

ROPAQUE™ ULTRA-E Opaque Polymer offers the possibility of increasing your savings. This means some reformulation work, but is definitely worth the effort: We recommend taking advantage of our computer reformulation support to introduce ROPAQUE ULTRA-E Opaque Polymer. Please contact our Sales Representative to obtain this support. The guidelines to reduce costs in the tables on the following pages will help to develop starting point reformulations, but are unlikely to fully optimize paints.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>TiO₂</td>
<td>Reduce TiO₂ by 15–30% of its initial PVC</td>
</tr>
<tr>
<td>ROPAQUE™ ULTRA-E Opaque Polymer</td>
<td>Introduce ROPAQUE ULTRA-E Opaque Polymer 3–4 times the PVC of TiO₂ removed</td>
</tr>
<tr>
<td>Extenders</td>
<td>Adjust extenders so that total PVC is 4–6 PVC higher than the original paint. Generally reduce fine extenders and adjust total PVC with the large extenders</td>
</tr>
<tr>
<td>Dispersant</td>
<td>Adjust dispersant level keeping it constant on total pigment and extenders</td>
</tr>
<tr>
<td>Coalescent</td>
<td>Adjust coalescent level keeping it constant on binder and ROPAQUE ULTRA-E Opaque Polymer solids</td>
</tr>
<tr>
<td>Other ingredients</td>
<td>All other ingredients should remain constant per liter of paint. The volume solids is constant</td>
</tr>
</tbody>
</table>

The resulting formulation could require fine tuning, for which we recommend the following guidelines.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloss and sheen increase</td>
<td>Adjust large/fine extenders ratio decreasing the fine extenders</td>
</tr>
<tr>
<td>Wet hiding decrease</td>
<td>Adjust TiO₂ / ROPAQUE™ ULTRA-E Opaque Polymer ratio, increasing the amount of TiO₂</td>
</tr>
<tr>
<td>Dry hiding adjustment</td>
<td>Adjust TiO₂ / ROPAQUE ULTRA-E Opaque Polymer ratio and play on extenders package</td>
</tr>
<tr>
<td>Scrub resistance decrease</td>
<td>Limit total PVC increase to 3%</td>
</tr>
</tbody>
</table>

Example of a ROPAQUE™ ULTRA-E Opaque Polymer Reformulation

The objective here is to obtain the same overall performance and to lower the total formulation cost. The reformulation below has been done on an exterior house paint formulation based on a 100% acrylic binder: PRIMAL™ SG-380 Acrylic Emulsion.

<table>
<thead>
<tr>
<th>Without OP</th>
<th>ROPAQUE Ultra E Opaque Polymer</th>
</tr>
</thead>
<tbody>
<tr>
<td>TiO₂ PVC</td>
<td>20.0</td>
</tr>
<tr>
<td>Micro Mica PVC</td>
<td>12.0</td>
</tr>
<tr>
<td>ROPAQUE™ ULTRA-E PVC</td>
<td>0.0</td>
</tr>
<tr>
<td>Total PVC</td>
<td>32.0</td>
</tr>
<tr>
<td>Total VS</td>
<td>35.0</td>
</tr>
</tbody>
</table>

**Tint Strength**

| Blue            | 33.6           | 34.0           |
| Yellow          | 63.9           | 64.7           |
| Grey            | 36.4           | 37.4           |
| Gloss 20°       | 5.4            | 5.4            |
| Gloss 60°       | 34.6           | 33.7           |
| Gloss 80°       | 79.1           | 78.7           |

This reformulation leads to a cost reduction of about 5% while maintaining other paint performance.
Example of a ROPAQUE™ ULTRA-E Opaque Polymer Reformulation (Continued)

ROPAQUE™ ULTRA-E Opaque Polymer Characteristics

The introduction of ROPAQUE™ ULTRA-E Opaque Polymer into existing formulations to reduce costs requires changes in most other formulation ingredients. We recommend taking advantage of our computer reformulation support to introduce ROPAQUE ULTRA-E Opaque Polymer into existing formulations with the objective of reducing costs. Please contact our Sales Representatives to obtain this support.

Consistent Product Quality

Dow’s long experience with opaque polymer technology has enabled the development of robust production processes leading to consistent product quality. The particle size distribution for instance is key, and a narrow distribution leads to maximum light scattering efficiency.

To maintain the unique performance features of ROPAQUE™ ULTRA-E Opaque Polymer in paint formulations, Dow has established a sophisticated quality management system which minimizes variation in the production process and seeks continuous improvement in the system. The use of global Quality Control Systems (QCS), Statistical Quality Control (SQC), and Product and Process Quality Measurement (PPQM) ensures the consistency of ROPAQUE ULTRA-E Opaque Polymer’s quality and performance, no matter where or when it is produced in our global operations.

Exterior Applications

Over the years, DOW scientists have compiled extensive data from DOW exposure sites confirming the benefits of using ROPAQUE™ Opaque Polymer in exterior coatings. In particular improved resistance to dirt pick up, reduction of mould and algae growth and superior color retention are the main benefits observed on numerous wood or masonry exterior coatings containing ROPAQUE Opaque Polymer.
**Interior Applications**

The lower levels of TiO$_2$ and extender in paints containing ROPAQUE™ Opaque Polymer provide less loose particles available to abrade the paint film. The lower binder demand of ROPAQUE ULTRA-E Opaque Polymer vs. TiO$_2$ particles also leads to enhanced mechanical properties including scrub resistance. The overall effect improves washability.

**Interactions with Other Paint Ingredients**

The hiding properties of ROPAQUE ULTRA-E Opaque Polymer depend on the integrity of the hollow sphere in the paint film. All ROPAQUE Opaque Polymers can be affected by solvents, white spirit and plasticizers.

As with all ROPAQUE Opaque Polymer products, except with the new ROPAQUE DUAL Opaque Polymer that offers resistance to solvents, avoid using white spirits and plasticizing solvents. The aromatic contents of white spirits and many monomeric plasticizers have similar solubility parameters as ROPAQUE ULTRA-E Opaque Polymer. This can soften the polymer shell and cause the collapse of the spheres during film formation.
Handling Precautions
Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

Storage
Store products in tightly closed original containers at temperatures recommended on the product label.

Disposal
Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user’s responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Dow Coating Materials Technical Representative for more information.

Chemical Registration
Many countries within the Asia-Pacific require the registration of chemicals, either imported or produced locally, prior to their commercial use. Violation of these regulations may lead to substantial penalties imposed upon the user, the importer or manufacturer, and/or cessation of supply. It is in your interests to ensure that all chemicals used by you are registered. Dow does not supply unregistered products unless permitted under limited sampling procedures as a precursor to registration.

Note on Asia-Pacific Product Line
Product availability and grades vary throughout the countries in Asia-Pacific. Please contact your local Dow Coating Materials representative for further information and samples.

Product Stewardship
Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products - from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer Notice
Dow strongly encourages its customers to review both their manufacturing processes and their applications of Dow products from the standpoint of human health and environmental quality to ensure that Dow products are not used in ways for which they are not intended or tested. Dow personnel are available to answer your questions and to provide reasonable technical support. Dow product literature, including safety data sheets, should be consulted prior to use of Dow products. Current safety data sheets are available from Dow.

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