



Dow Industrial Solutions

Low Foam Surfactant for Automatic Dishwashing, Rinse Aids and Hard Surface Cleaning

ECOSURF™ LFE-1410 Surfactant



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Dow has introduced a new low foam surfactant product family which enables improved performance in phosphate-free automatic dishwashing and rinse aid formulations, and offers excellent hard surface cleaning performance. ECOSURF™ LFE-1410 Low Foam Surfactant offers outstanding foam control and proteinaceous soil removal. Compared to industry benchmarks, ECOSURF™ LFE-1410 reduces spotting and filming in rinse aid formulations. ECOSURF™ LFE-1410 is a 100% active, liquid surfactant with excellent handling properties.

As an industry leader in sustainability, we are committed to reducing our environmental footprint, increasing resource efficiencies, and developing multi-functional products that do

more for consumers. ECOSURF™ LFE Series Surfactants are readily biodegradable, low foam surfactants with very low aquatic toxicity, which meet or exceed existing environmental regulations. These surfactants meet the criteria for US EPA's Safer Choice program.

Automatic Dishwashing and Rinse Aid Performance Benefits

- Improved filming, spotting and cleaning efficiency in industrial machine dishwashing, warewash and rinse aids
- Sparkling dishes
- Extremely effective in removing proteinaceous soil in automatic dishwashing applications

Table 1: Typical Physical Properties

| | Cloud Point ⁽¹⁾ | Draves Wetting ⁽²⁾ | Contact Angle ⁽³⁾ | CMC ⁽⁴⁾ / Surface Tension ⁽⁵⁾ | Readily Biodegradable ⁽⁶⁾ | Meets US EPA Safer Choice Criteria |
|-------------------------------------|----------------------------|-------------------------------|------------------------------|-----------------------------------------------------|--------------------------------------|------------------------------------|
| ECOSURF™ LFE-1410 Surfactant | 10 | 82 | 73 | 85/35 | Yes | Yes |

⁽¹⁾ °C, 1% actives aqueous solution; ⁽²⁾ wetting time in seconds @ 0.1 wt%; ⁽³⁾ 0.1% active aqueous solution on polytetrafluoroethylene (PTFE); ⁽⁴⁾ ppm at 25°C; ⁽⁵⁾ dynes/cm at 1% actives, 25°C; ⁽⁶⁾ OECD 301

Automatic Dishwashing Performance

Table 2: Spotting and Filming (Rinse Performance)

| | Industry Benchmark | ECOSURF™ LFE-1410 |
|-----------------------------------------------------|--------------------|-------------------|
| Plates (Melamine, Glass, Porcelain, Ceramic) | = | = |
| Glasses | = | = |
| Stainless Steel | = | ++ |

50 g soil (ketchup, milk, starch, fat, egg yolk, benzoic acid), European machine and conditions
Formulations include dispersant and co-surfactant

ECOSURF™ LFE-1410 performed equal to the industry benchmark on melamine, glass, porcelain and ceramic surfaces for spotting and filming. On stainless steel, ECOSURF™ LFE-1410 demonstrated improved spotting and filming compared to the industry benchmark.

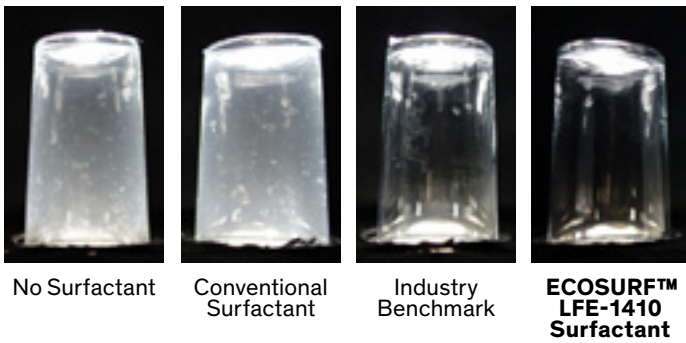
Table 3: Cleaning

| | Industry Benchmark | ECOSURF™ LFE-1410 |
|-------------------|--------------------|-------------------|
| Pasta | = | = |
| Milk | = | + |
| Tea | = | = |
| Egg Yolk | = | = |
| Starch Mix | = | = |

50 g soil, European machine and conditions
Formulations include dispersant and co-surfactant

In automatic dishwashing applications, ECOSURF™ LFE-1410 had performance equivalent to the industry benchmark in cleaning tough kitchen soils, and better performance on milk soil.

Figure 1: Filming, Spotting and Cleaning Comparison

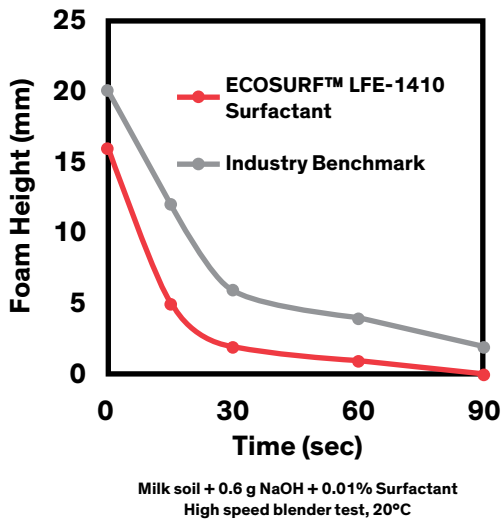


ECOSURF™ LFE-1410 significantly reduced filming and spotting compared to a conventional surfactant and the industry benchmark. ECOSURF™ LFE-1410 had the best cleaning efficiency and performance of the formulations tested.

Defoaming Performance

ECOSURF™ LFE-1410 exhibited more effective defoaming of proteinaceous soil than the industry benchmark, with both lower initial foam formation and more rapid foam collapse.

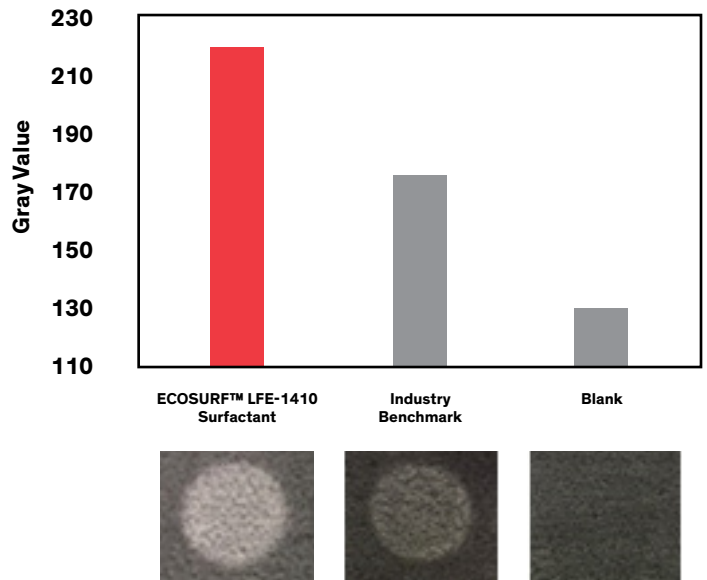
Figure 2: Effective Defoaming of Proteinaceous Soil



Hard Surface Cleaning Performance

ECOSURF™ LFE-1410 exhibited excellent cleaning and degreasing of hard surfaces compared to the industry benchmark. It is compatible with a wide range of nonionic, anionic and cationic formulations.

Figure 3: Excellent Hard Surface Cleaning



Generic hard surface cleaner formulation, carbon black/vegetable oil soil on vinyl tile surface





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|----------------------|------------------|---------------------------|-------------------|----------------|
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