Additives influencing Coatings Properties

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Common Defects in Coatings

- Poor flow and leveling
- Insufficient substrate wetting
- Foam stabilization / Popping
- Overspray acceptance
- Recoat ability (On-line Repair)
- Craters

→ Related to surface tension
Substrate Wetting: Impact of Surface Tension

Good substrate wetting:

\[ \sigma_{\text{paint}} < \sigma_{\text{substrate}} \]

0.1% BYK-333  no additive
Craters

Paint (30 mN)

Particle/
Droplet/
Dirt (28 mN)

Substrate 32 mN
Surface slip

higher content of dimethylgroups = higher surface slip
Leveling: Definition
Leveling

What controls leveling?

• Rheology
• Time
• Surface tension

How to improve leveling?

• Deflocculating wetting & dispersing additives (rheology in pigmented systems)
• Solvents (time)
• Resins
• Additives
Influence of rheology modifier on the Wave Scan Values

![Graph showing the effect of rheology modifiers on wave scan values](image)

- **Without rheology agent**
- **+ 0.5% Rheology modifier**
- **+ 1.0% Rheology modifier**

**Wave Scan Values**
- **du dullness**
- Wa 0.1-0.3mm
- Wb 0.3-1.0mm
- Wc 1-3mm
- Wd 3-10mm
- We 10-30mm
Silicones: Recommended Areas of Usage

For improvement of
Substrate wetting
Surface slip
Crater resistance
Adjustment of flow and leveling

..........................different types of silicones are required
Silicones: Adjustment of Surface Tension Reduction

- Polyether (EO / PO)
- Aralkyl
- Polyester
- reactive
  - Acrylic
  - COOH
  - OH

<table>
<thead>
<tr>
<th>Alkyl</th>
<th>mN/m</th>
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</thead>
<tbody>
<tr>
<td>CH₃</td>
<td>21</td>
</tr>
<tr>
<td>CH₂CH₃</td>
<td>26</td>
</tr>
<tr>
<td>(CH₂)₉CH₃</td>
<td>32</td>
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Influence of organic modified siloxanes on the surface tension

<table>
<thead>
<tr>
<th>Dosage</th>
<th>mN/m</th>
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</thead>
<tbody>
<tr>
<td>BYK-300</td>
<td>30</td>
</tr>
<tr>
<td>BYK-315</td>
<td>29.2</td>
</tr>
<tr>
<td>BYK-331</td>
<td>28.2</td>
</tr>
<tr>
<td>BYK-300</td>
<td>26</td>
</tr>
<tr>
<td>BYK-310</td>
<td>25</td>
</tr>
<tr>
<td>BYK-378</td>
<td>25</td>
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</tbody>
</table>

Flow/Levelling
Substrate wetting/Surface slip
Anti Cratering/Surface slip
Acrylates: Orientation by Controlled Incompatibility

optimal  too incompatible  too compatible
Chemistry of Acrylates

\[
R^1_\text{C} \quad CH_2 \quad C = O \quad C = O \quad R^2
\]

- \(R^1\) = - H (Acrylate)
  - CH\(_3\) (Methacrylate)
- \(R^2\) = - Alkyl
  - Polyester
  - Polyether
  - Salt
“Standard” Silicone Additives vs. Silicone Macromer modified Acrylates

„Standard“ Silicone

- Modified silicone additive
- Silicone content: 30-60%
- Branched or linear modification

Silicone Macromers

- Silicone modified acrylate
- Silicone content: 2-15%
- Single or multi modification with Silicone Macromers
Silicon modified acrylates
No Ghosting Effect when Recoated

Measurement of the surface energy of the dried film by contact angle

Wiped with isopropanol

Active Silicone

BYK-3550

<table>
<thead>
<tr>
<th></th>
<th>Measurement 1</th>
<th>Measurement 2</th>
<th>Measurement 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiped</td>
<td>27,7 mN/m</td>
<td>27,6 mN/m</td>
<td>27,4 mN/m</td>
</tr>
<tr>
<td>BYK-3550</td>
<td>25,8 mN/m</td>
<td>25,8 mN/m</td>
<td>25,8 mN/m</td>
</tr>
<tr>
<td></td>
<td>27,4 mN/m</td>
<td>27,4 mN/m</td>
<td>27,4 mN/m</td>
</tr>
</tbody>
</table>

Measurement performed on samples wiped with isopropanol.
Excellent Adhesion of Wrap Guard Foils

Low influence onto surface energy of the paint results in a better adhesion of wrap guard foil and adhesives

Source: Sabine Nollmann, kontexta
Influence of the additive dosage onto the leveling

bell-application of a 1K-OEM-clear coat, horizontal dried,
dosage: % active substance on total formulation
Influence of the additive dosage onto the leveling

bell-application of a 1K-OEM-clear coat, horizontal dried,
dosage: % active substance on total formulation
Influence of the additive dosage onto the leveling

bell-application of a 1K-OEM-clear coat, horizontal dried, dosage: % active substance on total formulation
Influence of additive combination onto the leveling

Silicone & Acrylate in combination

- 0.10% less active silicone
- 0.1% less active silicone + 0.25% Acrylate
- 0.05% very active silicone
- 0.05% very active silicone + 0.25% Acrylate

bell-application of a 1K-OEM-clear coat, horizontal dried, dosage: % active substance on total formulation
Measurement of the surface tension by ring method

![Graph showing the measurement of surface tension by ring method for different substances. The x-axis represents the percentage of active substance on the total formulation, while the y-axis represents the mN/m. The graph includes lines for less active silicone, very active silicone, silicone mod. acrylate, and acrylate. The 1K-OEM-clear coat is used as the formulation.](image)
Measurement of the surface slip

1K-OEM-clear coat

Measurement of the force which is needed to push a 500 g weight over the coating layer

Newton

% active substance on total formulation

- less active silicone
- very active silicone
- silicone mod. acrylate
- acrylate

1K-OEM-clear coat

Measurement of the force which is needed to push a 500 g weight over the coating layer
Summary:

• Surface additives are useful to adjust leveling.

• It is necessary to find the optimum between leveling and substrate wetting/anti crater properties.

• Various additives provide different effects.

• Combinations of additives are necessary for the optimal performance.
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