

# Capstone™

Fluorosurfactants

For high value-in-use applications  
that require maximum performance

# Solutions to Fuel Your Innovation

Capstone™ surfactants and repellents 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, 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, Chemours has a robust supply of Capstone™ fluorosurfactants, so you can be confident your production lines will run smoothly—no matter where in the world you operate.

Chemours 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 that products are safe for their intended use. A more detailed summary is available in our “Product Stewardship Detail” brochure that can be found at [capstone.chemours.com](http://capstone.chemours.com).

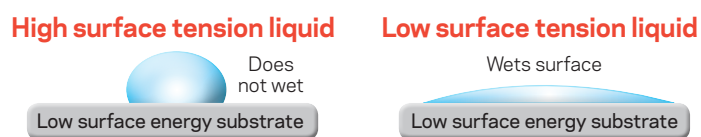
The Capstone™ fluorosurfactants team stands ready to work with you to help your business grow—from choosing the Capstone™ fluoroadditive that is right for your application and business needs to answering technical questions.

## 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, Capstone™ fluorosurfactants enhance the properties of formulations by improving properties, such as wetting and spreading, leveling, penetrating, foaming control, and substantially reducing surface tension.

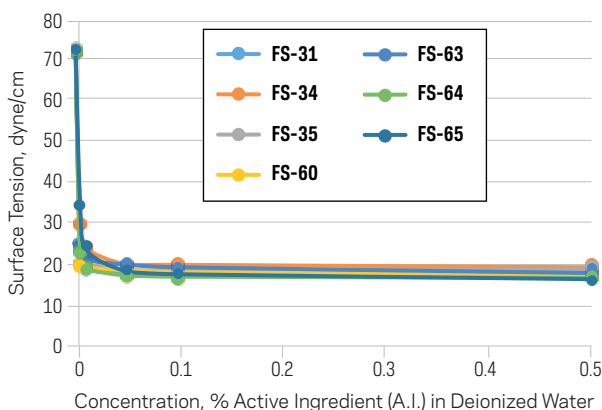
To effectively wet a substrate, the surface energy of the formulation must be lower than the surface energy of the substrate (see **Figure 1**). Capstone™ fluorosurfactants offer unparalleled wetting and leveling power in both water- and solvent-borne formulations with surface energies as low as 18 dyne/cm at extremely low concentrations (see **Figure 2**).

**Figure 1. Schematic for Wetting**



Substrate	Typical Surface Energies, dyne/cm
Polyurethane	43
Alkyd	38
Polyethylene	31
Paraffin	26
Silicone	24
Teflon™ PTFE	19

**Figure 2. Capstone™ Surface Tension**



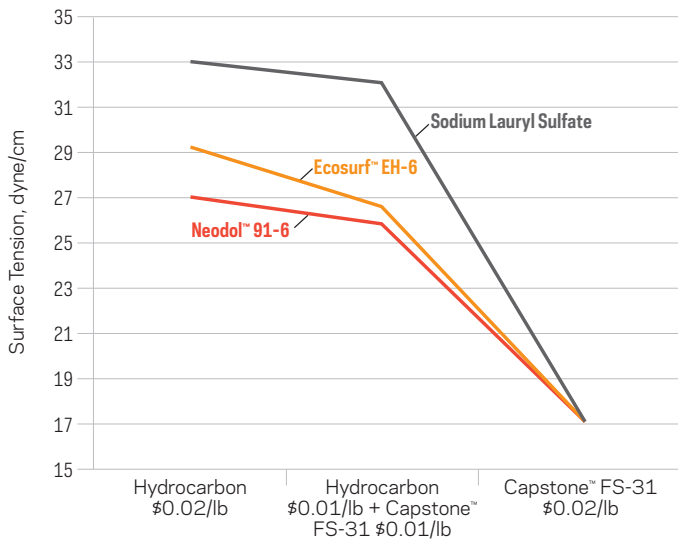
Capstone™ fluorosurfactants work well in harsh chemical and thermal conditions and can also help reduce the amount and number of other additives in formulations—helping to reduce complexity while creating higher-performing products. For more detailed information, please refer to the Capstone™ Fluoroadditive 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. The cost benefits of such blending can be between three-fold and ten-fold.

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**



Note: Individual results may vary.

### 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 achieved 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 and 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 amphoteric FS-50 and FS-51 fluorosurfactants, are best 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 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.

**Figure 4. Improved Performance of Floor Finish Formulations**



*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.*

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 refinishing. 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 re-deposition) to give superior performance.

### Re-Formulation Recommendations with Capstone™ for Low-VOC or VOC-Free Latex Paints

Capstone™ fluorosurfactants are multi-functional additives in paints and coatings, which are equally effective when formulated with low-VOC or VOC-free products. New research demonstrates that adding Capstone™ fluorosurfactants into both the grind and 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, resulting in the following benefits:

- Reduction of non-fluorinated surfactant load
- Reduced foaming, leading to
  - Reduction of defoamer load
  - Reduced foam generation in letdown phase
- Improved oily stain resistance of paint film

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, which simplifies the formulation and can lead to cost savings. Because every formulation is different and designed to meet a wide variety of performance needs, there is no simple formula for how to unlock the performance of Capstone™ fluorosurfactants. However, to help you gain a better understanding of how to use Capstone™ fluorosurfactants in your formulations, we have created the following general guidelines (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 30-100%	Wetting Agent	Eliminate
<b>ADD Capstone™ Fluorosurfactant 0.01-0.05%<sup>1</sup></b>		<b>ADD Capstone™ Fluorosurfactant 0.01-0.05%<sup>1</sup></b>	
Defoamer	Reduce by 50-100%	Defoamer	Reduce <sup>2</sup>
Pigment TiO <sub>2</sub>	No Adjustment	Leveling Agent	Eliminate
Filler (CaCO <sub>3</sub> , Clay, Talc)	No Adjustment	Wax and Other Anti-Blocking Agents	Eliminate
Rheology Modifier	May Require Minor Adjustment	In-Can and Film Preservatives	No Adjustment

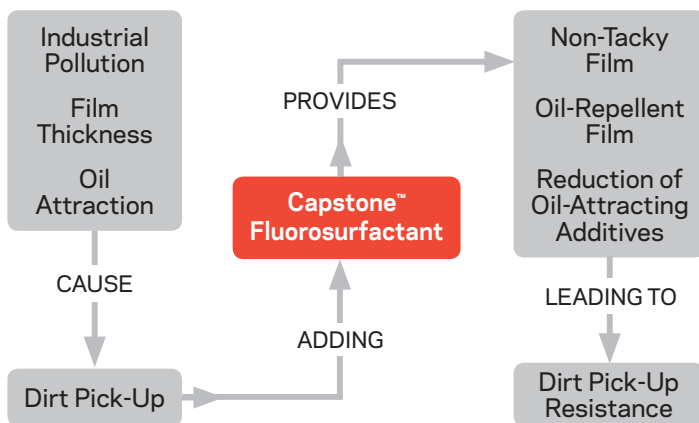
<sup>1</sup>For selection and use rates of Capstone™ fluorosurfactants, refer to technical data sheets or ask your Chemours technical representative.

<sup>2</sup>If required, use minimal amount of water-dispersible polysiloxane.

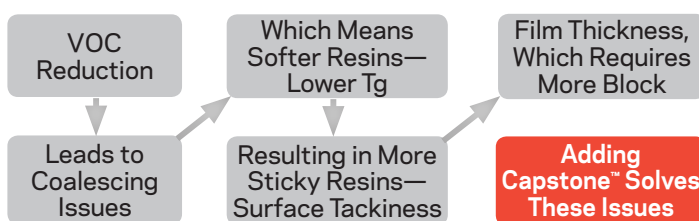
Note: Individual results may vary.

Note: The dispersant is calculated by the chemical nature of the pigment, so it should not be altered or changed in this formulation example. The addition of Capstone™ fluorosurfactant in this phase of production essentially replaces the need for a pigment wetting agent. Consequently, this reduction in non-fluorinated surfactant can lead to the 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.

**Figure 5. Dirt Pick-Up Resistance (DPR) Problems**



### Anti-Block Problems



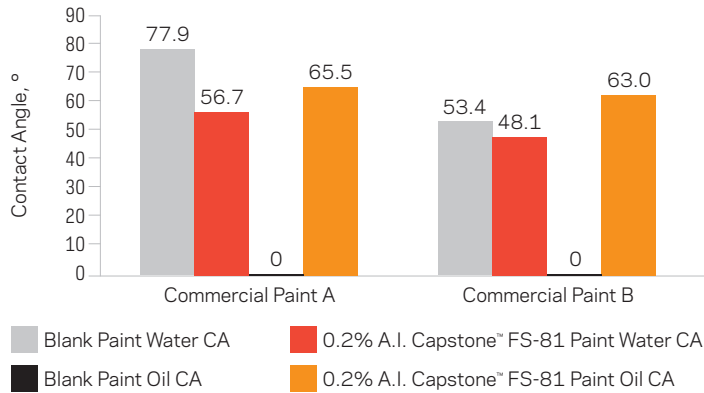
Benefits in paint formulations include wetting (improved intercoat adhesion and the ability to wet out low energy surfaces), leveling (improved gloss and reduced “orange peel” or decreased incidence of Benard cells), anti-blocking (reduce tendency of glossy paints to stick to themselves), and reduced cratering (an effect due to the presence of surface imperfections or contaminants). The benefits are summarized in Figure 7. 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 200-350 ppm in latex paints with FS-61, FS-63, and FS-64. Please contact a Chemours representative to discuss your particular situation.

With the use of FS-81 or FS-61 in architectural low-sheen paints and waterborne coatings, final products can achieve improved cleanability of oil-based stains and dirt, oil repellency, and enhanced wetting—often called “Easy Clean” or dirt pick-up resistance (DPR). Additionally, FS-81 does not interfere with re-coat adhesion or create water repellency (see Figure 6). In order to obtain optimal results, it is recommended that the coating be re-formulated 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 both interior and exterior paint applications. The use rates recommended for FS-81 as an additive are dependent on the particular coating system, end-use application, and desired outcome. Table 2 provides guidance based on the knowledge Chemours has gained from evaluations of FS-81.

**Table 2. FS-81 Use Rate for Various Applications**

Use Rate (Active Ingredient)	Application		
	Interior Stain Washability	Dirt Pick-Up Resistance (DPR)	Wetting Agent
	0.1-0.2%	0.1-0.3%	0.07-0.1%

**Figure 6. Static Water and Oil Contact Angles in Low-Sheen Commercial Latex Paint**



**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 multi-functional 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, because 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, and Caulks**

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.

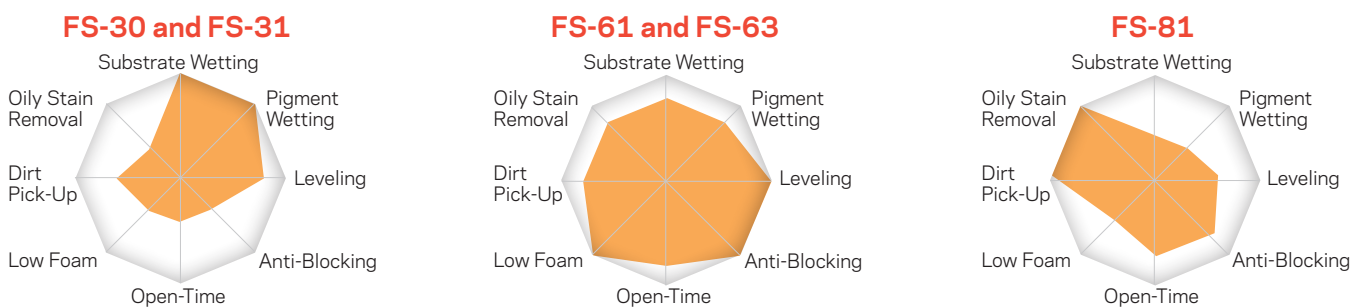
**Films**

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, adhesion and abrasion resistance, and general “printability,” as well as reduce transfer. 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.

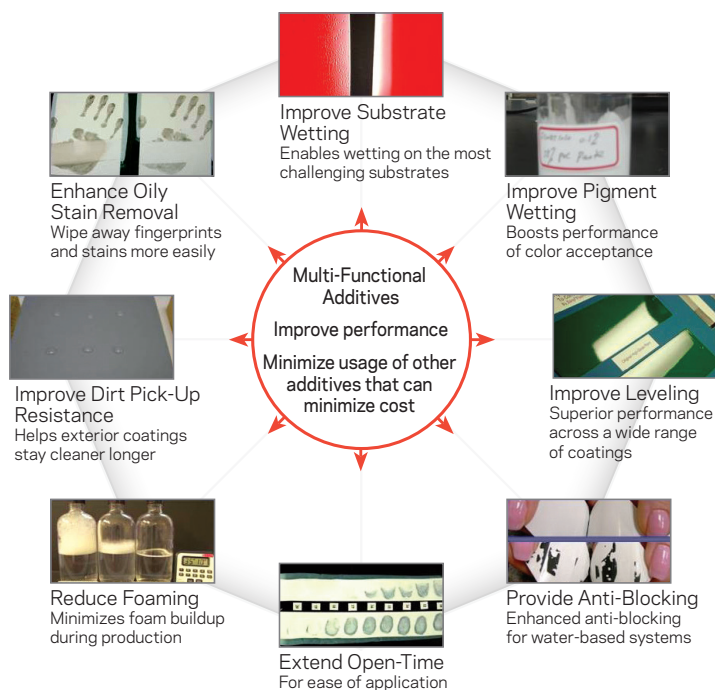
Suitable Capstone™ fluorosurfactants for these applications include: FS-10, FS-30, FS-31, and FS-50. In release coatings, there are two general types of films: CAST (polymer is dissolved in solvent and then cast on a belt or drum, with the solvent driven off and recovered) and EXTRUDED (melted resin is pushed through a die). Because 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 of specific features and applications of Capstone™ fluorosurfactants, refer to the Application Guide on page 7.

**Figure 7. Demonstrating the Multi-Functional and Easy-to-Use Performance Benefits of Specific Capstone™ Fluorosurfactants**



# Highlights of Capstone™ Fluorosurfactants



## 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 nonflammable. It is stable in acidic, basic, brine, and hard water environments. FS-65 is VOC-free, 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-3100, FS-34, and FS-35 are non-ionic, VOC-free, APEO-free, nonflammable fluorosurfactants that provide exceptionally low surface tension in aqueous- or solvent-based products, enabling better wetting, spreading, and leveling. 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 them easy to formulate into a variety of systems. FS-3100 is the preferred product for electronics and lithium ion battery electrolytes for wetting. This product is superb in polar solvent systems.

## FS-50 and FS-51

FS-50 and FS-51 are APEO-free, nonflammable, 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, APEO-free, nonflammable, anionic fluorosurfactant dispersion that provides excellent anti-blocking, oil repellency, and DPR 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, APEO-free, nonflammable, anionic fluorosurfactant, combines the unique properties of fluorine with the strength of a Chemours Renewably Sourced™ material that 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, DPR, excellent leveling characteristics, and stability in highly acidic and alkaline media.

## FS-81

APEO-free, nonflammable 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, Easy Clean, latex coatings.

## FS-22 and FS-83

APEO-free, nonflammable 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.

Please see product-specific technical data sheets for use rates and further information.

### 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
<b>Polishes/Waxes</b>																	
Wetting	■		■	■	■	■	■	■	■	■	■	■	■				■
Leveling	■				■	■	■	■	■	■	■	■	■				
Gloss	■				■	■	■	■	■	■	■	■	■				
Strippers	■		■	■	■	■	■	■									■
<b>Cleaners</b>																	
Wetting	■		■	■	■	■	■	■	■	■	■	■	■				■
Leveling	■				■	■	■	■	■	■	■	■	■				
Anti-Fog			■	■	■	■							■				■
Antistatic	■		■	■	■	■							■				■
Oxidizing	■												■				
Acidic			■	■	■	■	■	■				■	■				■
Basic			■	■	■	■			■	■	■	■	■				■
<b>Paints and Coatings</b>																	
Anti-Block									■	■	■	■					
Open-Time			■	■	■	■							■		■		■
Wetting	■		■	■	■	■	■	■	■	■	■	■	■				■
Leveling	■				■	■	■	■	■	■	■	■	■				
Cleanability															■		
Water-Based	■		■	■	■	■	■	■	■	■	■	■	■		■		■
Solvent-Based		■												■		■	
Mold Release											■	■		■			
Inks	■		■	■	■	■							■				■
Films	■	■	■	■			■						■	■		■	■
Adhesives	■		■	■	■	■							■				■
<b>Foamers</b>																	
Aqueous	■		■		■		■	■									
Solvent		■															■
Biodegradability			■										■				
VOC-Free			■	■	■	■				■		■	■	■			■

For more information about eco-label compliant Capstone™ fluoroadditives, please contact your regional customer service representative.

