Stepan Alkoxylates

Collaborative Chemistry. Creative Solutions.

Be Clean, Look Clean

Stepan's Low Film/Streak Technology

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Overview

- Market Needs and Trends
- Background: Why Low Film/Streak (LFS)?
- Role of Surface Free Energy (SFE)
- Role of Soil, Wetting and Surface Types
- LFS Performance Overview
- LFS Fundamentals
- Discussion, Q&A

Identifying Market Need

Desire for Cleaning Ingredients with Multi-Functionality

- Excellent cleaning performance
- Visibly clean surface
- Useful in household care, industrial and institutional cleaning, vehicle care, truck wash, etc.
- Useful on glass, ceramic, vinyl, metal, etc.

Market Trends

Hard Surface Cleaning Product Introductions 2015 - 2019

26% of HSC products had “shine” or “streak” on label in relation to performance claims

94% growth in those claims

Highest growth in:

- Bath, Shower, Tile Care
- Metal Cleaners
- Floor Care
- Furniture Care
- All-Purpose/Multi-Purpose Surface Care

Source: Mintel

Be Clean, Look Clean

Cleaning a surface is more than just lifting the dirt.

- If the cleaning process leaves behind soil, the surface will not ***Be Clean***
- If the cleaner leaves a visible residue, the surface will not ***Look Clean***

This is a polished vinyl tile that is “clean,” but with visible residue left from the cleaning solution.

Why LFS? Watch These Cleaners in Action

Ceramic

Typical Nonionic Surfactant

Stepan's LFS Technology

All-Purpose Cleaners consisting of 1 wt% of the corresponding nonionic surfactant, C9-11 6EO (left) and BIO-SOFT® LFS-04 (right) in deionized water

Why LFS? Watch These Cleaners in Action

Acrylic Polished VCT

Typical Sugar-Based Surfactant	Stepan's LFS Technology

All-Purpose Cleaners consisting of 1 wt% of the corresponding nonionic surfactant, alkyl polyglycoside (left) and BIO-SOFT LFS-04 (right) in deionized water

Why Low Film/Streak?

Cleaners should remove soils and not leave a visible residue behind

Property	Alcohol Ethoxylates	Alkyl Polyglycosides
Activity	90-100%	50%
Leave Film-Free and Streak-Free Surface	X	✓
Degreasing	✓	X

Are there any 90-100% active alcohol alkoxylates that can clean and not leave a visible residue?

Time For Some Science …

Role of Surface Free Energy in Cleaning & LFS

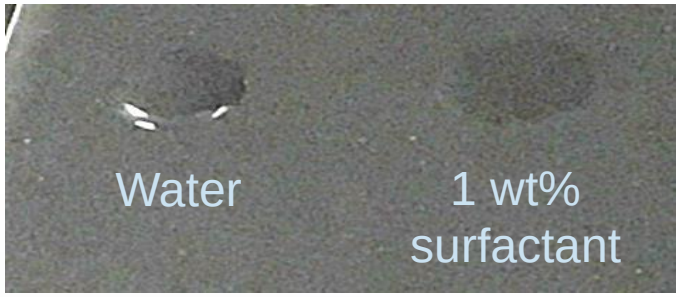
Glass	Ceramic	Finished Oak	Engineered Laminate	Acrylic Polished VCT	Luxury Vinyl Tile (LVT)	Polypropylene	Sealed Granite
70.9	68.8	64.8	51.6	40.8	37.7	32.9	29.4

(SFE in units of mN/m)

First requirement: cleaner must wet the surface

- Necessary for cleaning
- Spreads residues over larger area to dry
- Some surfaces wet easily
- Others are very difficult to wet

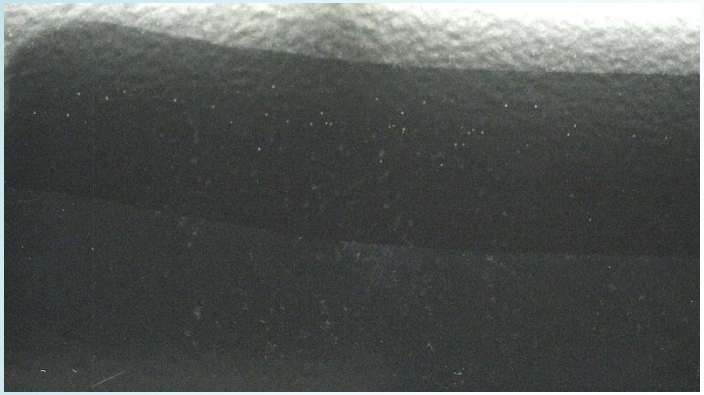
Ceramic



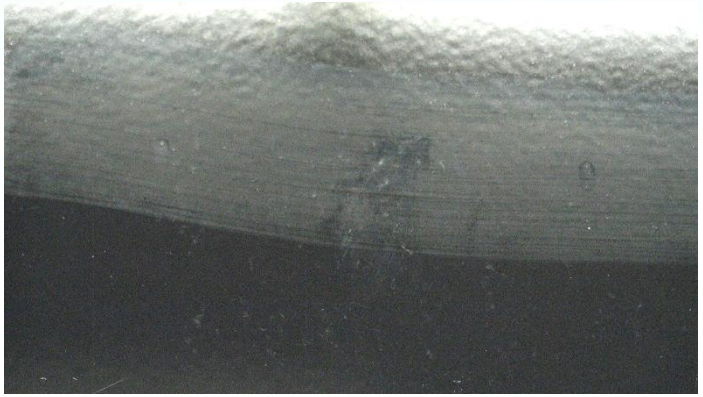
Sealed Granite

There is More to Film/Streak than Effective Wetting

Even when a cleaner wets a surface well …



Car Panel – Wet with cleaner
(1 wt% C10 Guerbet 8EO)



Car Panel – After cleaner dries
(1 wt% C10 Guerbet 8EO)

… it does not guarantee a film/streak-free result.

Soil Removal and Film/Streak Combined

Soil can lower the SFE of a surface *(water doesn't spread well on oil)*

Good cleaning is the first step:

- Surfactants penetrate, emulsify and remove soil

Improved appearance is the second step:

- Does the soil re-deposit?
- Does the cleaner leave its own residue?

Average Cleaning, Poor Film/Streak

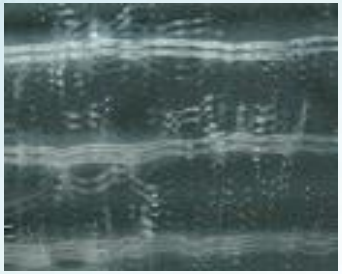
Average Cleaning, Good Film/Streak

Gardner Scrub Test with ASTM Soil, No Rinse

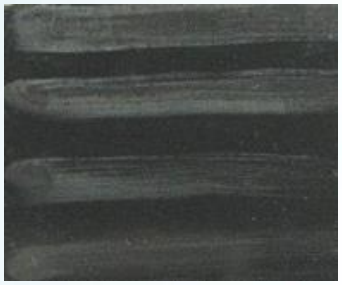
Film/Streak Across Surface Types

Surfaces are not all equal: some show film/streak more than others

Glass Mirror

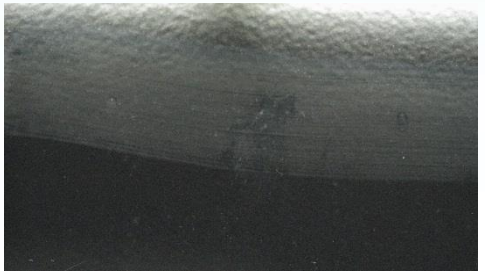


Ceramic Tile



Acrylic Polished VCT

Car Panel



Luxury Vinyl Tile

Solving the Problem: Development of LFS

With Stepan's expansion of our alkoxylate platform, R&D set out to work on this problem:

- Conducted extensive research across many classes of nonionic surfactants
- Identified the origin of the problem
- Developed a solution

Property	Alcohol Ethoxylates	Alkyl Polyglycosides	**BIO-SOFT LFS-Series**
Activity	90-100%	50%	90-100%
Leave Film-Free and Streak-Free Surface	X	✓	✓
Degreasing	✓	X	✓

Stepan Alkoxylates

Introducing: BIO-SOFT LFS-04 and BIO-SOFT LFS-07

BIO-SOFT LFS-04

Average soil loads, best film/streak on glossy/glass surfaces and high-dilution applications

BIO-SOFT LFS-07

Heavier soil loads, great for low film/streak, fast-break foam

- ✓ Patent-Pending WO2020018356
- ✓ 90-100% Active
- ✓ Easy-to-Handle Liquids
- ✓ Dilutable
- ✓ Low Foam or Fast Break
- ✓ Cost-Effective Performance
- ✓ Versatile, Multi-Surface Performance
- ✓ Greasy Soil Remover

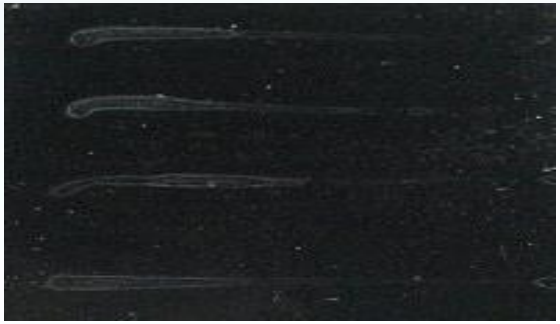
Typical Properties

Tradename	Appearance at 25°C	Cloud Point (°C)	Pour Point (°C)	Surface Tension at CMC (mN/m)	pH (1% in DI water)	Ross-Miles 0.1% aqueous		Draves Wetting at 25°C, 1% aqueous, seconds
						Initial, cm	5 min, cm	
BIO-SOFT LFS-04	Clear Liquid	45.5	18	27.3	10.5	8.7	8.2	15.5
BIO-SOFT LFS-07	Clear Liquid	33.5	-15	27.1	10.5	7.9	3.3	4.3

Measurement of Film/Streak

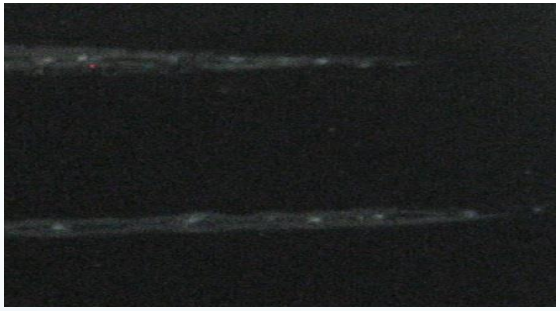
BIO-SOFT LFS-04 on
Acrylic Polished VCT = 0.8

Decyl/Undecyl Glucoside on
Acrylic Polished VCT = 2.4



BIO-SOFT LFS-04 on
Glossy Ceramic = 0.7

Guerbet Alcohol Ethoxylate
on Glossy Ceramic = 4.8



0 → Visibly poor film/streak begins at about 2 and above

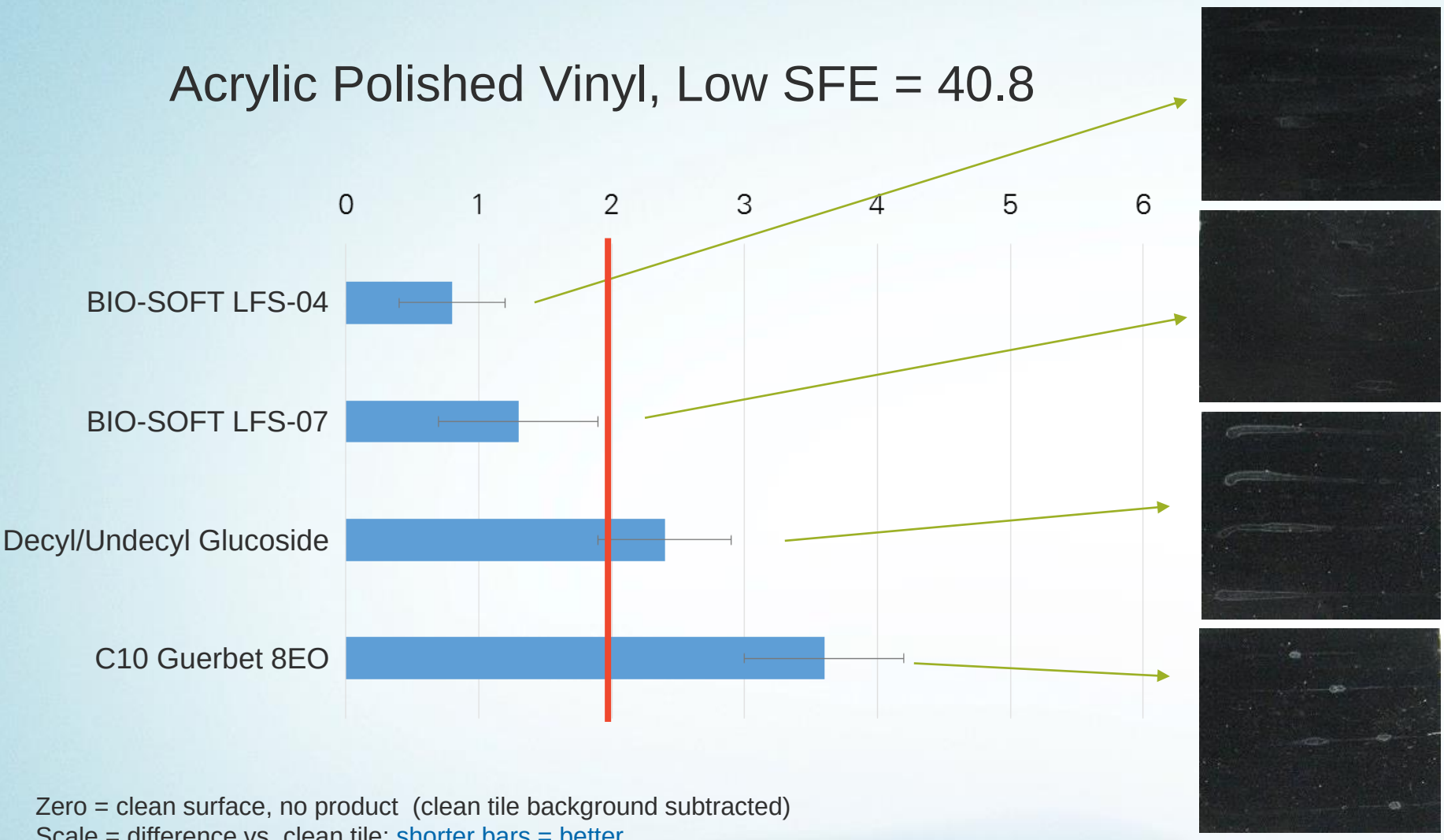
Zero is best
(most like clean surface)

Scale = difference vs. clean tile

The top end is
unbounded

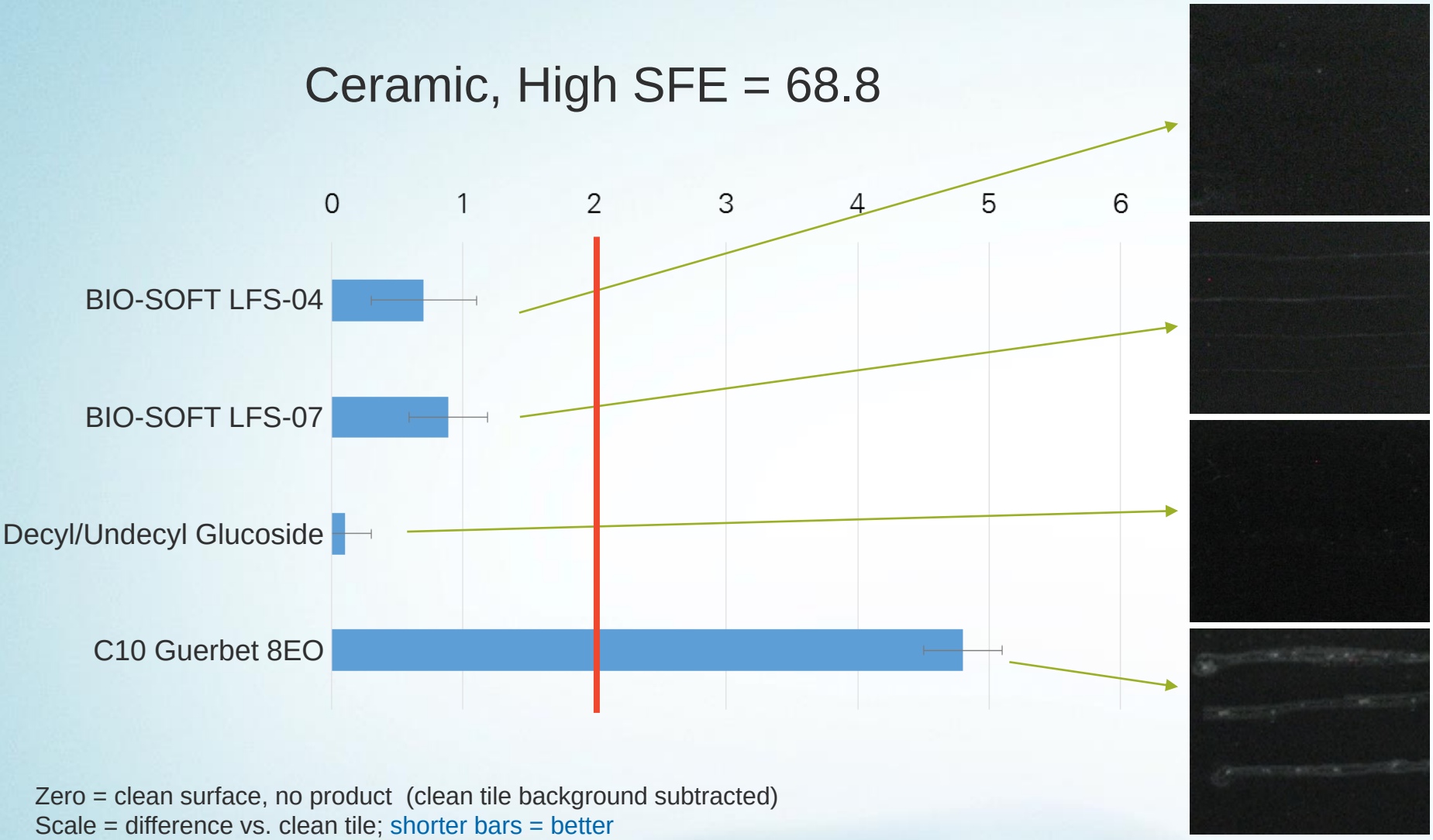
BIO-SOFT LFS-Series Performance vs. Alternative Nonionics

Acrylic Polished Vinyl, Low SFE = 40.8



Zero = clean surface, no product (clean tile background subtracted)
Scale = difference vs. clean tile; shorter bars = better
Relates to intensity = how noticeable film/streak is

BIO-SOFT LFS-Series Performance vs. Alternative Nonionics



Zero = clean surface, no product (clean tile background subtracted)
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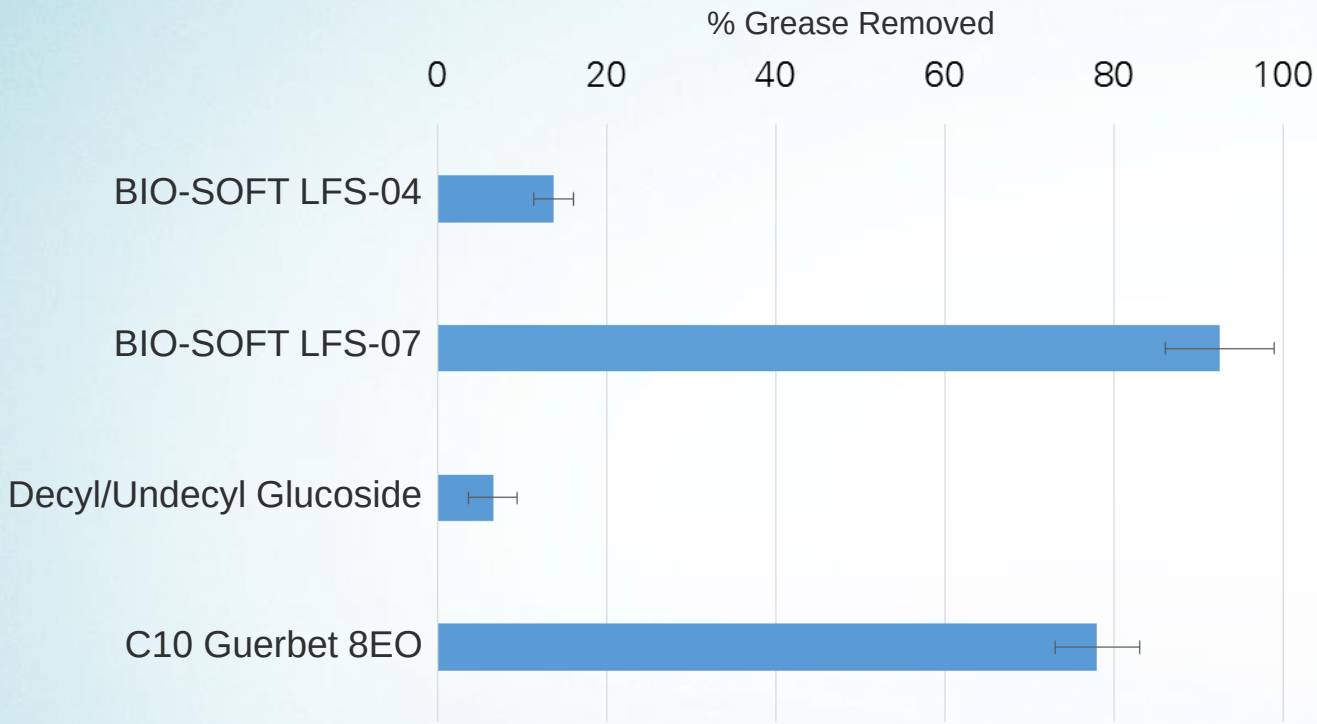
BIO-SOFT LFS-Series Cleaning Performance

Immersion Degreasing of Tough Grease



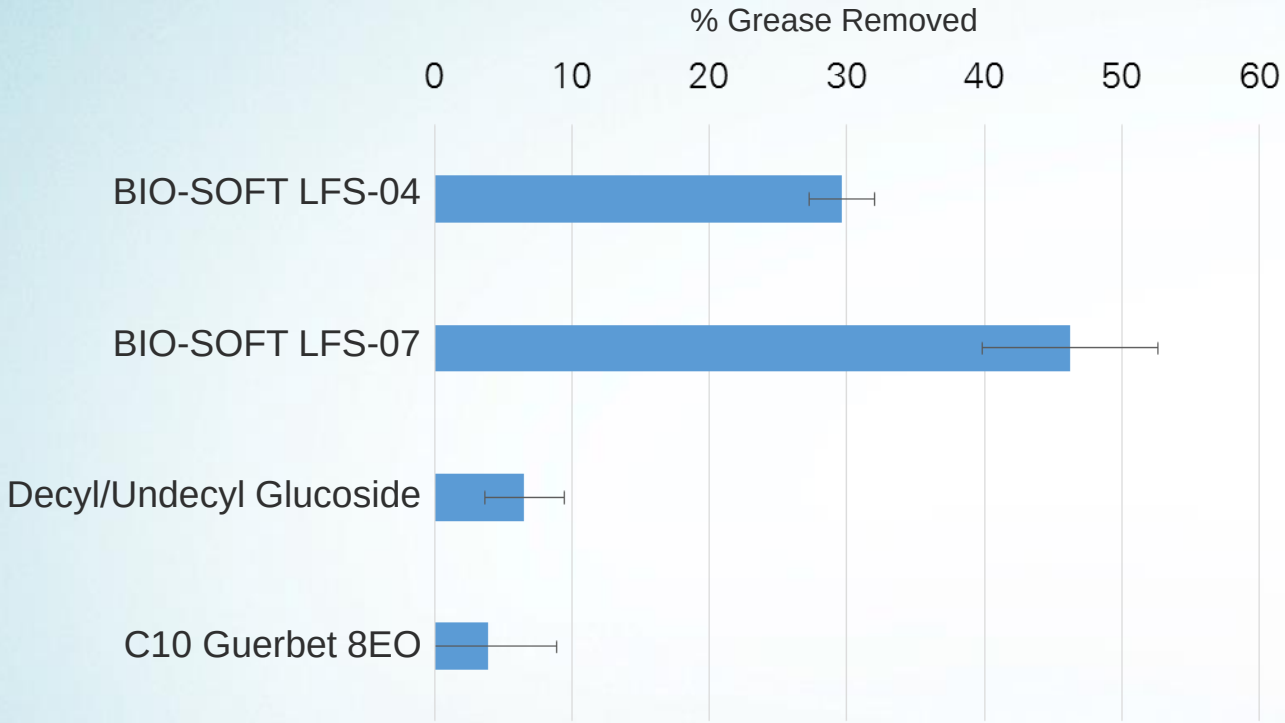
BIO-SOFT LFS-07 is the best option for heavy duty degreasing.

Cleaning formula: 1 wt% surfactant + 1 wt% potassium hydroxide (45%) + 1 wt% sodium metasilicate

BIO-SOFT LFS-04 is not designed for industrial greases such as Lithium Complex Grease.

BIO-SOFT LFS-Series Cleaning Performance

Immersion Degreasing of Cooking Shortening

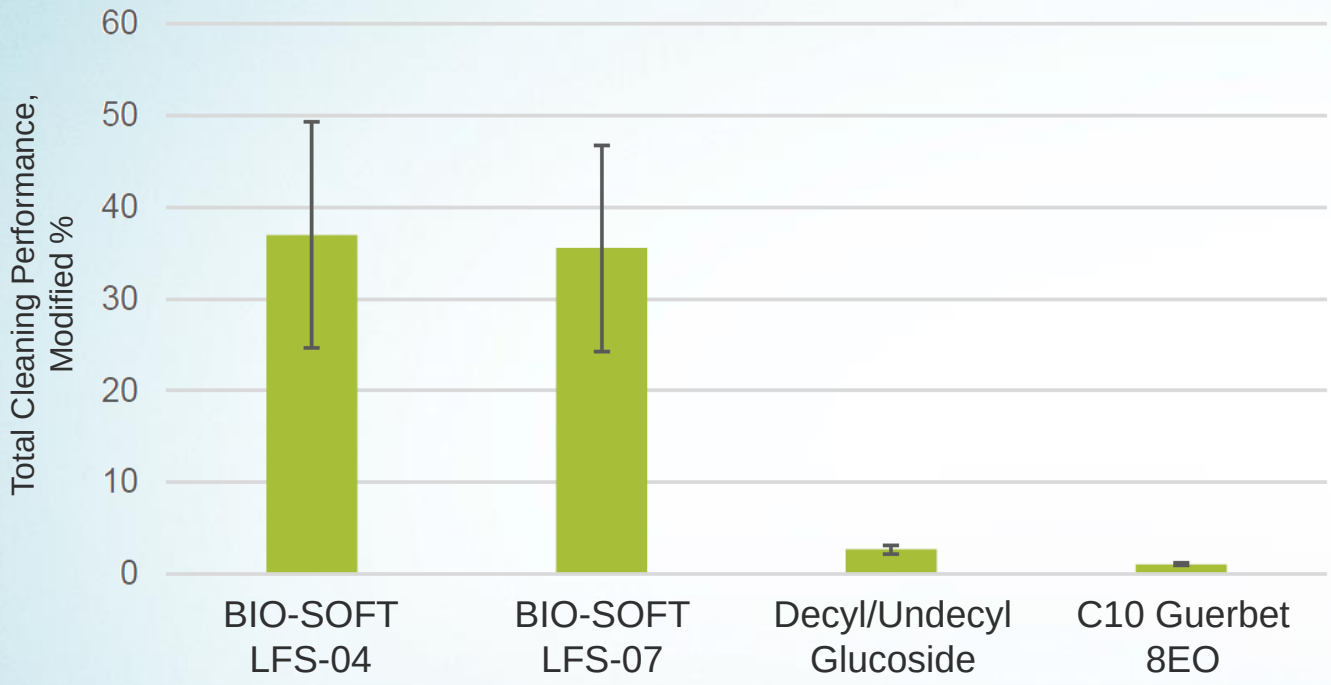


BIO-SOFT LFS-04 & BIO-SOFT LFS-07 are superior.

Cleaning formula: 0.2 wt% surfactant in deionized water

Total Cleaning Performance

Cooking Shortening on Acrylic Polished Vinyl



BIO-SOFT LFS-04 & BIO-SOFT LFS-07 are superior.

Total cleaning performance is equal to percent soil removal divided by film/streak score.

Formulation Guidance

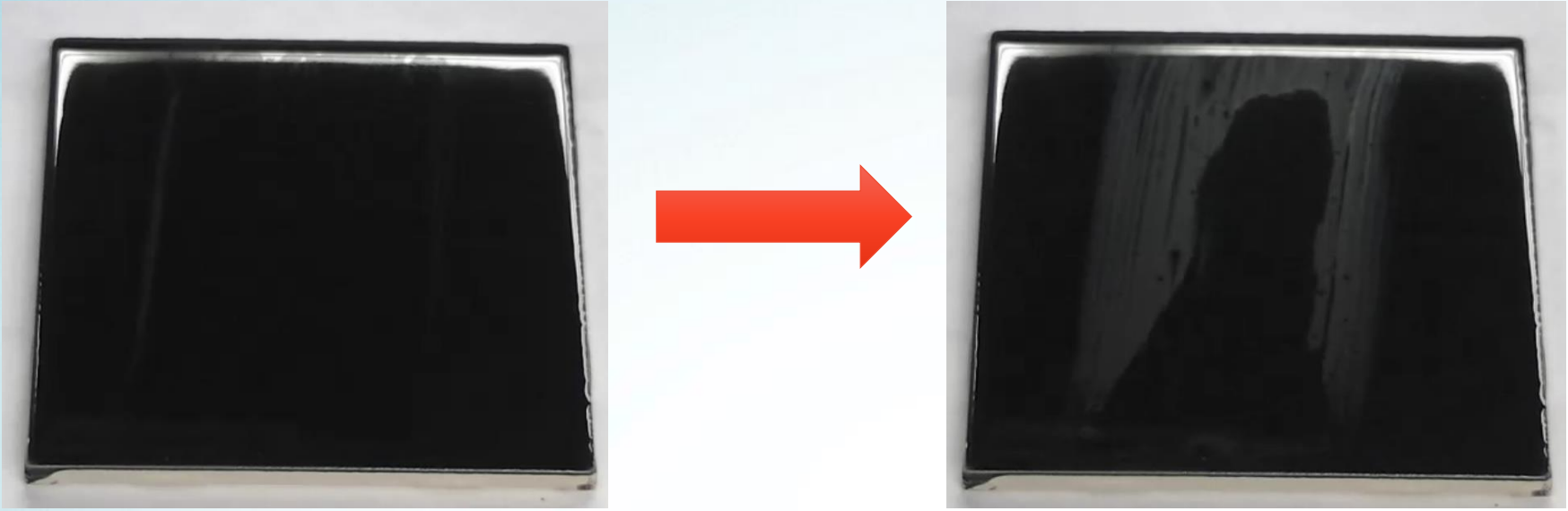
All Exterior Vehicle Spray and Wipe Cleaner (Formulation No. 1321)

Ingredient	% by Weight
Deionized Water	99.54
AMPHOSOL® CS-50	0.28
BIO-SOFT LFS-07	0.10
Propylene Glycol n-Butyl Ether	0.08
Preservative, Fragrance, Dye	q.s.

Glass Cleaner Concentrate (Formulation No. 1319)
Multipurpose Cleaner Concentrate (Formulation No. 1320)
Stainless Steel Cleaner and Polish (Formulation No. 1322)

Visit ulprospector.com for starter formulation details.

Stepan LFS: How Does It Work? Origin of Film/Streak

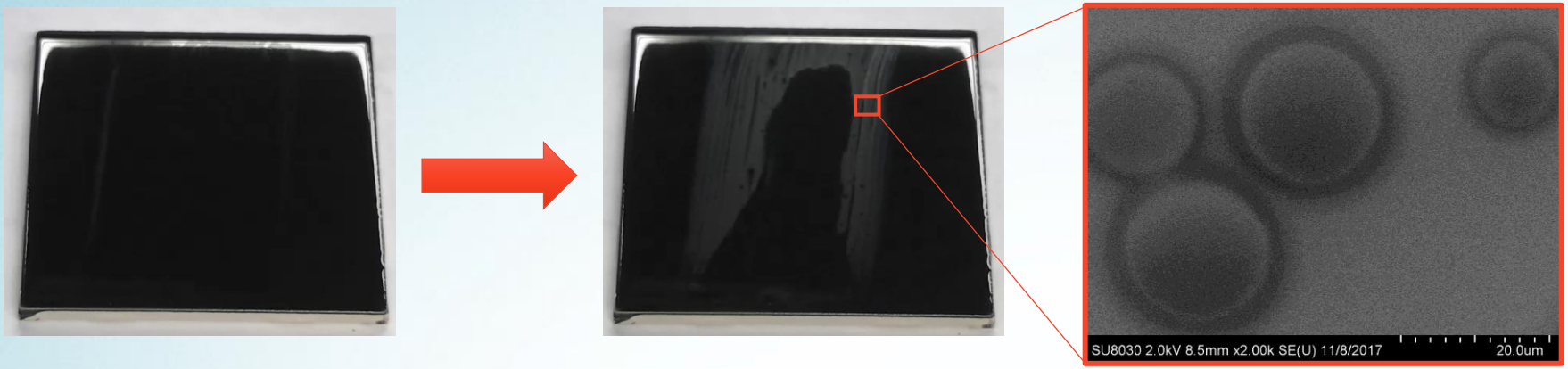


- Wet to Dry => Phase Inversion
- From 90+% water to < 10% water

  Wet: Water continuous, surfactant hydrophobic tails internal

  Dry: Hydrophobe continuous, water/hydrophilic headgroups internal

Stepan LFS: How Does It Work? Origin of Film/Streak



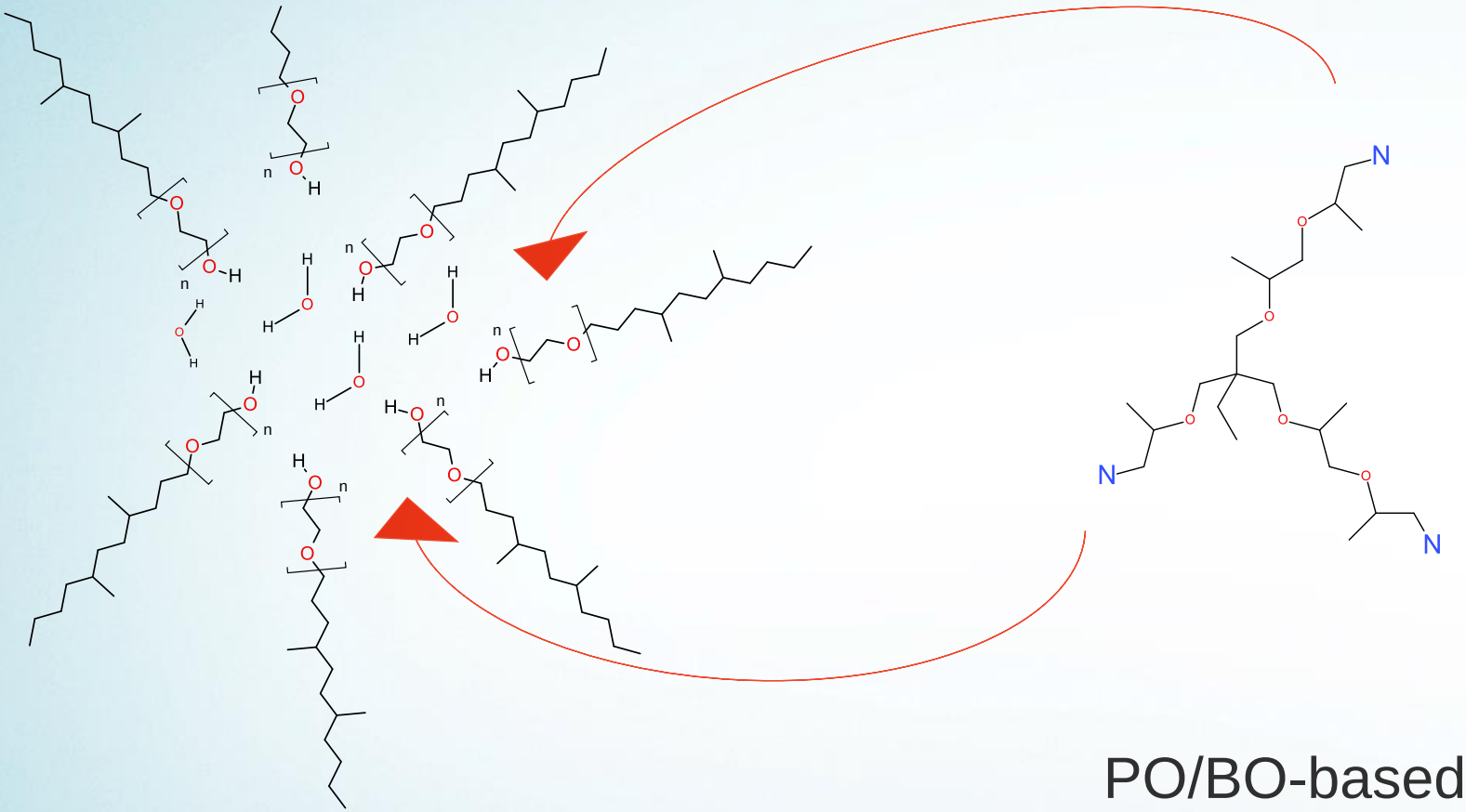
SEM (NUANCE center, Northwestern University) reveals micron-size droplets of nonionic surfactant on pristine surface

Micron-scale de-wetting of nonionic surfactant

- Hydrophobic liquid ⟷ Hydrophilic ceramic/glass surface
- Forms discrete droplets across surface
- Droplets act as a “fog” and scatter reflected light
- Origin of film/streak from alcohol ethoxylate surfactants

Stepan LFS: How Does It Work? Solving the Problem

Additive to Alter Phase Behavior During Drying Process



AE aggregate + water

PO/BO-based
Polyetheramine

Stepan LFS: How Does It Work? Solving the Problem

Many possible options: 1. General Blend Principle

Advantages: Choice of Nonionic Surfactant, Already Registered

1-20 wt%

Head Group Cohesion Disruptor

and/or

Surface Adhesion Promoter

+

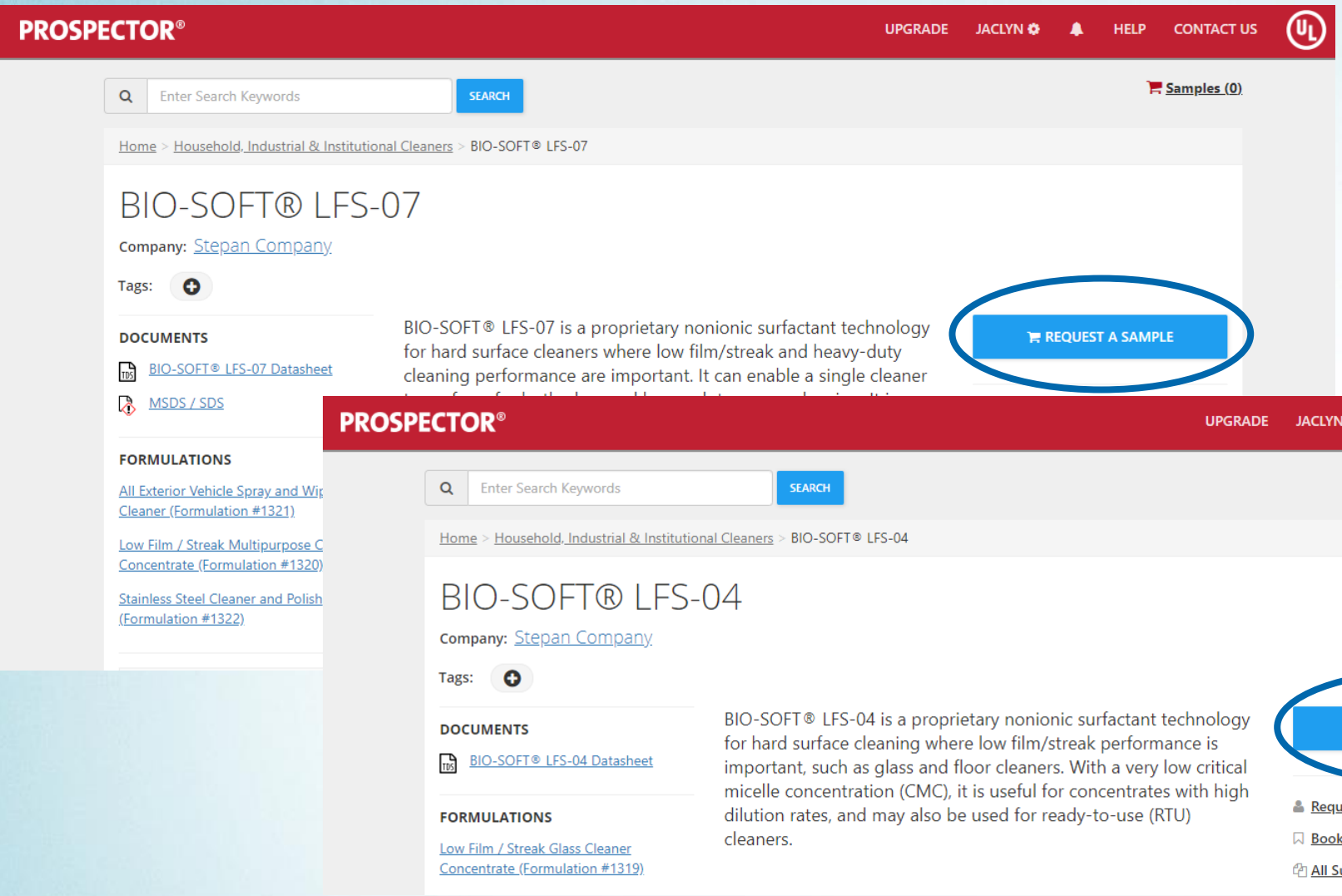
80-99 wt% Alcohol Ethoxylate Surfactant

Use all nonionic components for stable high active blends

Multi-Surface and Multi-Purpose Solutions

Performance		BIO-SOFT LFS-04	BIO-SOFT LFS-07	Alcohol Ethoxylates	Alkyl Polyglycosides
Film/Streak	Acrylic Polished Vinyl	✓	✓	X	X
	Ceramic	✓	✓	X	✓
Cleaning	Tough Grease	X	✓	✓	X
	Cooking Shortening	✓	✓	X	X
Total Cleaning Performance		✓	✓	X	X

Stepan Alkoxylates



Questions?

Stepan Alkoxylates