

CoatOSil™ 7001E

CoatOSil* 7001E

Description

CoatOSil 7001 copolymer is an additive for improved flow and leveling of solventborne two-component acrylic-polyol isocyanate cured coatings.

When CoatOSil 7001 copolymer is incorporated as a flow and leveling additive, the appearance and distinctness of image (DOI) of the clearcoat is typically excellent, compared to current commercial additives used in the formulations discussed.

Key Features and Benefits

Incorporation of 0.05% to 0.10%wt CoatOSil 7001 copolymer into the polyol resin solids portion of a solvent-borne, two-component acrylic polyol clearcoat formulation, cured with a polyisocyanate, can improve the appearance of the final product as viewed by the customer

- greater distinctness of image (DOI)
- improved clarity of final film
- improved film coalescence
- reduces long wavelength wavescan values

Typical Physical Properties

| Property | CoatOSil 7001 |
|---|-------------------------|
| Density (g/cm ³) at 25°C | 1.03 |
| Viscosity at 25°C, cPoise | 1,700 |
| Flash Point, Pensky-Martens (closed cup) ASTM D93 °C (°F) | 97 (207) |
| Liquid Static Surface Tensions @ 25°C (dyne/cm) | (Results on Next table) |

CoatOSil 7001 copolymer added to various solvents on a wt% basis

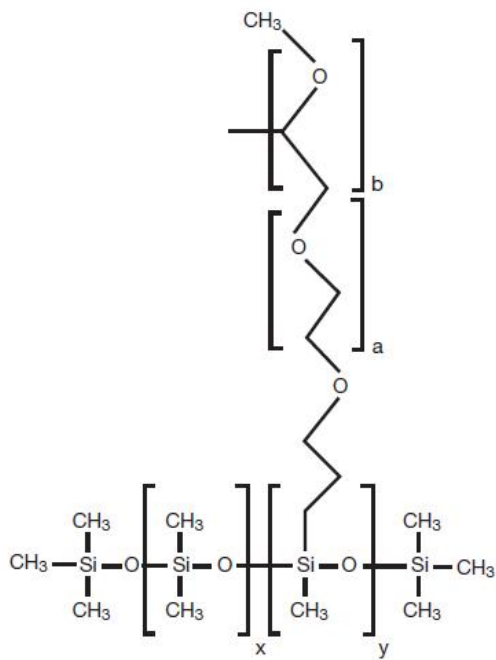
| Liquid Surface Tensions | | | (dyne/cm) | |
|-------------------------|----------|----------------------|-----------|--------------|
| wt. % CoatOSil 7001 | DI Water | PGMEA ⁽¹⁾ | m-pyrol | Aromatic 100 |
| 0.0% | 72.3 | 28.2 | 41.2 | 29.1 |
| 0.1% | 31.1 | 26.1 | 23.7 | 28.0 |
| 0.5% | 28.4 | 25.7 | 22.5 | 27.3 |

Solubility studies @ 25°C (0.5%wt CoatOSil 7001 copolymer levels^(a)) show compatibility/solubility with multiple solvents including:

- ketones
- acetates
- aromatics
- glycol ethers
- alcohols
- water(a) ~ 0.1%wt CoatOSil 7001 copolymer loading

(a) Unless specified otherwise

Chemical Structure



Potential Applications

CoatOSil 7001 silicone-polyether block copolymer is an excellent candidate to consider for use as a flow and leveling additive in acrylic-polyol resin formulations for monocoat and clearcoat formulations. Table 1 shows two sample formulations using two acrylic polyol resins as the primary binder in the polyol portion of the formula.

Table 1: Sample Testing Coating Formulation and Preparation

| Grind Paste Preparation: | | |
|---|-------------------|--|
| Material | Total Added (gms) | Comments |
| Acrylamac* 232-1375 ⁽²⁾ | 142.9 | Add material under agitation |
| Fumed Silica ⁽³⁾ | 20.0 | Slowly add fumed silica |
| n-Butyl Acetate | 237.1 | Cowles grind for 20 minutes |
| Add 1.0mm - 1.5mm mill beads to material blend. Grind for additional 30min. Hegman grind gauge will need to indicate a grind of >6.0. If this hasn't been attained, additional grinding time may be required. | | |
| n-Butyl Acetate | 75.0 | Add as a solvent flush to remove additional paste. (25.26% solids - Theoretical) (Test for % solids) Store for use |
| | 475.0 gms | |
| | | |

| Coating Formulations: Under slow agitation add the following components sequentially: | | |
|--|--------------------------------|--------------------------------|
| | Coatings Formulation #1 | Coatings Formulation #2 |
| Material | Total Added (gms) | Total Added (gms) |
| Grind Paste from above | 14.2 | 11.8 |
| Acrylamac 232-1375 | 138.6 | — |
| Commercial Acrylic Polyol ⁽⁴⁾ | — | 139.3 |
| UVA Light Stabilizer | 3.0 | 3.0 |
| Hindered Amine Stabilizer | 1.0 | 1.0 |
| Tin Catalyst | 0.05 | 0.05 |
| CoatOSil 7001 copolymer | 0.10 | 0.10 |
| n-Butyl Acetate | 40.0 | 40.0 |
| MEK | 25.0 | 25.0 |
| | | |
| Solvent Reducer ⁽⁵⁾ | 144.0 | 115.0 |
| 100% solids HDI trimer ⁽⁶⁾ dissolved in n-Butyl Acetate to 70% wt solids | 80.1 | 73.1 |

Product formulations are included as illustrative examples only. Momentive makes no representation or warranty of any kind with respect to any such formulations, including, without limitation, concerning the efficacy or safety of any product manufactured using such formulations

These formulated viscosities may be sprayed through conventional or HVLP spraygun application.

Spray Application:

Application was via handspray using DeVilbiss† Starting Line† HVLP touchup gravity spray gun.⁽⁷⁾ The substrates used to test CoatOSil 7001 copolymer were smooth electrocoated cold roll steel and flat glass microscope slides.

Commercial automotive refinish black basecoat was applied over the smooth electrocoated substrate and the microscope slides, to produce a smooth, thin coating for better analysis of the effects of the CoatOSil 7001 copolymer flow and leveling additive. The prepared basecoat film build was ~ 0.3 to 0.4 mils thick. The clearcoat film builds were prepared to ~2.0 to 2.3 mils thick.

Coatings were applied at ~35 psi wall gauge pressure.

The technique used to spray the coatings was a side-to-side sweep of the spraygun onto the panel at a rate of ~1,000 ipm. The gun to target distance was ~12 inches. The gun orifice was 1mm at the full open position.

Both the basecoat and the clearcoat were applied using the same spraygun. Ensure appropriate cleaning of the guns when switching between coating systems

Panel Cure:

After spray application, air flash coating under ambient conditions for 10 to 15 minutes horizontally and vertically (optional). After the air flash, the coating systems may be placed in an oven between 140°F to 180°F for 30 minutes, to accelerate topcoat cure. When the samples have fully cured, sample testing may begin.

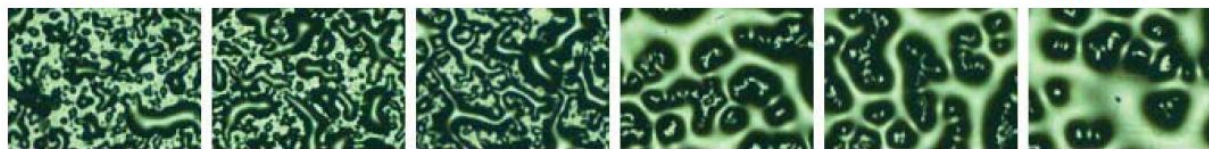
Sample Testing:

Flow and leveling was tested using a “Chrysler C-Box” visual rating system and with a Wave-Scan Dual Instrument. ⁽⁸⁾ The coatings on the glass slides were observed under a microscope at low power to determine flow and leveling effects.

Performance Application Data

Clearcoat samples of **Formulation #1** were spray applied as a film build gradient over black basecoated glass substrate to evaluate the coalescence, flow and leveling performance on very smooth surfaces. The three samples tested were: 0.00%wt additive, 0.06%wt CoatOSil 7001 copolymer, and 0.06%wt of a commercially available flow additive, based on a 100 gram total resin solids basis.

NO ADDITIVE → HIGHER FILM BUILD



0.06%wt COATOSIL 7001 COPOLYMER

Coalescence at ~1.8 mils

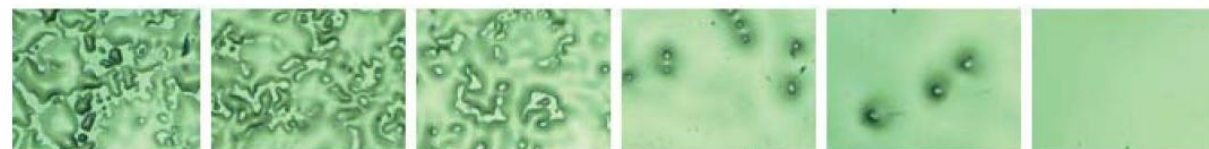


0.06%wt COMMERCIAL ADDITIVE



Additionally, these clearcoat samples were applied directly over the glass substrate to evaluate flow and leveling over a distinctly different substrate.

NO ADDITIVE → HIGHER FILM BUILD

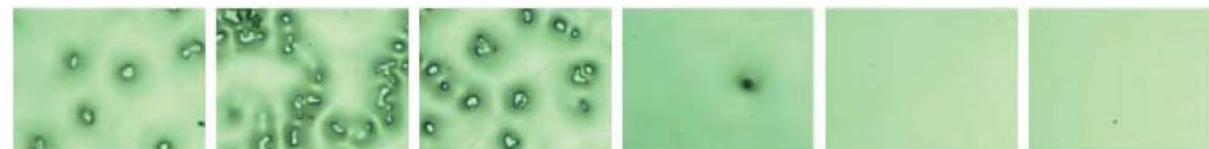


0.06%wt COATOSIL 7001 COPOLYMER

Coalescence at ~1.0 mil

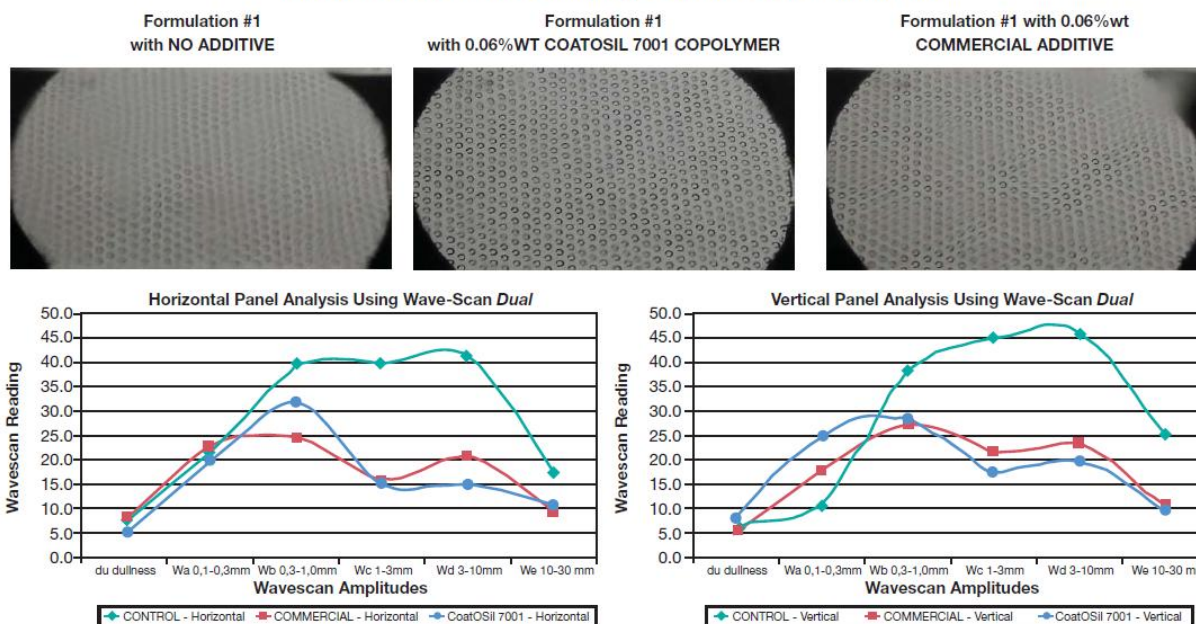


0.06%wt COMMERCIAL ADDITIVE

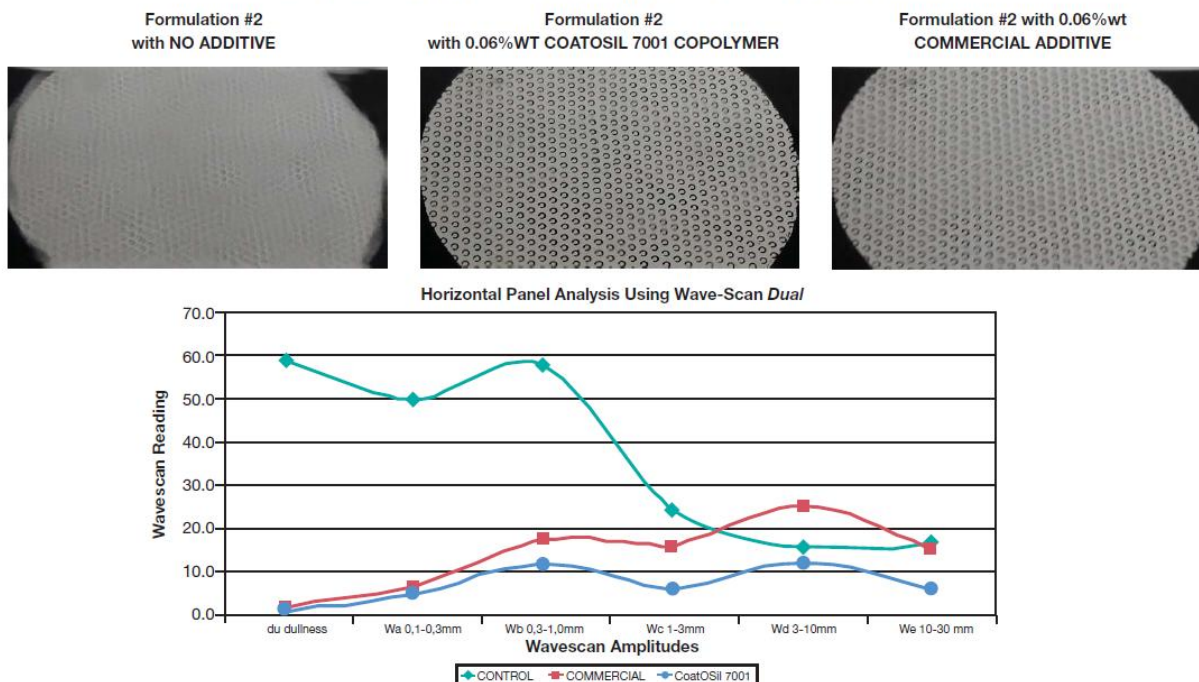


Clearcoat coating **Formulations #1 and #2** were also prepared over a smooth electrocoated substrate and coated with black basecoat. The Chrysler C-Box and Wave-Scan Dual results are shown for the following systems: No additive, 0.06%wt CoatOSil 7001 copolymer, and 0.06%wt of a Commercial control on a 100gram resin solids basis. Clearcoat film builds were in the ~2.0 to 2.3mil film thickness range for all topcoats.

Horizontal Panel Evaluations Using COATING FORMULATION #1



Horizontal Panel Evaluations Using COATING FORMULATION #2



Conclusions

CoatOSil 7001 copolymer provided improved flow and leveling properties in the clearcoat formulations tested when compared to a commercially available flow and leveling additive and a control formulation with no additive. These flow and leveling improvements were quantified in formulations using two distinct acrylic-polyol binder resin systems. Application is not limited to these two types of acrylic-polyols and may be considered for use in a wider formulation array of acrylic-polyol resins and blends. Hydroxy functional polymers and amine functional polymers, compatible with main acrylic-polyol binders would also be excellent candidate resins to consider for formulations with specific performance requirements, along with flow and leveling properties provided by CoatOSil 7001 copolymer.

An initial starting point for incorporating CoatOSil 7001 copolymer into coating formulations would be ~0.06%wt on 100 grams Total Resin Binder (Polyol + Polyisocyanate) Solids or ~0.10%wt on 100 grams resin solids basis on polyol portion.

Patent Status

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Product Safety, Handling and Storage

References

1. PGMEA is Propylene Glycol Methyl Ether Acetate
2. Acrylamac* 232-1375, available through MOMENTIVE
3. Treated fumed silica having BET surface area $\sim 250 \pm 40 \text{ m}^2/\text{g}$ and 1.5% to 3.5% wt carbon content
4. Commercial acrylic polyol (~460 OH equiv. wt @ 100% solids, supplied at 70% wt solids
5. Fast to medium solvent evaporation rates using acetates, ketones, aromatic and aliphatic blends
6. Aliphatic polyisocyanate HDI trimer
7. Devilbiss† and Starting Line† are registered trademarks of Illinois Tool Works, Inc.
8. Wave-Scan Dual Instrument available through Byk-Gardner USA

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Limitations

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