Realizing Performance Benefits Through Alcohol-Based Surfactant Optimization

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Introduction

- A wide range of technical and economic criteria are considered when selecting surfactants for consumer cleaning products.

- Key surfactant properties that influence performance include:
  - Solubility
  - Hard water tolerance
  - Emulsification and detergency

- Different surfactants may be used to address market trends, such as liquid formulations and lower temperature laundry. Common surfactants include:
  - Anionic: alcohol sulfate (AS), alcohol ethoxysulfate (AES), linear alkylbenzene sulfonate (LAS)
  - Nonionic: alcohol ethoxylate

- Synergies between these surfactants can offer new formulation options, in both laundry and hand dish products.

Surfactant Physical Properties Influence Performance: Mixed Surfactant Systems Provide Opportunities – (I)

Anionic	Krafft Temp. (°C)	Hardness tolerance (ppm Ca^{2+})
LAS	0 - 5	100 -150
AS 1215	20 – 30	50 - 150
AE 1213-2S	< 5	>1000
AE 1215-3S	< 5	>1000

Krafft Temperature:

- Lower values give improved low temperature storage and reduced need for hydrotropes
  - AES has benefits

Hard water tolerance:

- Exhibited as precipitation with divalent ions
  - LAS and AS are similar and relatively poor (low ppm Ca ions)
  - AES gives substantial improvements

Surfactant Physical Properties Influence Performance: Mixed Surfactant Systems Provide Opportunities – (II)

Nonionic	Cloud Point (°C)	Pour Point (°C)
AE 1213-6.5	41	15
AE 1215-7	49	20

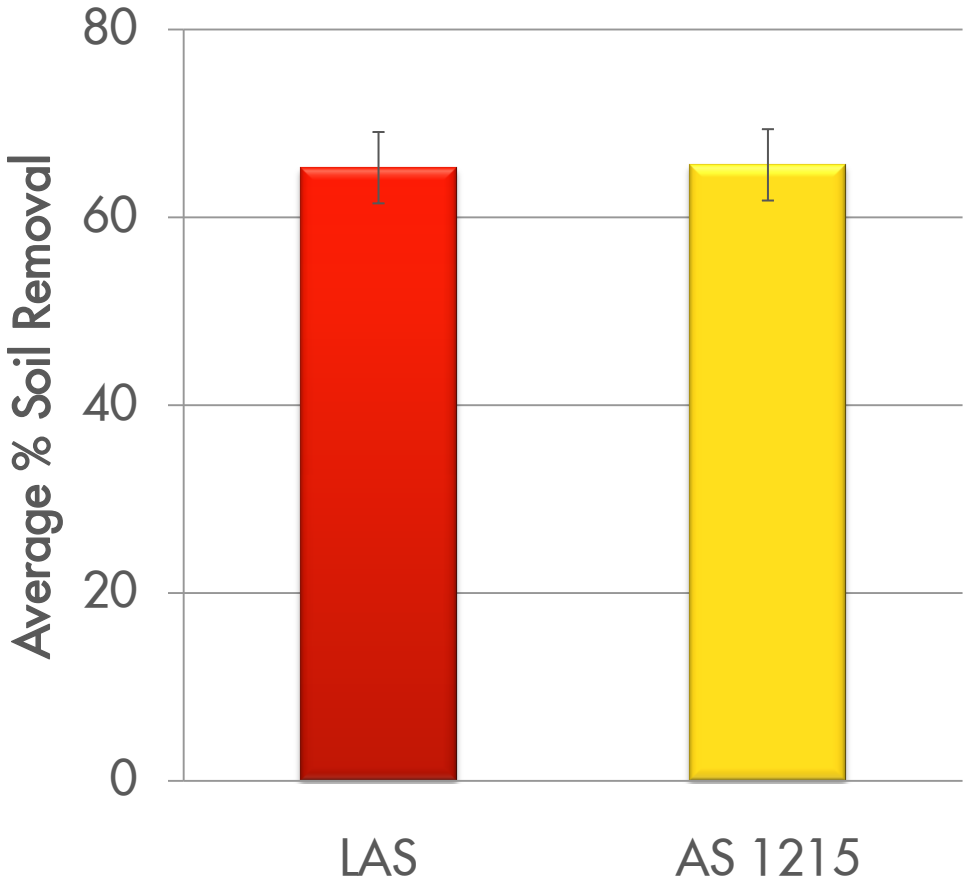
Alcohol ethoxylate properties:

- Good oily soil detergency
- Suitable cloud points for effective cleaning, particularly in the presence of monovalent electrolytes
- Outstanding tolerance to divalent ions (hard water)

Nomenclature		
Name	Hydrophobe	Average EO
AE 1213-2S	C12, C13	2
AS 1215	C12, C13, C14, C15	0

These alcohol based surfactants are based on modified OXO alcohols, which contain ~20% 2-alkyl branching.

Alcohol Sulfates Give Comparable Soil Removal to LAS in Prototype Heavy Duty Powders



Component	%w
Anionic	20
Nonionic	1
Zeolite	28
Carbonate	25
Silicate	7
Sulfate	20

Anionic : LAS or AS

Dosage : 1 g/L

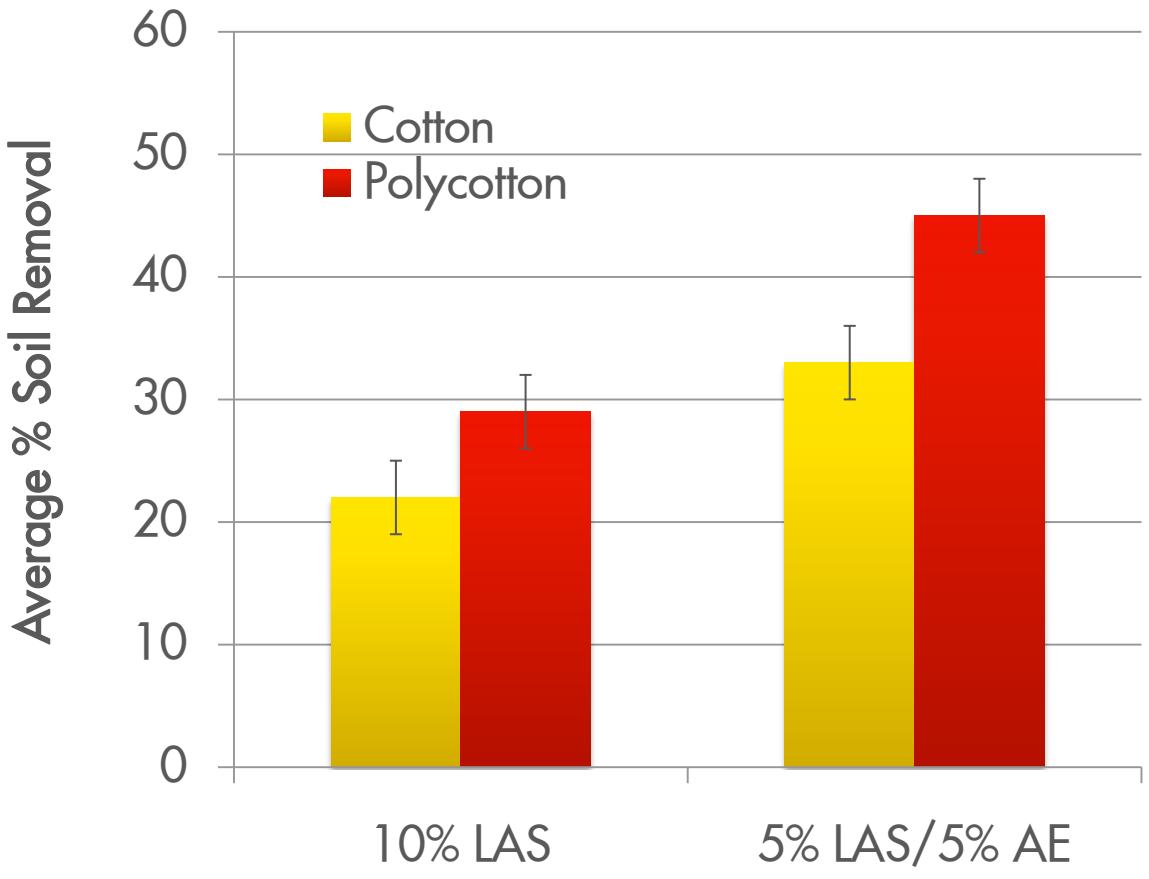
Wash : 35 °C

Hardness : 100 ppm

Soil : Radiolabeled synthetic sweat on polycotton fabric

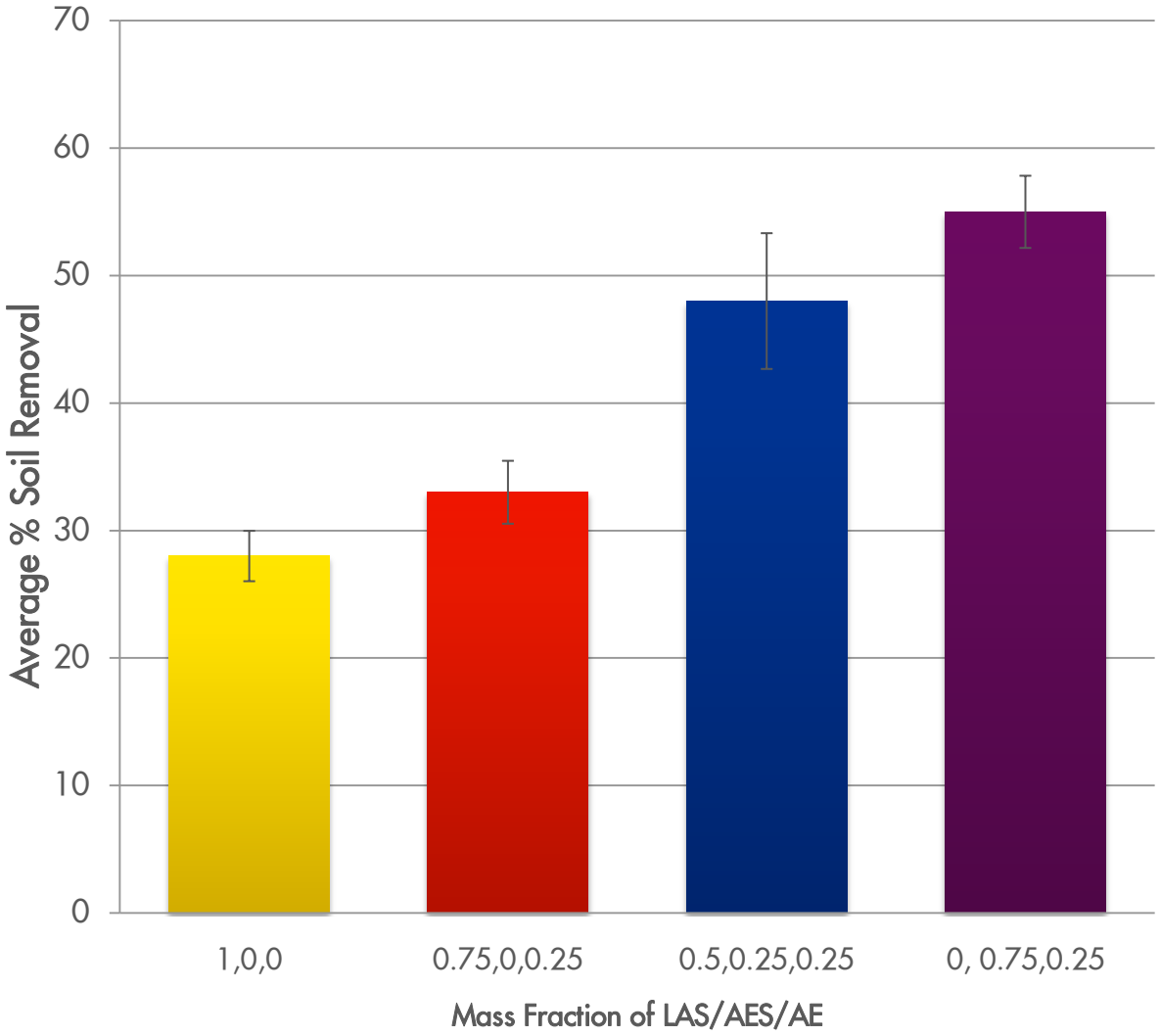
Method: Radiotracer method, published by Shell, shown to correlate with dust-sebum soil measured by reflectance

Alcohol Ethoxylates Combined with LAS Boost Liquid Laundry Performance at Low Temperature



Total surfactant: 10%
Anionic : LAS
Nonionic : AE 1215-7
Dosage : 3 g/L
Wash : 20 °C
Hardness : 150 ppm
Other : 5% citrate, 5% TEA
Soils : Dust sebum
Fabrics : Cotton and polycotton
Method : Reflectance

Ethoxylated Surfactant Mixtures Give Options for Boosting Laundry Liquid Performance at Low Temperature



Total surfactant: 15%

Anionic : LAS, AE 1213-2S

Nonionic : AE 1213-6.5

Dosage : 3 g/L

Wash : 20 °C

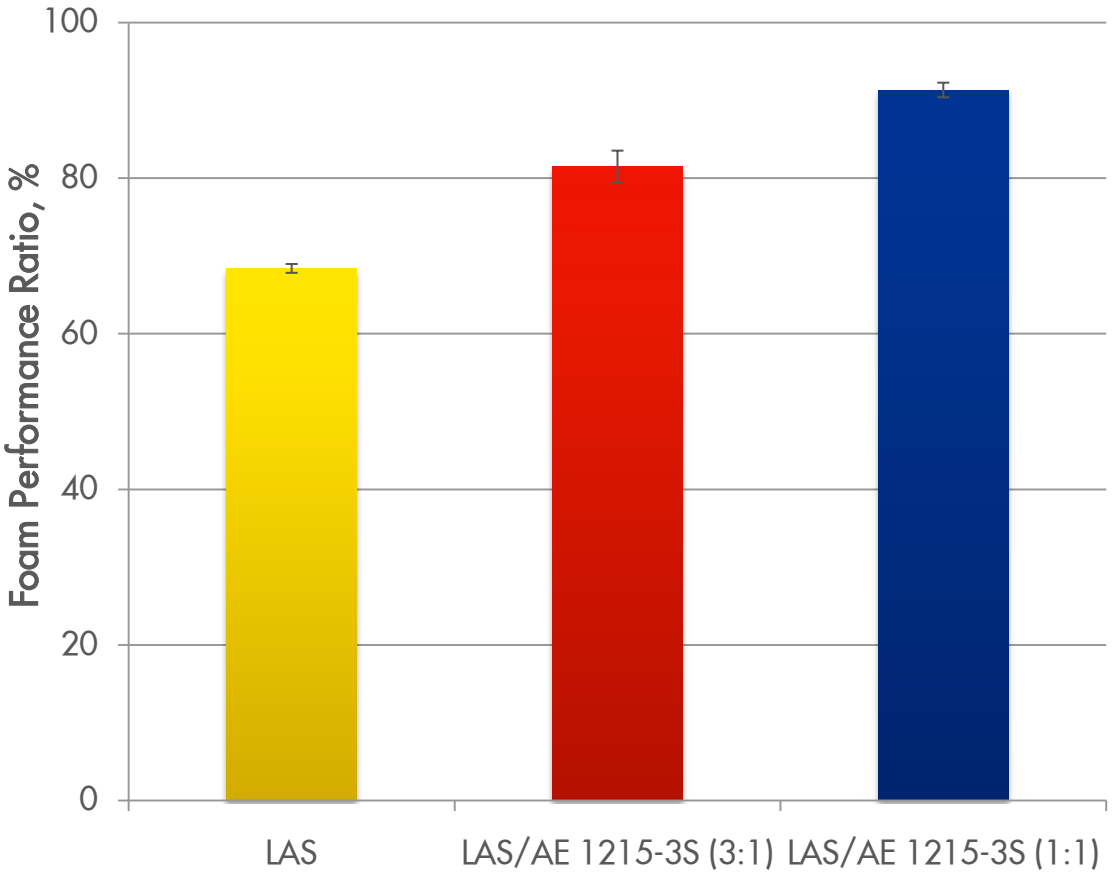
Hardness : 150 ppm

Other : 5% citrate, 5% TEA

Soil : Radiolabeled synthetic sweat on polycotton fabric

Method: Radiotracer method, published by Shell, shown to correlate with dust-sebum soil measured by reflectance

Mixtures of Alcohol Ethoxysulfates and LAS Demonstrate Synergy in Liquid Dish Performance



Formulation : 6% total surfactant, no foam booster

Temperature : 40 °C

Method : Foam persistence is observed as food soil is added to a dish wash formulation. The performance ratio is relative to a dish wash standard and reflects the capability of the formulation to emulsify soil.

Conclusions

- Physical properties of alcohol-based surfactants enable effective cleaning at a variety of conditions, alone or in combination with LAS.
- Alcohol sulfates show comparable cleaning to LAS in prototype powder formulations.
- In liquid laundry :
  - Combining alcohol ethoxylate with LAS improves detergency performance even when total surfactant content is held constant
  - Surfactant mixtures that include alcohol ethoxylate and alcohol ethoxysulfate surfactants show formulation synergy and performance benefits
- In hand dish, mixed alcohol ethoxysulfate and LAS systems improve performance.
- In summary, surfactants based on alcohols and ethoxylated derivatives are good options for a variety of household formulations.