New Rheological Additive for 2K Waterborne Epoxies

CTT 2019, Chicago
Wes Huff
Sr Technical Sales Representative
Summary of today's discussion

- Rheological additives for epoxies
- Some of the challenges
- New polyamide additive for water-borne epoxies
  - chemistry
  - its heritage
- How the new polyamide compares to other technologies
  - Incorporation
  - Stability
  - Sag resistance
  - Activation temp
Rheology Additives available for Epoxies

- HCO & Derivates
- Amid-Waxes
- Organoclays
- Polyurea
- Polyamid
- Hydroclays
- Synthetic Clays
- Polyurea
- Synthetic Clays
- Assoc. Thickener
Incorporation Rheology Additives
Water-borne Coatings

- Polyurea
- Assoc. Thickeners
- Synth. Clays
- Hydroclays
Incorporation Rheology Additives
Water-borne Coatings

- Polyurea
- Assoc. Thickener
- Synth. Clays
- Hydroclays

Incorporation Time vs Sag Resistance
Incompatible

Increase in viscosity over storage time

High KU-viscosity, but low sag resistance
New Polyaide for water - Chemistry

Liquid, polyamide-based rheology additive for water-borne systems

Polyamide backbone → Hydrogen bonds for rheological effect
Compatibility providing unit (EO, PO, Alkyl-chains)
Rheology enhancing group
Completing the Family of Liquid Polyamides

Polyamide for solvent

Polyamide for solvent

New Polyamide for water-borne

Polyamide backbone → Hydrogen bonds for rheological effect
 Compatibility providing unit (EO, PO, Alkyl-chains)
 Rheology enhancing group
 Urea unit

urea-modified, medium polarity
modified, high polarity
modified, high polarity
New liquid polyamide in water-borne epoxies
Incorporation: Point, Time and Shear Forces

Test method:
WB 2-pack Epoxy

Dosage liquid polyamide:
4% as supplied

<table>
<thead>
<tr>
<th>Sag resistance</th>
<th>Post addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 µm</td>
<td>10 min. 10 m/s</td>
</tr>
<tr>
<td></td>
<td>5 min. 10 m/s</td>
</tr>
<tr>
<td></td>
<td>5 min. 7 m/s</td>
</tr>
<tr>
<td>450 µm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 min. 3 m/s</td>
</tr>
<tr>
<td>350 µm</td>
<td>5 min. 3 m/s</td>
</tr>
</tbody>
</table>

→ Liquid polyamide – Post addition recommended

NO TEMPERATURE ACTIVATION
Rheology
Pseudoplastic Flow

Pseudoplastic liquids show a **shear thinning effect**. The viscosity is dependent on the shear rate. The higher the shear rate is, the lower the viscosity appears.

\[
\eta = f(D)
\]

(shear thinning effect)
Thixotropic liquids show a **shear thinning effect and a time depending recovery effect**. The viscosity is depending on the shear rate. The shear thinning is faster than the recovery of the initial viscosity. This time difference is called thixotropy. The higher the thixotropy the longer the recovery time is.
Viscometry
Equipment Selection

- **Application**
- **Production**
- **Storage**
- **Sagging**
- **Leveling**
- **Settling**

Viscosity $\eta$ [Pa·s]

- 0.001
- 0.01
- 0.1
- 1
- 10
- 100
- 1'000
- 10'000

Shear rate $D$ [1/s]

- **Low shear**
- **Medium shear**
- **High shear**

- **Rotational viscometer**
- **Brookfield**
- **Krebs-Stormer**
- **ICI cone/plate**

- Storage
- Transportation
- Production
- Application
- Leveling
- Sagging
- Settling
- Can viscosity under stirring

- Low shear
- Medium shear
- High shear

- Rotational viscometer
- Brookfield
- Krebs-Stormer
- ICI cone/plate
**Test System**
WB 2-pack Epoxy:

**Additive Dosage**
0.5% active substance on component A

**Viscosity measurement**
Oscillation:
γ = 1%
\( f = 1 \text{Hz} \)
Rotation:
\( \gamma = 1000 \text{ 1/s} \)

**Anton Paar Rheometer MCR 302**

**New Liquid Polyamide in Water-borne Epoxies**
3-Interval Thixothropy Test (Osc.Rot.Osc.)

Higher viscosity, but...
→ More viscous than elastic parts = **Less sag resistance**

Storage modulus higher than loss modulus after deformation, means...
→ More elastic than viscous parts = **High sag resistance**
New liquid polyamide in Water-borne Epoxies
High Sag Resistance

Test method:
WB 2-pack Epoxy

Sag resistance:
after mixing A and B

<table>
<thead>
<tr>
<th>[µm]</th>
<th>Control</th>
<th>Associative Thickener 0.5% active substance*</th>
<th>Liquid polyamide 0.5% active substance*</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>![Control](100 µm)</td>
<td>![Associative Thickener](200 µm)</td>
<td>![Liquid polyamide](≥ 500 µm)</td>
</tr>
<tr>
<td>100</td>
<td>![Control](100 µm)</td>
<td>![Associative Thickener](200 µm)</td>
<td>![Liquid polyamide](≥ 500 µm)</td>
</tr>
<tr>
<td>150</td>
<td>![Control](100 µm)</td>
<td>![Associative Thickener](200 µm)</td>
<td>![Liquid polyamide](≥ 500 µm)</td>
</tr>
<tr>
<td>200</td>
<td>![Control](100 µm)</td>
<td>![Associative Thickener](200 µm)</td>
<td>![Liquid polyamide](≥ 500 µm)</td>
</tr>
<tr>
<td>250</td>
<td>![Control](100 µm)</td>
<td>![Associative Thickener](200 µm)</td>
<td>![Liquid polyamide](≥ 500 µm)</td>
</tr>
<tr>
<td>300</td>
<td>![Control](100 µm)</td>
<td>![Associative Thickener](200 µm)</td>
<td>![Liquid polyamide](≥ 500 µm)</td>
</tr>
<tr>
<td>350</td>
<td>![Control](100 µm)</td>
<td>![Associative Thickener](200 µm)</td>
<td>![Liquid polyamide](≥ 500 µm)</td>
</tr>
<tr>
<td>400</td>
<td>![Control](100 µm)</td>
<td>![Associative Thickener](200 µm)</td>
<td>![Liquid polyamide](≥ 500 µm)</td>
</tr>
<tr>
<td>450</td>
<td>![Control](100 µm)</td>
<td>![Associative Thickener](200 µm)</td>
<td>![Liquid polyamide](≥ 500 µm)</td>
</tr>
<tr>
<td>500</td>
<td>![Control](100 µm)</td>
<td>![Associative Thickener](200 µm)</td>
<td>![Liquid polyamide](≥ 500 µm)</td>
</tr>
</tbody>
</table>

* = 3% as supplied on total formulation
* = 2% as supplied on total formulation

→ New liquid polyamide – Fast structure recovery – perfect sag resistance
New liquid polyamide in Water-borne Epoxies
Perfect anti sagging – Perfect anti settling

Test method:
WB 2-pack Epoxy

Viscosity:
measurement with amine hardener

→ Liquid polyamide – Fast structure recovery – pseudo plastic! behaviour

Thixotropic Additive*

Liquid Polyamide
— Up-curve
--- Down-curve

* No storage stability 40°C - 14 days
New liquid polyamide in Water-borne 2P Epoxies
Optimized Flow Behaviour

Test method:
WB 2-pack Epoxy

CSR measurement:
Anton Paar Rheometer MCR 302

Liquid Polyamide
– Highly shear thinning & stable rheology with hardener

* = 2.6% as supplied on total formulation

* = 1.6% as supplied on total formulation
New liquid polyamide in water-borne epoxies
Post Added in Amine Formulation

Test method:
WB 2-pack Epoxy

CSR measurement:
Anton Paar Rheometer MCR 302

Sag resistance:
directly after mixing
A and B

* as supplied on total formulation

→ Liquid Polyamide – Post added in amine grind formulation
New liquid polyamide in Water-borne Epoxies
No Negative Influence on Salt Spray Resistance and Adhesion

Corrosion tests in artificial atmospheres – Salt spray tests (ISO 9227:2006)

Test formulation:
WB 2-pack Epoxy

Substrate: smooth steel
DFT: 80 µm
Drying: 7 d ambient
Duration: 360 h

→ Liquid Polyamide – No negative impact on corrosion
**New liquid polyamide - General Industry**

**Excellent Anti-Settling Properties**

**Test Method**

**Test System:**
2-pack Acrylic Metallic Topcoat
STAPA® IL HYDROLAN 2154

**Additive Dosage:**
0.1% active substance on total formulation

1. Control
2. Synthetic clay
3. Polyurea
4. New Polyamide for Water

→ **Liquid Polyamide** – Perfect anti settling properties
**New liquid polyamide**

Results Transportation Coatings

**System:**
Acrylic Copo. Disp. Plus
Hydrolan IL 2156

**Film thickness:**
10 µm

**Flop Value Results – OEM Basecoat – ESTA Spray Application**

11.3 12.1 14.2 14.5 11.1 12.1

1-wax, 2-wax+syn clay, 3-polyamide, 4-polyamide+syn clay, 5-comp, 6-comp+syn clay

→ **Liquid Polyamide – Perfect metallic pigment orientation**
New liquid polyamide
Special – Extraordinary – Unique

Especially designed for the latest water-borne epoxy systems

- Improves anti-sagging and anti-settling properties.
- Provides fast structure recovery. Highly shear thinning.
- Stable rheology when mixed when hardener.
- No gelling or viscosity increase over storage.

Easy to handle and to incorporate

- Pre-activated, liquid product
- Post-addition
- No pH-value adjustment necessary and pH-value resistant

Final coating properties are not affected (e.g. corrosion resistance, adhesion, …)
New liquid polyamide
Not only for latest water-borne Epoxy-Technologies

Suitable Water-borne Systems e.g.
• 2-pack Epoxy
• 2-pack PUR
• Acrylate / Melamine
• 1-pack Acrylics
• 1-pack PUR
Summary

- Rheological additives for epoxies
- Some of the challenges
- New polyamide additive for water-borne epoxies and its heritage
- How the new polyamide compares to other technologies
  - Incorporation
  - Stability
  - Sag resistance
  - Activation temp
Thank you for your attention.
The information herein is based on our present knowledge and experience. The information merely describes the properties of our products but no guarantee of properties in the legal sense shall be implied. We recommend testing our products as to their suitability for your envisaged purpose prior to use. No warranties of any kind, either express or implied, including warranties of merchantability or fitness for a particular purpose, are made regarding any products mentioned herein and data or information set forth, or that such products, data or information may be used without infringing intellectual property rights of third parties. We reserve the right to make any changes according to technological progress or further developments.