NEW SILICONE ADDITIVES FOR ENHANCED DURABILITY WATERBORNE WOOD COATINGS

Solve compatibility issues when using slip and mar, anti-blocking and foam control additives
PRESENTERS

Bertrand Lenoble
Principal Technical Service & Development Scientist

Lidaris San Miguel Rivera
Technical Service & Development Scientist

Stéphane van Oycke
Technical Service & Development Scientist
NEW SILICONE ADDITIVES FOR ENHANCED DURABILITY WATERBORNE WOOD COATINGS

Solve compatibility issues when using slip and mar, anti-blocking and foam control additives
AGENDA

- Background
- Product description & positioning
  - DOWSIL™ 211S Additive for slip and mar resistance
  - DOWSIL™ 402LS Additive for blocking ability
  - DOWSIL™ 107F Additive for foam control
- Conclusions
- Questions & answers
This is Dow

2019 Net Sales
$43B

Employees
~36,500

Manufacturing Sites
109 sites

Global Reach
31 countries
in which Dow manufactures products

Dow Coatings

2019 Net Sales
$3.5B

Employees
2,500

Manufacturing Sites
29

Global Reach
>30 countries
in which Dow has facilities

Global leaders in acrylic binders and water-borne additives

Broad portfolio of chemistries with high value innovation pipeline

8 R&D locations

Largest global silicones player with 75+ years of industry leadership

Note: All data as of December 31, 2019

1Largest global silicones player, based on annual sales
**Did you know?**

Silly putty was invented by accident ... and then became a world popular toy.
DOWSIL™ 211S Additive

Slip and mar resistance additive with improved compatibility
DOWSIL™ 211S ADDITIVE – FEATURES AND BENEFITS

- Novel Si technology to deliver high molecular weight silicone into waterborne systems
- Modified surfactants combination provides uniform particle size distribution and emulsion stability
- Low viscosity emulsion with high active content
- Typical addition levels starts at 0.1%

Improved compatibility with various organic emulsions. Lower tendency to cause craters

Slip enhancement to improve coating quality

Abrasion resistance to protect coating surface from abrasion during producing and using

High dilution stability by various solvents
PERFORMANCE IN WATERBORNE WOOD COATINGS

Testing formulation:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight %</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROSHIELD™ 3311 Emulsion</td>
<td>70.0</td>
<td>Binder</td>
</tr>
<tr>
<td>DOWSIL™ 106F Additive</td>
<td>0.2</td>
<td>Antifoam</td>
</tr>
<tr>
<td>DOWANOL™ DPM Glycol Ether</td>
<td>3.0</td>
<td>Coalescent</td>
</tr>
<tr>
<td>DOWANOL™ DPnB Glycol Ether</td>
<td>3.0</td>
<td>Coalescent</td>
</tr>
<tr>
<td>DOWSIL™ 501W Additive</td>
<td>0.5</td>
<td>Wetting agent</td>
</tr>
<tr>
<td>ACRYSOL™ RM-8W Rheology Modifier</td>
<td>0.8</td>
<td>Thickener</td>
</tr>
<tr>
<td>Water</td>
<td>22.0 (adj.)</td>
<td>Diluent</td>
</tr>
<tr>
<td>Slip Additive*</td>
<td>0.3 - 1.0</td>
<td>Slip Additive</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

*Comments: the dosage and type of slip additive are chosen according to testing requirement.

Protocol:

- Load binder into a container, disperse under 1000RPM, drop antifoam into binder. 2500RPM dispersion for 10 mins.
- Pre-mix coalescent, wetting agent, thickener and water.
- Drop the pre-mixed solution into binder with 1000RPM dispersing. Then 2000RPM dispersion for 5 mins.
- Add slip additive according to desired dosage, 1500RPM dispersion for 5 mins afterwards.

Application:

Paint applied on 2 types of panels

- Draw down on Leneta chart with No. 6 wirebar for gloss, CoF, mar and anti-blocking testing.
- Spray on wood panel where base coat has been applied and sanded.
HIGH COMPATIBILITY IN WATERBORNE WOOD COATINGS

Additive dosage: 1%. Clear coating based on ROSHIELD™ 3311 Emulsion. Benchmarking with another 2 gum emulsions.

- Existing - 1 45 craters
- Market benchmark - 1 33 craters
- DOWSIL™ 211S Additive 2 craters

DOWSIL™ 211S Additive high compatibility, even at high dosage. High quality of coatings and more flexibility of formulation design.
DEMONSTRATION OF ABRASION RESISTANCE IMPROVEMENT

0.3% dosage, clear coating based on ROSHIELD™ 3311 Emulsion, test after 7 days drying
Gloss retention and damage description after 6000 cycles abrasion
Benchmarking with gum emulsion

<table>
<thead>
<tr>
<th>Control</th>
<th>Existing - 1</th>
<th>Market benchmark - 1</th>
<th>DOWSIL™ 211S Additive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloss retention: 43%</td>
<td>Gloss retention: 89.2%</td>
<td>Gloss retention: 75.7%</td>
<td>Gloss retention: 91.5%</td>
</tr>
<tr>
<td>Heavy damaged</td>
<td>Very slightly damaged</td>
<td>Very slightly damaged</td>
<td>Very slightly damaged</td>
</tr>
</tbody>
</table>
DEMONSTRATION OF SUPERIOR ABRASION RESISTANCE PERFORMANCE

0.3% dosage, clear coating based on ROSHIELD™ 3311 Emulsion, test after 7 days drying
Gloss retention and damage description after 6000 cycles abrasion
Benchmarking with silicone emulsion

<table>
<thead>
<tr>
<th>Control</th>
<th>Market benchmark - 2</th>
<th>DOWSIL™ 211S Additive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloss retention: 43%</td>
<td>Gloss retention: 56.9%</td>
<td>Gloss retention: 91.5%</td>
</tr>
<tr>
<td>Heavy damaged</td>
<td>Moderate to heavy damaged</td>
<td>Very slightly damaged</td>
</tr>
</tbody>
</table>
DEMONSTRATION OF SUPERIOR ABRASION RESISTANCE PERFORMANCE

0.3% dosage, clear coating based on ROSHIELD™ 3311 Emulsion, test after 7 days drying
Gloss retention and damage description after 6000 cycles abrasion
Benchmarking with silicone polyether

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>DOWSIL™ 401LS Additive</th>
<th>DOWSIL™ 205SL Additive</th>
<th>DOWSIL™ 211S Additive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloss ret.:</td>
<td>43%</td>
<td>50.6%</td>
<td>65.6%</td>
<td>91.5%</td>
</tr>
<tr>
<td>Damage</td>
<td>Heavy damaged</td>
<td>Moderate to heavy damaged</td>
<td>Moderate damaged</td>
<td>Very slightly damaged</td>
</tr>
</tbody>
</table>
Performance Overview of DOWSIL™ 211S Additive in Waterborne Wood Coating

DOWSIL™ 211S enables gloss retention in use

*The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.*
DOWSIL™ 402LS Additive

High compatibility multifunctional additive for wood coating
DOWSIL™ 402LS ADDITIVE – TYPICAL PROPERTIES AND BENEFITS

DOWSIL™ 402 LS Additive is a silicone polyether based additive that has multi-functional benefits

<table>
<thead>
<tr>
<th>Test</th>
<th>Unit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td></td>
<td>Clear to hazy liquid</td>
</tr>
<tr>
<td>Viscosity at 25 °C (77 °F)</td>
<td>mm²/s</td>
<td>300-500</td>
</tr>
<tr>
<td>Specific gravity at 25 °C (77 °F)</td>
<td></td>
<td>1.036</td>
</tr>
<tr>
<td>Active content</td>
<td>%</td>
<td>100</td>
</tr>
</tbody>
</table>

- Improved flow and leveling and no negative effect in gloss
- Early block resistance and good compatibility with waterborne acrylics
- Effective at low addition level, BTX free, and solventless**
- Wood and Industrial metal, Architectural, Inks and OPV, Pigmented and Clear formulations

*The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.
** DOWSIL™ 402 LS is solvent free, being manufactured without added solvent.
Performance in Waterborne Wood Coatings

Testing formulation:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight %</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROSHIELD™ 3188 Acrylic Emulsion</td>
<td>78.2</td>
<td>Binder</td>
</tr>
<tr>
<td>DOWSIL™ 107F Additive</td>
<td>0.5</td>
<td>Antifoam</td>
</tr>
<tr>
<td>DOWANOL™ PnB Glycol Ether</td>
<td>1.8</td>
<td>Coalescent</td>
</tr>
<tr>
<td>DOWANOL™ DPM Glycol Ether</td>
<td>1.9</td>
<td>Coalescent</td>
</tr>
<tr>
<td>DOWANOL™ DPnB Glycol Ether</td>
<td>1.2</td>
<td>Coalescent</td>
</tr>
<tr>
<td>RHOPLEX™ WP-1 Plasticiser</td>
<td>1.2</td>
<td>Plasticizer</td>
</tr>
<tr>
<td>ACRYSOL™ RM-8W Rheology Modifier</td>
<td>0.3</td>
<td>Thickener</td>
</tr>
<tr>
<td>Surfactant</td>
<td>0.3</td>
<td>Wetting</td>
</tr>
<tr>
<td>Water</td>
<td>14.5</td>
<td>Diluent</td>
</tr>
<tr>
<td>Leveling Additive*</td>
<td>0.1</td>
<td>Leveling/Slip Add.</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Process:

- Load binder into a container, disperse under 400 RPM, add antifoam into binder and mix for 10 mins.
- Pre-mix coalescent, plasticizer, and water and add slowly to binder. Mix at 500 RPM for 10 minutes.
- Add surfactant, water, and thickener and mix for 30 minutes.
- Add leveling/slip additive according to desired dosage, mixed at 2500 RPM with speed mixer for 2 minutes.

Application:

- Draw down on Leneta chart with No. 6 drawdown bar for compatibility (visual defects ranking), gloss, and anti-blocking testing at r.t and 50 °C (122 °F).

*Comments: Dosage and type of leveling/slip additive are chosen according to testing requirement.
COATING COMPATIBILITY – DRIED FILM (GLOSS)

Additive dosage: 0.1 and 0.5%. Clear WB wood coating based on ROSHIELD™ 3188 Acrylic Emulsion. Existing DOWSIL™ Additive-1: Silicone gum dispersion; Market BM-3: Polyether siloxane polymer

DOWSIL™ 402LS Additive shows good wet and dry film compatibility and gloss

Both Existing DOWSIL™ Additive-1 and Market Benchmark-3 show haziness in the dry film

The Market Benchmark-3 shows the lower gloss level relative to the other additives and control sample

*The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.
**ANTI-BLOCKING PERFORMANCE**

Additive dosage: 0.1 and 0.5%. Clear WB wood coating based on ROSHIELD™ 3188 Acrylic Emulsion. Existing DOWSIL™ Additive-1: Silicone gum dispersion; Market BM-3: Polyether siloxane polymer

DOWSIL™ 402LS Additive shows good antiblocking performance at 50 °C

Both Market Benchmark-3 and the control pain (no additive) show poor hot antiblocking behavior

### Blocking Test Reference Scale

- 10, no tack, perfect
- 8, slight tack, very good
- 7, slight tack, good
- 5, moderate tack, fair
- 3, 5-25% seal, poor
- 2, 25-50% seal, poor
- 0, complete seal, very poor

*The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.*
DOWSIL™ 107F Additive

Improved compatibility antifoam for waterborne coatings
**Typical Properties**

DOWSIL™ 107F Additive  
Silicone antifoam compound with silica, 100% active

<table>
<thead>
<tr>
<th>Test</th>
<th>Unit</th>
<th>DOWSIL™ 107F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td></td>
<td>Clear to translucent, colorless</td>
</tr>
<tr>
<td>Viscosity at 25 °C (77 °F)</td>
<td>mPa</td>
<td>300-500</td>
</tr>
<tr>
<td>Specific gravity at 25 °C (77 °F)</td>
<td>%</td>
<td>1.02</td>
</tr>
<tr>
<td>Active content</td>
<td>%</td>
<td>100</td>
</tr>
</tbody>
</table>

**Favorable EHS Profile:**

- No SVHC
- Low VOC and SVOC (1 wt%)
- Low Residual SiH level <2,5 ppm
- Can be used for formulating EU ecolabel compliant indoor and outdoor paints and varnishes (2014/312/EU)

*The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.
CLEAR WOOD COATING

Selected Guide Formulations

- **Formulation 1 - ROSHIELD™ 3188ER Emulsion**

  ROSHIELD™ 3188ER Emulsion is a self-crosslinking acrylic copolymer designed for use in factory-applied, waterborne, interior wood coatings.

- **Formulation 2 - PRIMAL™ IW-3311 Emulsion**

  - PRIMAL™ IW-3311 Emulsion is a one component acrylic technology designed for clear wood coatings.
  - Designed for use in factory-applied, water-borne, interior wood lacquers like furniture or parquet finishes.
**DEFOAMER EFFICACY – FOAM HEIGHT**

**DOWSIL™ 107F Additive shows better initial defoaming than the market benchmark product.**

---

**Formulation 1 - ROSHIELD™ 3188ER Acrylic Emulsion**

![Foam Height Chart for Formulation 1](image1)

- **DOWSIL™ 107F**
- **Market benchmark product**
- **control (no additive)**

- **Foam height (mm)**

---

**Formulation 2 - PRIMAL™ IW-3311 Acrylic Polymer**

![Foam Height Chart for Formulation 2](image2)

- **DOWSIL™ 107F**
- **Market benchmark product**
- **control (no additive)**

- **Foam Height (mm)**

---

**Additive loading level: 0.2% TFW**

TFW = total formulation weight

*The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.*
COATING COMPATIBILITY

DOWSIL™ 107F Additive shows no negative impact on gloss or surface defects.

Formulation 1 - ROSHIELD™ 3188ER Acrylic Emulsion

Formulation 2 - PRIMAL™ IW-3311 Acrylic Polymer

*The graphic representations are presented here for illustrative purposes only and should not be construed as product specifications.*
WE MAKE COATINGS WORK BETTER – THREE NEW PRODUCT LAUNCHES!

DOWSIL™ 211S Additive

Novel slip and mar resistant additive with improved compatibility in waterborne coatings

DOWSIL™ 402LS Additive

A multifunctional additive with high compatibility bringing slip, anti-blocking, levelling benefits to waterborne coating

DOWSIL™ 107F Additive

New generation foam control agent with improved compatibility & optimal performance for waterborne coatings
NOTICE: No freedom from infringement of any patent owned by Dow or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other government enactments. The product shown in this literature may not be available for sale and/or available in all geographies where Dow is represented. The claims made may not have been approved for use in all countries. Dow assumes no obligation or liability for the information in this document. References to "Dow" or the "Company" mean the Dow legal entity selling the products to Customer unless otherwise expressly noted. NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.