



DuPont™ Capstone® Fluorosurfactants

HIGH VALUE-IN-USE APPLICATIONS THAT
REQUIRE MAXIMUM PERFORMANCE



The miracles of science™

Solutions to Fuel Your Innovation

DuPont™ Capstone® surfactants are the result of our commitment to world-class science that delivers more sustainable solutions through superior product performance—products that help protect people as well as the environment. Providing a range of benefits not available with traditional surfactants, DuPont™ Capstone® fluoroadditives give you the ability to enhance the performance properties of your existing products, as well as the freedom to create unique and innovative products that help meet your customer needs worldwide.

As a major global manufacturer and supplier of innovative short-chain products, DuPont has a robust supply of DuPont™ Capstone® fluorosurfactants, so you can be confident your production lines will run smoothly—no matter where in the world you operate.

DuPont cares about what happens after our products are designed into end-use applications. Our rigorous product stewardship process evaluates product hazards and potential for exposure to ensure the products are safe for their intended use. A more detailed summary is available in our “Product Stewardship Detail” brochure, number K-20614, which can be found at www.capstone.dupont.com under Technical Information.

The DuPont™ Capstone® fluorosurfactants team stands ready to work with you to help your business grow—from choosing the DuPont™ Capstone® fluoroadditive that is right for your application and business needs to answering technical questions.

DuPont™ Capstone® fluorosurfactants enable simplified formulations and higher performance end-products.

For applications such as paints and coatings, adhesives, waxes and polishes, and industrial cleaning products, DuPont™ Capstone® fluorosurfactants enhance the properties of formulations by improving properties such as wetting and spreading, leveling, penetrating, foaming control, and substantially reducing surface tension.

To effectively wet a substrate, the surface energy of the formulation must be lower than the surface energy of the substrate (see Figure 1). Capstone® fluorosurfactants offer unparalleled wetting and leveling power in both water- and solvent-borne formulations with surface energies as

low as 18 dynes/cm at extremely low concentrations (see Figure 2).

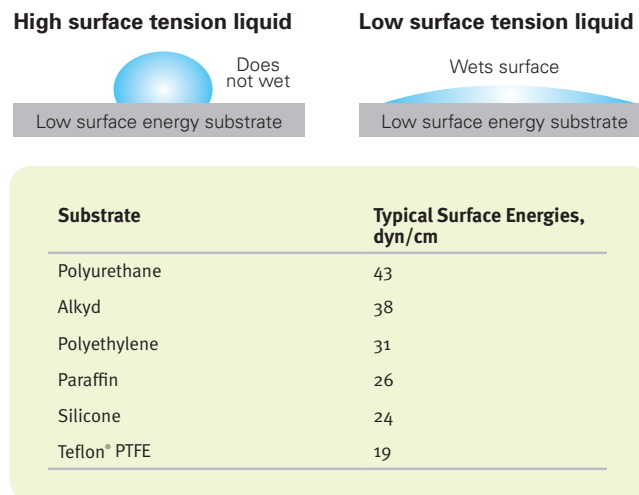


Figure 1. Schematic for Wetting

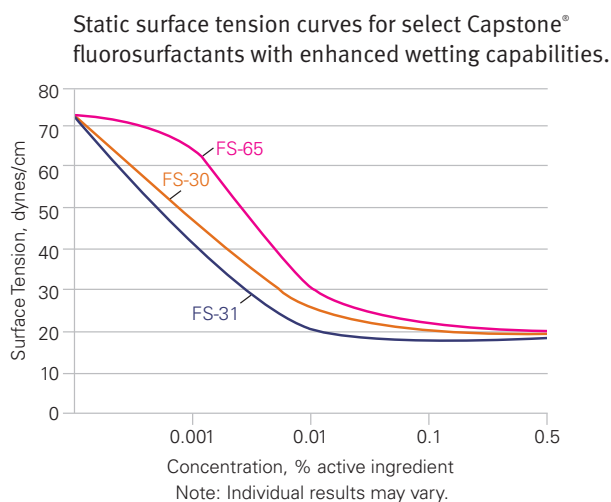


Figure 2. Static Surface Tension in Deionized Water

Capstone® fluorosurfactants work well in harsh chemical and thermal conditions and can also help reduce the amount and number of other additives in formulations, helping to reduce complexity while creating higher-performing products. For more detailed information, please refer to the DuPont™ Capstone® Fluoroadditive Application Guide on page 7.

Cost Synergies in Formulating with Capstone®

Capstone® fluorosurfactants are used in combination with conventional surfactants to lower the total cost of the formulation—by reducing the total amount of surfactant used, while providing better performance.

As demonstrated in Figure 3, a mixture of a Capstone® fluorosurfactant with a hydrocarbon surfactant can provide greater wetting power at an equivalent cost. Mixed surfactant systems are applied in cleaning and coating formulations, with additional benefits of reducing foam and improving dynamic surface tension reduction.

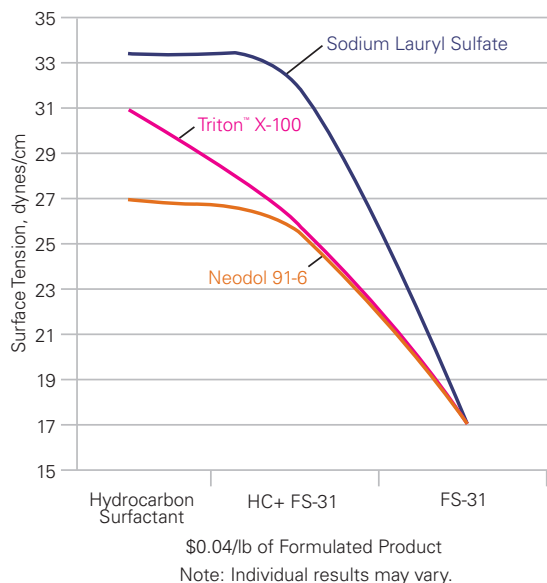


Figure 3. Cost vs. Performance Comparison

Cleaners for Glass or Other Hard Surfaces

The key to good performance on glass and hard surface applications is wetting power at low concentrations. Because low surface tension is realized with a small amount of fluorosurfactants (e.g., 200 ppm) there is less residue on evaporation and the residual film is thinner. This results in faster drying times as well as less haze and streaking.

FS-30 and FS-31, nonionic surfactants, will leave an invisible absorbed monolayer that encourages rewet of the surface. This will decrease the tendency of the surface to 'fog' in high humidity environments, a major benefit in glass cleaners. FS-61 and FS-65, anionic and nonionic surfactants respectively, provide good wetting properties to improve scale removal. FS-61 and FS-64 bind to metal, polymeric, or ceramic surfaces, to repel water or oily soils. These products are more strongly adsorbed onto those surfaces and provide protection against re-soiling, while still being very effective at low concentrations. When foam is used to promote adhesion of the active cleaning ingredient on the surface, Capstone® fluorosurfactant grades such as the amphoteric FS-50 and FS-51 fluorosurfactants are best at creating stable foam for these applications.

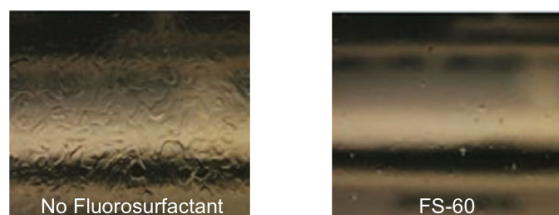
Concentrates

Capstone® fluorosurfactants perform at very low concentrations, allowing for the development of concentrates that can be diluted as much as 100:1. This is a key advantage when designing cleaning systems for industrial and institutional cleaning applications where large volumes of formulations are often required.

Floor Polishes/Waxes and Strippers

When a cleaner or polish/wax is spread on a substrate, two new interfaces are created: (1) the interface between the liquid layer and the substrate (flooring, in this case), and (2) the upper (and visible) surface of the coating. In polishes and waxes, Capstone® fluorosurfactants provide wetting power to give a uniform film on the substrate. Furthermore, they improve gloss and rewet characteristics on the upper surface, permitting multi-coat application without haze. Capstone® fluorosurfactants are widely used in this application and are recommended by nearly every resin manufacturer. At the low concentrations used (typically 200 ppm or less), they do not interfere with the hydrocarbon surfactants that are added to emulsify resins and waxes in the formulation, and minimal foaming is observed. FS-60, FS-61, FS-64, FS-65, FS-34, and FS-35 are the most common grades for this use. A visual demonstration of improved performance can be seen in Figure 4.

In 'strippers' for floor polish removal systems, the chemical stability (i.e., resistance to alkali) of fluorosurfactants is an important performance attribute. Good performance depends on the ability of the stripper to completely wet and penetrate the layer(s) of old polish/wax, so that they can be separated from the substrate to provide a surface ready for refinish. These surfaces can be difficult to wet; the addition of Capstone® fluorosurfactants can eliminate this concern. In stripper formulations, Capstone® fluorosurfactants work with the detergency of hydrocarbon surfactants (which emulsify the old finish to guard against redeposition) to give superior performance.



Floor finish without Capstone® fluorosurfactant shows clearly visible orange peel and significant surface defects.

Floor finish dosed with FS-60 at 75 ppm has drastically improved leveling and surface appearance of the floor finish on the vinyl tile.

Figure 4. Improved Performance of Floor Finish Formulations

Low-VOC or VOC-Free Latex Paints

Capstone® fluorosurfactants are multifunctional additives in paints and coatings, especially when formulated with low- or no-VOC products. New research demonstrates that adding Capstone® fluorosurfactants into both the grind and the letdown phases of production will help to simplify the formulation, improve performance and reduce raw material costs.

The addition of Capstone® fluorosurfactants in the grind phase of production replaces the need for a pigment-wetting agent. As a result, the reduction in non-fluorinated surfactants can lead to a reduction of foam and defoamer agents, which will improve oily stain resistance of the paint film and reduce the amount of foam generated during the letdown phase.

The addition of Capstone® fluorosurfactants in the letdown phase eliminates the need to add substrate wetting and film leveling agents. It also eliminates the need to use wax, silicone or other anti-blocking agents and reduces the need for a defoamer. For a summary, see Table 1.

Table 1. General Guidelines for Adding Capstone® Fluorosurfactants During Paint Production

Grind Phase		Letdown Phase	
ADDITIVE	ADJUSTMENT	ADDITIVE	ADJUSTMENT
Dispersant	No Adjustment	Resin/Emulsion Binder	No Adjustment
Pigment Wetting Agent	Reduce by 30% to 100%	Wetting Agent	Eliminate
ADD Capstone® Fluorosurfactant 0.01-0.05%¹		ADD Capstone® Fluorosurfactant 0.01-0.05%¹	
Defoamer	Reduce by 50% to 100%	Defoamer	Reduce ₂
Pigment TiO ₂	No Adjustment	Leveling Agent	Eliminate
Filler (CaCO ₃ , Clay, Talc)	No Adjustment	Wax and Other Anti-blocking Agents	Eliminate
Rheology Modifier	May Require Minor Adjustment	In-can and Film Preservatives	No Adjustment

1. For selection and use rate of Capstone® fluorosurfactants, refer to technical data sheets or ask your DuPont technical representative.
2. If required, use minimal amount of water-dispersible polysiloxane.
Note: Individual results may vary.

Benefits in paint formulations include wetting (improved intercoat adhesion, and the ability to wet out low energy surfaces), leveling (improved gloss, and reduced “orange peel,” or decreased incidence of Benard cells), anti-blocking (reduce tendency of glossy paints to stick to themselves), and the ability to reduce cratering,

an effect due to the presence of surface imperfections or contaminants. The benefits are summarized in Figure 5. The nonionic and amphoteric Capstone® fluorosurfactants (e.g., FS-30, FS-31, FS-50 and FS-51) provide enhanced wetting and leveling properties. Anti-block properties are demonstrated at low-use rates of 200-300 ppm in latex paints with FS-61, FS-63 and FS-64. A more detailed summary is available in our “Simplify Formulations and Improve Performance in Architectural/Decorative Paints and Coatings” brochure, number K-23574, which can be found at www.capstone.dupont.com under Technical Information.

Improved cleanability of oily dirt, oil repellency, good dirt pick-up resistance (DPR) and enhanced wetting are achieved in architectural flat paints and waterborne coatings with the use of FS-81 as an additive. Additionally, FS-81 does not interfere with recoat adhesion or create water repellency (see Figure 6). Using this fluoroadditive results in an improvement in washability of oil-based stains, such as dirty handprints, for low-sheen latex paints. In order to obtain optimal results, it is recommended that the coating be reformulated to minimize additives that attract oil and excess surfactants. The combination of anionic fluorosurfactants (e.g., FS-61) and FS-81 provides maximum performance for DPR. The use rates recommended for FS-81 as an additive are dependent on the particular coating system, end-use application and the desired outcome. Table 2 provides guidance based on the knowledge DuPont has gained from evaluations of FS-81.

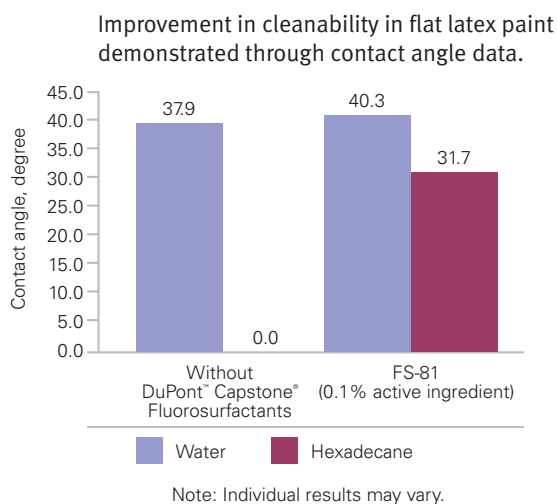
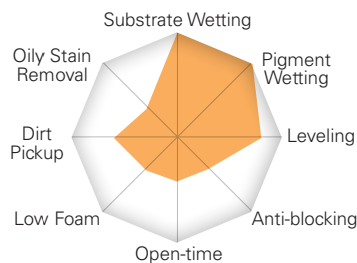
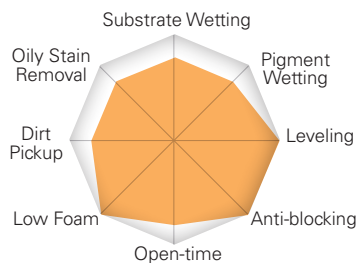


Figure 6. Flat Latex Paint Advancing Contact Angle Data

FS-30 and FS-31



FS-61 and FS-63



FS-81

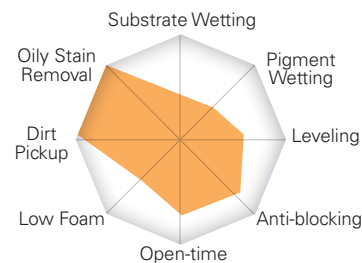


Figure 5. Demonstrating the Multi-Functional and Easy to Use Performance Benefits of Specific Capstone® Fluorosurfactants

Table 2. FS-81 Use Rate for Various Applications

	Application		
	Interior Stain Washability	Dirt Pick-up Resistance (DPR)	Wetting Agent
Use Rate (Product Weight)	0.3–0.5%	0.3–1%	0.2%
Use Rate (Active Ingredient)	0.1–0.2%	0.1–0.3%	0.07%

Solvent, Radiation-Cured and 100% Solids Systems

Manufacturers using solvent-based coatings, container manufacturers, ink formulation companies, and converters (finish films for printing, metalizing or tape manufacturers) all find a need for the use of multifunctional additives for their coating systems. FS-3100, FS-22 and FS-83 can provide improved properties to these systems.

Ink and Graphics Arts

Excellent wetting and leveling properties for ink and graphic arts types of coatings are achieved with the addition of Capstone® fluorosurfactants, without interfering with the dispersed phase dyes and pigments. Further, since Capstone® fluorosurfactants rise to the air interface, they reduce “transfer” to the next surface when sheet or roll-type products are stacked. The primary performance functions include anti-block, ink acceptance, leveling and wetting. For aqueous-based systems, FS-34, FS-35 and FS-65 provide enhanced wetting and leveling. FS-22 and FS-83 are ideal for non-polar solvent-based applications.

Adhesives, Sealants, Caulks

Adhesive applications exist in many forms, such as adhesives for tape, for hot-melt, for wood (and other porous surfaces). Adhesives are used in packaging, construction, and many OEM applications. The addition of a small amount of a Capstone® fluorosurfactant improves the wetting and penetration of the adhesive into the pore structure of the substrates, thus strengthening the bond. Capstone® fluorosurfactants such as FS-30 and FS-31

provide reduced surface defects, dynamic surface tension reduction (in combination with existing surfactant package), and penetration of the adhesive.

Films

Surface energy of the film is increased by ionization, flame treatment, or because the film contains some manner of “roughener” to improve adhesion of subsequent coatings. For print acceptors, Capstone® fluorosurfactants improve wetting and leveling of coatings for ink, improve adhesion, abrasion resistance, reduce transfer, and improve general “printability”. In a variety of coating applications, Capstone® fluorosurfactants can provide antistatic properties. In addition to wetting, Capstone® fluorosurfactants migrate to the top of a coating and thus encourage rewetting in multi-coat operations.

Suitable Capstone® fluorosurfactants for these applications include: FS-10, FS-30, FS-31 and FS-50. In release coatings, there are two general types of films: CAST (polymer is dissolved in solvent, cast on a belt or drum, and the solvent is driven off and recovered) and EXTRUDED (melted resin is pushed through a die). Since Capstone® fluorosurfactants migrate to the liquid-air interface in coatings, they can impart release characteristics to that coating surface. Fluorosurfactants such as FS-66 and FS-63 are ideal for release coating applications.

Overall, a variety of Capstone® fluorosurfactants can provide the performance benefits in film applications of anti-block, antistatic, improved surface properties, film leveling (even thickness), reduction in cratering (due to the presence of impurities), water repellency, wetting and film release (off the belt/drum without deformation, tearing or edge effects). For a summary specific features and applications of Capstone® fluorosurfactants, refer to the Application Guide on page 7.

Highlights of DuPont™ Capstone® Fluorosurfactants

FS-10

FS-10 is an anionic fluorosurfactant that reduces the surface tension of aqueous solutions to low levels and demonstrates exceptional stability in corrosive, and in particular, highly acidic media, while creating minimal to no foam. This is effective in chrome plating and metal treatment applications. FS-10 is useful as a wetting and antistatic aid in films.

FS-30 and FS-65

FS-30 and FS-65 combine the performance of superior wetting and leveling agents with the surface protection qualities of a coating additive. FS-30 is VOC-free, APEO-free and non-flammable. It is stable in acidic, basic, brine and hard water environments. FS-65 is VOC-free and APEO-free, and has a strong non-ionic character under all conditions. It is stable in acidic, basic and brine environments. In addition to providing superior performance, both FS-30 and FS-65 meet the OECD 301B test methods criteria pertaining to biodegradability.

FS-31, FS-3100, FS-34 and FS-35

FS-31, FS-34 and FS-35 are non-ionic, VOC-free and APEO-free fluorosurfactants that provide exceptionally low surface tension in aqueous or solvent-based products, enabling better wetting, spreading, leveling and other beneficial properties. FS-34 and FS-35 have shown enhanced leveling and wetting properties in floor care and ink applications. FS-31, FS-3100, FS-34 and FS-35 are stable in acidic, basic, brine and hard water environments, making it easy to formulate into a variety of systems.

FS-50 and FS-51

FS-50 and FS-51 are amphoteric fluorosurfactants that significantly reduce the surface tensions of aqueous fluids and are effective in providing sustainable foams. Both products are effective additives in industrial and institutional cleaning, floor care, and latex and water-based alkyd paints.

FS-60, FS-61 and FS-63

FS-61 is a VOC-free and APEO-free anionic fluorosurfactant dispersion that provides excellent anti-blocking, oil repellency and dirt pick-up resistance properties. FS-60 and FS-63 are similar to FS-61, but contain isopropyl alcohol. Both of these waterborne surface-modifying products provide outstanding multi-functional performance for both interior and exterior paint and coating applications, as well as Industrial and Institutional applications.

FS-64

FS-64, a VOC-free anionic fluorosurfactant, combines the unique properties of fluorine with the strength of a DuPont™ Renewably Sourced™ material, which contains a minimum of 20% renewably sourced ingredients by weight. FS-64 is an environmentally preferred fluorosurfactant that provides all the general performance attributes you would expect from a fluorosurfactant, including: superior surface tension reduction, anti-block, oil repellency, dirt pick-up resistance, excellent leveling characteristics and stability in highly acidic and alkaline media.

FS-81

FS-81 is a self-dispersed, waterborne, partially fluorinated polymeric coating additive designed to improve cleanability of oily dirt and common household stains on flat architectural waterborne coatings and latex paints. As shown in Figure 6, FS-81 improves oil contact angles on interior, flat finish, latex coatings.

FS-22 and FS-83

FS-22 and FS-83 are solvent-borne, partially fluorinated copolymers that provide surface tension reduction and superior easy-clean performance in solvent-based coating systems, which enables better wetting, spreading and leveling.

DuPont™ Capstone® Fluoroadditive Application Guide

Features	FS-10	FS-22	FS-30	FS-31	FS-34	FS-35	FS-50	FS-51	FS-60	FS-61	FS-63	FS-64	FS-65	FS-66	FS-81	FS-83	FS-3100
Waxes/Polishes																	
Wetting	•		•	•	•	•	•	•	•	•	•	•	•				•
Leveling	•				•	•	•	•	•	•	•	•	•				
Gloss	•				•	•	•	•	•	•	•	•	•				
Strippers	•		•	•	•	•	•	•									•
Cleaners																	
Wetting	•		•	•	•	•	•	•	•	•	•	•	•				•
Leveling	•				•	•	•	•	•	•	•	•	•				
Antifog			•	•	•	•							•				•
Antistatic	•		•	•	•	•							•				•
Oxidizing	•												•				
Acidic			•	•	•	•	•	•				•	•				•
Basic			•	•	•	•			•	•	•	•	•				•
Metal Plating/Etch	•		•	•									•				
Paints & Coatings																	
Anti-block									•	•	•	•					
Open-time			•	•	•	•							•		•		•
Wetting	•		•	•	•	•	•	•	•	•	•	•	•				•
Leveling	•				•	•	•	•	•	•	•	•	•				
Cleanability															•		
Water-based	•		•	•	•	•	•	•	•	•	•	•	•		•		•
Solvent-based		•												•		•	
Mold Release											•	•		•			
Inks	•		•	•	•	•							•				•
Films	•	•	•	•			•						•	•		•	•
Adhesives	•		•	•	•	•							•				•
Foamers																	
Aqueous	•		•		•		•	•									
Solvent		•														•	
Biodegradability			•										•				
VOC-free	•		•	•	•	•				•		•	•	•			•

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- Product literature
- Material safety data sheets (MSDS)
- Technical data sheets
- Sample requests
- Customer support

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