High Performance substrate wetting agents

*Dow Corning®* brand Superwetter Family
Agenda

- Description of “wetting” technology
- Megatrends and customer needs driving growth of superwetters
- The superwetter family approach
- Application data
- Summary
- Marketing launch information
Wetting Definition

**WETTING**
The degree to which the liquid coating flows out over the substrate surface uniformly and rapidly.
To achieve good wetting, the coating must have the same or lower surface tension than the substrate.

Surfactants alleviate cratering by lowering the surface tension of the coating.

Liquids flow from areas of low $\gamma$ to areas of high $\gamma$ (Marangoni flow).
Superwetter Mechanism

- Conditions at the liquid/surface interface also have to be considered

- At the liquid/surface interface, the lower the contact angle, the better the spreading
- Wetting agents work by reducing the surface tension of the liquid
- Speed of migration to surface is essential; also dependent on MWt and solubility in the coating solution (balance)
Megatrends

- Waterborne Coatings & Inks
- UV Coatings & Inks
- Sustainable Environment: Lower Weighted Plastic
- For Multiple Formulations
- Time-Chaser: High-Speed Applications*

- Greener Wood Materials
- Dow Corning® 67 Additive
- Dow Corning® 500W Additive
- Dow Corning® 501W Additive
- Dow Corning® 502W Additive

- Reduced Inventory Cost
- Fashion of ‘Natural Look’ for Wood Furniture
- Food Safety**
- Low VOCs
- Low/Reduced Unwanted Solvents

* Dow Corning® 502W Additive.
** Dow Corning® 67 Additive and Dow Corning® 501W Additive. Please seek guidance from your Dow Corning representative regarding up-to-date regulatory profiles.
Current Market Offerings

MARKET TECHNOLOGIES

- Silicone polyether copolymers (varying in molecular weight and architecture)
- Gemini silicone surfactants
- Acetylenic diols
- Fluoro-surfactants
A New Solution for Superwetters

DOW CORNING® 67 ADDITIVE

• A single product (Dow Corning® 67 Additive) may not meet all the diverse needs of the market for superwetters

NEW SERIES OF SUPERWETTERS

• A series of superwetters launched as a total solution package
  – Provides wider options to optimize the formulations
  – Time efficiency: Increase the chances of a formulator solving his or her problem in a rapid manner
  – Providing more detailed test results about products may facilitate a more simple choice by formulators
  – No-VOC solutions allow formulators to better control their formulations without unwanted solvents
# Features and Benefits

<table>
<thead>
<tr>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compatible with modern formulations</td>
<td>Can be used in both waterborne and radiation-cured (solventless and waterborne) formulations</td>
</tr>
<tr>
<td>Imparts good spreading and wetting in various applications <em>consistently</em></td>
<td>Small range of superwetters works across a broad range of formulas</td>
</tr>
<tr>
<td>Imparts wetting capability, even over oily substrates</td>
<td>Potential for easier application for customers with difficult substrates with leftover residue</td>
</tr>
<tr>
<td>Highly effective at low concentrations in the total formulation</td>
<td>Good cost-in-use vs. competition</td>
</tr>
<tr>
<td>Improve coating/printing and high-speed productivity</td>
<td>Ability to wet out very quickly – suitable for high-speed printing applications for greater productivity</td>
</tr>
<tr>
<td>Adds zero VOC</td>
<td>Meets modern regulations</td>
</tr>
<tr>
<td>Benzene/Toluene/Xylene (BTX)-free</td>
<td>Mitigates environmental concerns in formulations</td>
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</table>
Silicone Polyether Chemistry

INFLUENCES ON PERFORMANCE

- Molecular weight
- Hydrophilic-lipophilic balance
- End-capping
Product Profile

- A family of low-viscosity and low-MWt silicone polyethers
- These easy-to-incorporate additives give low surface tension to achieve good wetting, even on low-energy substrates
- Varying architectures with different end-capping functionalities and degrees of hydrophilicity allow for different reactivity and compatibility in different formulations

*HLB-EO = hydrophilic - lipophilic balance = %EO/5

<table>
<thead>
<tr>
<th>Products</th>
<th>Silicone Polyether Copolymer (%)</th>
<th>Viscosity (cst)</th>
<th>HLB-EO*</th>
<th>End Cap</th>
<th>Surface Tension (aqueous 0.1 % solution)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow Corning® 67 Additive</td>
<td>100</td>
<td>31-51</td>
<td>11.5</td>
<td>OH</td>
<td>21.0</td>
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<tr>
<td>Dow Corning® 500W Additive</td>
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<td>25.5-29.5</td>
<td>10.7</td>
<td>OAc</td>
<td>22.0</td>
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<tr>
<td>Dow Corning® 501W Additive</td>
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<td>10-30</td>
<td>10.6</td>
<td>OMe</td>
<td>20.5</td>
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<td>49-75</td>
<td>13.2</td>
<td>OH</td>
<td>22.4</td>
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Performance in Waterborne Wood Coatings

**PERFORMANCE IN A POLYURETHANE DISPERSION (PUD)-BASED FLOORING COATING**

- Surface appearance, coefficient of friction (COF) and wetting performance at 0.2 wt% addition levels in an aromatic (anionic) urethane acrylic copolymer dispersion for use in parquet and wood lacquers.

**PERFORMANCE IN AN ACRYLIC-BASED EXTERIOR JOINERY/TRIM COATING**

- Surface appearance, coefficient of friction and wetting performance at 0.2 wt% addition levels in a self-crosslinking acrylic polymer emulsion for industrial (exterior) wood coatings.

Consistent, good wetting performance in a range of formulations, with little or no impact on slip, for all four products.
Performance in Waterborne PUD Coating

No additive

With Dow Corning® 67 Additive 0.2% by weight

Improved wetting performance in a waterborne PUD coating with Dow Corning® 67 Additive
Performance Versus Fluoro-Surfactants

Performance in a polyurethane dispersion (PUD)-based flooring coating

Surface appearance (wetting/leveling) of Dow Corning® superwetters versus fluoro-surfactants in waterborne wood parquet coatings; comparison is made at 0.1 and 0.2% by weight in the total formulation

- A higher addition level of the Dow Corning® superwetters is required to give the same performance as the fluoro-surfactants
- However, on a cost-in-use basis, they can be competitive, exemplified here with both Dow Corning® 500W Additive and Dow Corning® 67 Additive
To achieve equivalent performance, acetylenic diol products must be used at approximately 4X the concentration.
Performance in Radiation-Cured Coatings

This toolbox approach allows the formulator to choose the right product for the application but also allows for a limited number of products in his or her portfolio.

Waterborne radiation-cured formulation for flexographic ink

Good wetting across a variety of substrates with little/no influence on slip properties.
Slip can be modified, if required, to lower COF with *Dow Corning®* slip additives

**Solventless radiation-cured formulation for flexographic ink**

[Graph showing wetting and dynamic COF measurements.]
Performance in Waterborne Flex Ink Over a Polyethylene (PET) Substrate

Surface appearance, coefficient of friction and wetting performance at 0.2 wt% addition levels in waterborne flexographic gravure ink

- Good performance on difficult-to-wet plastics
- No negative impact on coefficient of friction

Modify slip with *Dow Corning®* 52 Additive or *Dow Corning®* 57 Additive
Dynamic Surface Tension

- This family of wetting additives performs well at low to medium application speeds, as indicated by low DST at 1 and 5 Hz.
- At high speeds, *Dow Corning®* 502W Additive and Competitor 7 maintain their very low DST.
  - While this also is observed for Competitor 7, we will later see this is not reflected consistently in coatings formulations.

Dynamic surface tension (DST) is measured using a bubble tensiometer and effectively measures how quickly the surfactant lowers the surface tension; this is more representative of coating applications (e.g., spraying).

DST values for Dow Corning® additives versus competition as 0.2% by weight aqueous dispersions.

Note: Values for Competitor 1 are not given, as this could not be dispersed easily in water.

We help you invent the future™
**pH Stability**

- *Dow Corning® 500W Additive* also will perform in extreme-pH formulations.
- Long-term performance is achieved, even after 1 month, with *Dow Corning® 500W Additive*.
- Other additives show high ST at pH 11, indicating instability; with *Dow Corning® 500W Additive*, ST remains consistently low.
- This allows the formulator to use the additive in high-pH formulations with certainty of long-term wetting performance for the end user.

*Dynamic surface tension in pH 11 solution at 0.4 wt% addition levels after 1 month aging*
Application over oily substrates is improved with the use of any of the products in the *Dow Corning®* superwetter family.
Foam Stabilization

Here we see the foam controlled with the addition of low levels (0.1%) of silicone defoaming additives.
Foam Stabilization

Wetting additives are surfactants and will therefore promote foam stabilization to some extent, as shown in a WB flexographic ink below (foam height after high-speed mixing)

Foaming property at 0.2 wt% addition levels (.4% for Competitor 1)

Lower foam levels do not necessarily indicate best performance!
<table>
<thead>
<tr>
<th>Products</th>
<th>Swiss Ordinance RS 817.023.21 Annex 6*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dow Corning® 67 Additive</strong></td>
<td>All substances intentionally formulated in <em>Dow Corning®</em> 67 Additive are listed on Annex 6, Part A or Part B, of the Swiss Ordinance RS 817.023.21*</td>
</tr>
<tr>
<td><strong>Dow Corning® 500W Additive</strong></td>
<td>NO</td>
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<tr>
<td><strong>Dow Corning® 501W Additive</strong></td>
<td>All substances intentionally formulated in <em>Dow Corning®</em> 501W Additive are listed on Annex 6, Part B, and on Annex 5, Part B, of the Swiss Ordinance RS 817.023.21*</td>
</tr>
<tr>
<td><strong>Dow Corning® 502W Additive</strong></td>
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</tr>
</tbody>
</table>

*Status on May 1, 2011*
Target Markets and Positioning

**Inks**
- Excellent for wetting plastic substrates
- *Dow Corning®* 67 Additive and *Dow Corning®* 501W Additive are listed on Annex 6 of the Swiss Ordinance RS 817.023.21

**Plastic coatings**
- Growing market segment and growing range of low-energy substrates

**Wood coatings**
- All four products provide wetting but do not create unwanted slip

**Other industrial coatings**
- Waterborne is an increasing market in all industrial applications and with significant problems in substrate wetting
Applications

The optimum level of addition should be determined for each application by the user. Typical concentration of 0.1 to 0.4% by weight of the total formulation is normally suitable for most applications. Start with 0.2% as your recommendation.

EXAMPLES OF APPLICATIONS

- Wood: Flooring and furniture coatings, trim paints and joinery
- Plastic coatings
- Industrial (protective) metal coatings
- Automotive
- Inks and overprint varnishes
- Long-lasting performance of Dow Corning® 500W Additive in high-pH binders
## Performance Summary

<table>
<thead>
<tr>
<th>Products</th>
<th>Wetting</th>
<th>Does Not Impact Slip</th>
<th>High pH Stability</th>
<th>Consistent Performance</th>
<th>Low ST at High Speed</th>
<th>Swiss Ordinance</th>
<th>Low VOC</th>
<th>BTX-Free</th>
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<tbody>
<tr>
<td><strong>Dow Corning® 67 Additive</strong></td>
<td>***</td>
<td>***</td>
<td>O</td>
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<td><strong>Dow Corning® 500W Additive</strong></td>
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<td>O</td>
<td>O</td>
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<tr>
<td><strong>Dow Corning® 501W Additive</strong></td>
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<td><strong>Dow Corning® 502W Additive</strong></td>
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<td>***</td>
<td>O</td>
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<tr>
<td><strong>Dow Corning® 57 Additive</strong></td>
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<td>O</td>
<td>**</td>
<td>**</td>
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</tr>
</tbody>
</table>

● = good  
★★ = better  
★★★ = best  
○ = not suitable
Available Packaging

200 KG DRUM SIZE
- *Dow Corning®* 500W Additive
- *Dow Corning®* 501W Additive
- *Dow Corning®* 502W Additive

20 KG PAIL SIZE
- *Dow Corning®* 500W Additive
- *Dow Corning®* 501W Additive
- *Dow Corning®* 502W Additive

SAMPLE BOTTLE
- 120 ml
  - *Dow Corning®* 500W Additive
  - *Dow Corning®* 501W Additive
  - *Dow Corning®* 502W Additive
- 120 ml (6-ctn)
  - *Dow Corning®* 500W Additive
  - *Dow Corning®* 501W Additive
  - *Dow Corning®* 502W Additive
Many thanks for your attention!

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