Evonik Additives for Unsaturated Polyester Resins & Vinyl Ester Resins

BL Interface & Performance
Technical Service – Polymers
Applications of UPES

**Reinforced Composite Types**
- Automotive engineering
- Molded parts
- Tanks, tubes
- Casing, reinforced coating

**Non-reinforced Types**
- Isolation
- Cast plaster floor
- Artificial marble
- Clear casting for buttons and buckles

1. e.g. with glass fibre (GF)

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[Image of boat and ship building]

[Image of automotive engineering]

[Image of isolated objects]

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November 2019 | Unsaturated Polyester Resins & Vinyl Ester Resins Additives from Evonik
## Additives for Deaeration, Enhanced Filler Loading and Scratch Prevention

<table>
<thead>
<tr>
<th>Deaeration</th>
<th>Filler Loading</th>
<th>Scratch Resistance (UPES/ATH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>no additive (VE-Resin)</td>
<td>competitor deaerator (3)</td>
<td>no additive: $\Delta L = 4.5$</td>
</tr>
<tr>
<td>competitor dispersant (1) dull surface</td>
<td>TEGO® Antifoam D 2340</td>
<td>GMW 14688 with 10N</td>
</tr>
<tr>
<td>TEGOPREN® 6875</td>
<td></td>
<td>0.4% TEGOMER® M-Si 2650: $\Delta L = 0.3$</td>
</tr>
</tbody>
</table>
### Raw Materials used for the Evaluation of Evonik Additives

<table>
<thead>
<tr>
<th>Name in this presentation</th>
<th>Resin</th>
<th>Viscosity</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>VE Resin</td>
<td>Vinylester Epoxy bisphenol A vinyl ester</td>
<td>~ 500 mPas</td>
<td>Parts of high chemical resistance</td>
</tr>
<tr>
<td>OA Resin 1</td>
<td>UPES Orthophthalic acid based</td>
<td>~ 1,000 mPas</td>
<td>Pipes, profiles, tanks, vessels, boats and parts of the automotive body</td>
</tr>
<tr>
<td>OA Resin 2</td>
<td>UPES Orthophthalic acid based</td>
<td>~ 2,000 mPas; thixotropic</td>
<td>Spray up, hands lay-up processing for boats, open storage tanks, truck roofs</td>
</tr>
<tr>
<td>OA Resin 3</td>
<td>UPES Orthophthalic acid based</td>
<td>~ 1,200 mPas</td>
<td>Centrifugal Processing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product</th>
<th>Chemistry</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Butanox LPT</td>
<td>MEKP</td>
<td>Methyl ethyl ketone peroxide</td>
</tr>
<tr>
<td>BPO</td>
<td>BPO</td>
<td>Benzoyl peroxide</td>
</tr>
<tr>
<td>Accelerator NL -49P</td>
<td>Cobalt in Styrene</td>
<td></td>
</tr>
</tbody>
</table>
TEGO® Antifoam D for Deaeration
Deaeration in the thixotropic OA Resin 2

Thickness of the plates:
~ 5 mm.

Transparency variations on the pictures are therefore irrelevant.

<table>
<thead>
<tr>
<th>No additive – air bubbles</th>
<th>0.2% Competitor Deaerator 1 craters, slightly turbid</th>
<th>0.2% TEGO® Antifoam D 2340 small amount of craters, slightly turbid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.2% TEGO® Antifoam D 2345 orange peel, slightly turbid</td>
<td>0.2% TEGO® Antifoam D 2345 orange peel, turbid</td>
</tr>
</tbody>
</table>

TEGO® Antifoam D 23XX Deaerators show a very efficient defoaming and allow the production of transparent formulations.
Deaeration in the OA Resin 3

Thickness of the plates:
~ 5 mm.

Transparency variations on the pictures are therefore irrelevant.

TEGO® Antifoam D 23XX Deaerators show a very efficient defoaming and allow the production of transparent formulations.

0.2% Competitor Deaerator 1
very turbid

0.2% Competitor Deaerator 2
turbid

No additive – air bubbles

0.2% TEGO® Antifoam D 2340
turbid

0.2% TEGO® Antifoam D 2345
slightly turbid

(Red by BPO Hardener)
Deaeration of OA Resin 3

Specimen front view

TEGO® Antifoam D 2315

0.9%, respectively

Used for non-transparent applications (turbidity)

TEGO® Antifoam D 23XX Deaerators show a very efficient defoaming of UPES resins.
Deaeration of OA Resin 3 – Transparent Applications

**TEGO® Antifoam D 2340**

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2%</td>
<td>clear</td>
</tr>
<tr>
<td>0.4%</td>
<td>clear</td>
</tr>
<tr>
<td>0.6%</td>
<td>clear</td>
</tr>
<tr>
<td>0.8%</td>
<td>turbid</td>
</tr>
</tbody>
</table>

Up to a concentration of 0.6% TEGO® Antifoam D 2340 the UPES plate (5 mm) stays clear.
Deaeration of the VE Resin

Specimen front view

VE-Resin
Deaerator 1
Deaerator 2
Deaerator 3
TEGO® Antifoam D 2315
TEGO® Antifoam D 2340
TEGO® Antifoam D 2345

0.9%, respectively
Used for non-transparent applications (turbidity)

TEGO® Antifoam D 23XX Deaerators show a very efficient defoaming of vinyl ester resins.
Deaeration of the VE Resin – Transparent Applications

Up to a concentration of 0.6 % TEGO® Antifoam D 2340 the vinyl ester plate (5 mm) stays clear.
TEGOMER® Additives for the Dispersion of Fillers
Why Using a Dispersant?

- To increase the filler loading
- To reduce the viscosity at a certain filler level
- To improve the processing of the final good
- For a better filler / resin bonding resulting in an improved scratch resistance and enhanced mechanical properties
- For a longer storage stability of filled formulations
TEGOPREN® 6875 for a higher Filler Loading

The filler content can be increased by up to 15% using 0.4% TEGOPREN® 6875.

OA-Resin 3 with TEGOPREN® 6875

- 75% Apyral 24 still glossy
- 80% Apyral 24 dull surface
- 85% Apyral 24 lumps
### TEGOPREN® 6875 for a higher Filler Loading

<table>
<thead>
<tr>
<th>Formulation</th>
<th>24.32 g Resin</th>
<th>0.37 g Additive (active)</th>
<th>0.24 g Butanox LPT-IN (MEKP in Diisononyl phthalate)</th>
<th>0.07 g Accelerator NL-49P</th>
<th>75.00 g Filler (ATH)</th>
</tr>
</thead>
</table>

- **Apyral 24 (ATH) in OA Resin 3 / 0.5% additive (active) on filler / 75% filler**
  - No additive lumps
  - Competitor dispersant 1 dull surface
  - Competitor dispersant 2 dull, dry
  - **TEGOPREN® 6875** glossy

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TEGOMER® for Scrach Resistance
Additive Recommendation for Enhanced Scratch Resistance

<table>
<thead>
<tr>
<th>Formulation</th>
<th>35.00 g Resin</th>
<th>0.33 g Additive (active) (\triangleq 0.5%) active on filler</th>
<th>0.24 g Butanox LPT-IN (MEKP in Diisononyl phthalate)</th>
<th>0.11 g Accelerator NL-49P</th>
<th>65.00 g Filler (ATH)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UPES / ATH surface without additive</strong></td>
<td>Delta L = 4.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UPES / ATH surface with 0.4% Tegomer® M-Si 2650</strong></td>
<td>Delta L = 0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GMW 14688 with 10N</strong></td>
<td></td>
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</tbody>
</table>

TEGOMER® additives improve the scratch resistance significantly.

**UPES / ATH surface without additive**
Delta L = 4.5

**UPES / ATH surface with 0.4% Tegomer® M-Si 2650**
Delta L = 0.3

**GMW 14688 with 10N**
Enhances Scratch Resistance of OA Resin 3 with ATH

Improved Scratch Resistance is achieved with just 0.5% TEGOMER® on filler.
Enhances Scratch Resistance of OA Resin 1 with ATH

OA Resin 1 + ATH (Apyral 24) + 0.5 % additive (active on filler)

Improved Scratch Resistance is achieved with just 0.5% TEGOMER® on filler.
Scratch Resistance and Levelling of Clear Formulations

Vinyl Ester Resin

- No additive
- TEGOPREN® 5895
- Dispersant 1
- Dispersant 2

Orthophtalic Acid based Resin (OA 3)

- No additive
- TEGOMER® DA 646
- Dispersant 1
- Dispersant 2
Summary – Additives for Deaeration, Enhanced Filler Loading and Scratch Prevention

Deaeration

Without Additive

TEGO® Antifoam D 2340

Filler Loading

Without Additive

TEGOPREN® 6875

Scratch Resistance

UPES/ATH without Additive: Δ L = 4.5

UPES/ATH with TEGOMER® M-Si 2650: Δ L = 0.3

Our technical service will be happy to support you with your personal needs.