CYTEC

TECHNICAL BULLETIN Specialty Additives

New AEROSOL® Surfactant Formulations For Enhanced Waterborne Overprint Varnishes

Introduction

Waterborne Overprint Varnishes (OPV's) are coatings applied to an already printed sheet or web. OPV's are principally applied for aesthetic purposes to assist in providing a glossy or dull appearance, or to provide a cast over portions of the sheet that highlights specific areas. Additionally, OPV's also provide some protection against the wear and tear of daily handling, allowing the document to remain intact longer and providing some resistance to stain and discoloration.

As the name implies, waterborne coatings use water as the primary solvent system and are usually applied during the printing process. Waterborne coatings offer some advantages over solvent-based varnishes in that they will not yellow over time, are less toxic and emit fewer VOCs.

Problems that are inherent with the use of waterborne OPV's are foam generation especially in high-speed applications leading to reductions in line speeds, poorer wetting out of the substrate and increased water sensitivity of the final dried binder. Cytec has formulated existing products in such a way that they provide not only excellent wetting but also address these performance issues.

AEROSOL Surfactants for the Manufacture of OPV's

Typically water-based or aqueous coatings have styrenic or acrylic based binding systems. These binders prepared by emulsion polymerization processes, use surfactants as emulsifiers, stabilizing agents and post-addition agents to improve the wetting properties and flow behavior of the binders.

As mentioned above there are some drawbacks to working with surfactant-stabilized waterborne OPV's, such as foam generation during application of the OPV and an increased water sensitivity of the dried binder afterwards. However, despite these drawbacks, there is broad industry use of waterborne OPV's and the surfactant component of the formulation allows converters extra wetting to enable high-speed coating and fast drying.

Currently, Cytec's AEROSOL surfactant product portfolio offers a range of options to enhance OPV wetting and control foaming. However a need was identified for products that would allow customers to operate their systems at increased speeds while still enjoying increased water resistance of the final product. It is hoped that these formulations will assist OPV producers to achieve this and to also improve their productivity.

Standard Product Offerings from Cytec for Post Formulating OPV's

Role/Function	Product	Reason For Use
Wetting	AEROSOL OT-75	Industry standard wetting agent
Wetting	AEROSOL GPG	Low cost alternative when color is not an issue
Wetting	AEROSOL OT-70 PG	For higher flashpoint allowing for non-regulated storage
Wetting	AEROSOL OT-85 AE	For coalescent free/low VOC OPV's
Wetting	AEROSOL MA-80	For ease of handling
Wetting	AEROSOL LF-4	For low foaming

Table 1: Cytec's standard product offering

New Surfactant Formulations for Post-Addition of OPV's

To address the industry need for reduced water sensitivity of dried OPV's, Cytec has made a study of their current wetting agents and found that formulations containing AEROSOL TR-70 or AEROSOL OT-85 AE increase resistance to water. Additionally, these new formulations offer improved wetting performance and minimize foam generation.

Suggested AEROSOL Surfactant Formulations

Easy to incorporate liquid surfactant formulations have been developed (see Table 2 below).

Optimization of Surfactants Formulations

AEROSOL OT-85 AE has some significant features over standard AEROSOL OT-75 that makes it more interesting to use in the formulation.

AEROSOL OT-85 AE has improved coalescing properties, which give higher gloss and reduce the need for additional coalescing agent. It is a low VOC product that therefore reduces the safety hazards by reducing VOC and flammable components in the system. AEROSOL OT-85 AE also increases mechanical stability, preventing coagulum formation during the handling and processing of the OPV.

It has been found that increasing carbon length has a significant effect on foam behavior and dynamic surface tension. Through careful blending of the sulfosuccinate surfactants, AEROSOL OT-85 AE and AEROSOL TR-70, the desired behavior of each individual component has been optimized. The fast wetting, good dynamic surface tension behavior and low-foaming characteristics are attributable to specific carbon chain lengths*. The optimum for wetting is at C8-carbon length and the low-foaming properties are imparted by the longer carbon chain lengths. Water-resistant properties are brought to the formulations by selecting the long hydrophobe of AEROSOL TR-70.

** Not taking into account co-solvents or branching*

Component	Formulation 1	Formulation 2
AEROSOL TR-70	85.0	80.0
AEROSOL OT-75	15.0	
AEROSOL OT-85 AE		20.0
Total, % as is	100.0	100.0

Table 2: Formulation ratios of products

Foam Behavior vs. Chain Length (1% Solution)

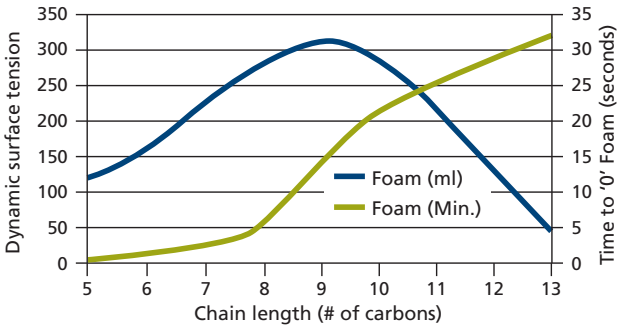


Figure 1: Effect of chain length on foam development. Highest foam building at C9-chain length

Dynamic Surface Tension vs. Chain Length

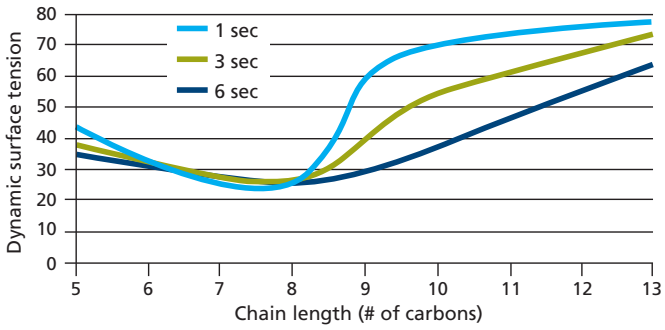


Figure 2: Effect of chain length on dynamic surface tension. Dynamic behavior optimal at C8-chain length

Performance of OPV After Post-Addition of Surfactant

Water Resistance

A standard OPV was produced with 5% of each surfactant or formulation. These OPV samples were further used throughout all tests.

A film was cast on a byk test chart with a 30 micron gap applicator (wet film ~15 micron) and dried for 45 seconds @ 80 °C.

The film was evaluated after 1 and 24 hrs by placing a piece of wet felt onto the film and covering the wet felt with a glass panel (see figure 3).

Whitening was recorded visually after 60, 150 and 300 seconds.

The films containing the formulated surfactants showed excellent water-resistance compared with the AEROSOL OT-75 standard (see figure 4). This use of formulated surfactants leads to an OPV with enhanced aesthetics and appearance.

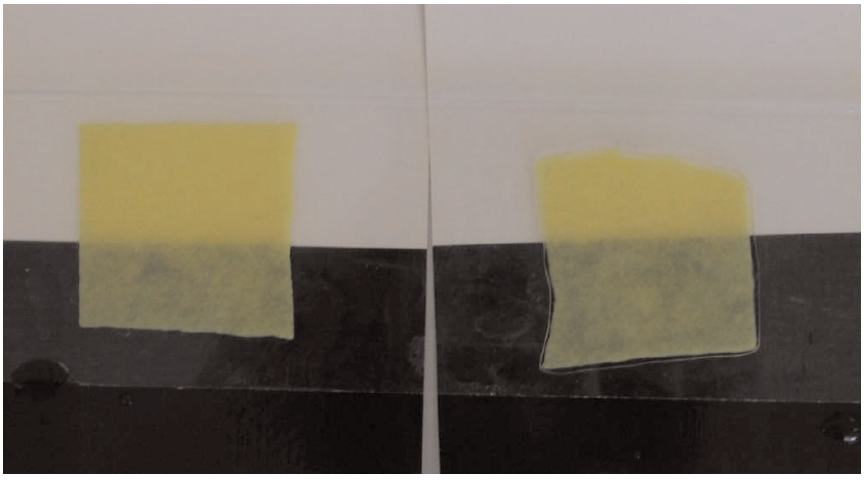
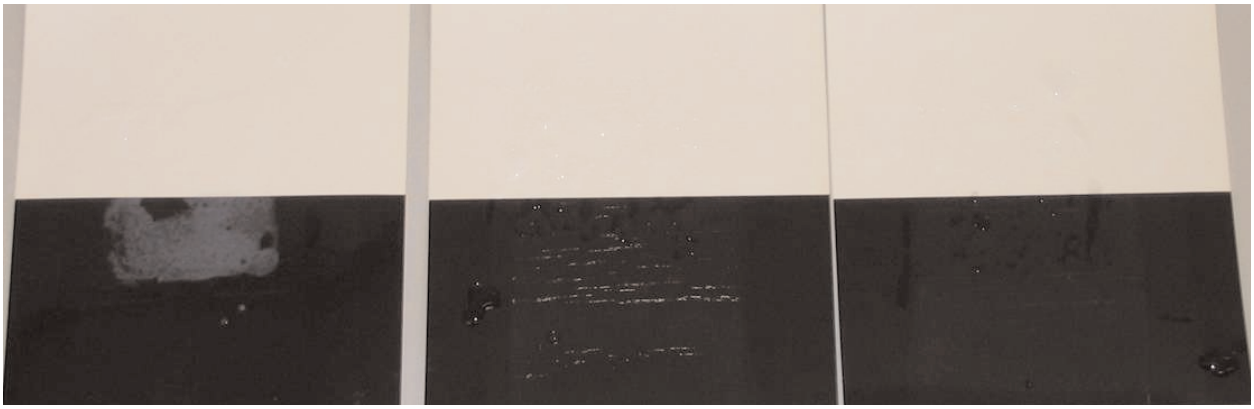


Figure 3: Evaluation of OPV by placing wet felt on film



AEROSOL OT-75 Formulation 2 Formulation 1

Figure 4: Appearance of formulated OPV after 300 seconds exposure to wet felt. Comparing the standard AEROSOL OT-75 with 2 formulated surfactant combinations.

The excellent performance of these novel surfactant formulations compared to the standard AEROSOL OT-75 performance is shown in Figure 4 above.

Viscosity

Post–addition of the AEROSOL TR-70 and AEROSOL OT-85 AE surfactants into a standard OPV does not affect viscosity significantly.

The observed small increase is similar to that of post-addition of AEROSOL OT-75.

Foaming Properties

The formulated surfactants give an outstanding performance showing both low-foam generation and very quick dissipation of generated foam (see Figure 5).

The use of this combination of AEROSOL TR-70 and AEROSOL OT-85 AE allows the OPV converter to achieve high line-speeds, thus improving efficiency.

Component	Blank OPV	Control AEROSOL OT-75	Formulation 1	Formulation 2
Viscosity (cps)	43	143	143	148

Table 3: Brookfield viscosity

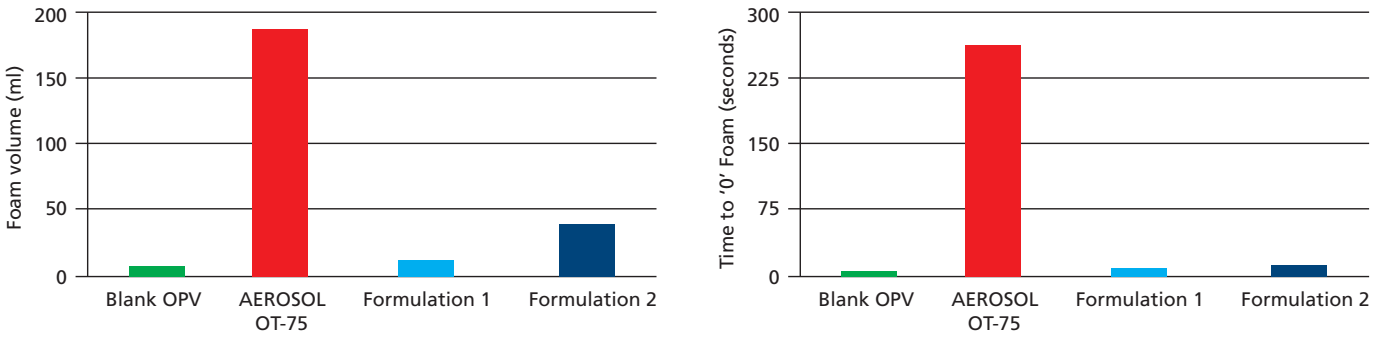


Figure 5: Foaming properties of 1% aqueous solution (Ross-Miles Foaming Test ASTM Method: D1173-53)

Dynamic Surface Tension Measurements

The excellent dynamic surface tension results indicate that the surfactant quickly migrates to the interface. This ensures excellent wetting, which allows faster operational speeds, thus improving overall efficiency. The fast wetting also ensures uniform coating of the OPV onto the substrate with overall improved coating aesthetics.

Formulations of AEROSOL TR-70 and AEROSOL OT-85 AE show similar excellent behavior as the standard AEROSOL OT-75.

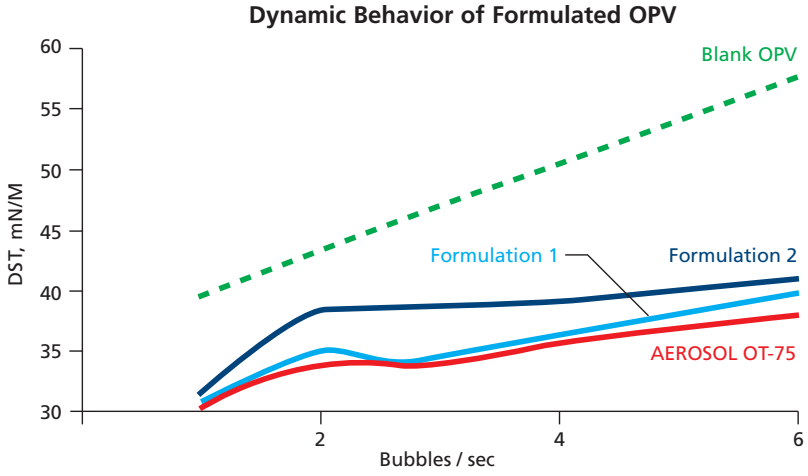


Figure 6: The dynamic surface tension properties were evaluated using Sensadyne Surface Tensiometer-6000

6 Summary

Features & Benefits of Formulated Surfactants

Feature	Benefit
Low foam generation	Facilitates high speed operation
Outstanding wetting	Uniformly coats varnish onto substrate
Improved water resistance	Enhanced OPV aesthetics and appearance
Optimised formulation	Balance of properties and reduced need for additional coalescing aids
Liquid	Easy formulation
Reduced solvent option	Safer to use

Table 4: Features and benefits of the formulated surfactants

Recommendations

The formulations of AEROSOL TR-70 and AEROSOL OT-85 AE are especially designed as post-additives for waterborne OPV's, that are used in high-speed applications. The unique composition ensures low-foaming behavior, excellent dynamic wetting properties and increased water resistance of the dried OPV.

These formulations will lead to improved productivity, by enabling customers to operate their systems at increased speeds while still enjoying increased water resistance of the final product.

Further Recommendations

To further increase the coalescing properties of the OPV without adding additional coalescing agent and so reducing total solvent content, AEROSOL TR-70 could be replaced by AEROSOL TR-70 HG. Also, because AEROSOL TR-70 HG is a higher flashpoint surfactant, safety hazards are reduced.

While in our tests the ratio of 80-85% AEROSOL TR with 15-20% AEROSOL OT proved to yield best overall performances, customers are encouraged to adjust the ratio to suit individual performance needs.

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