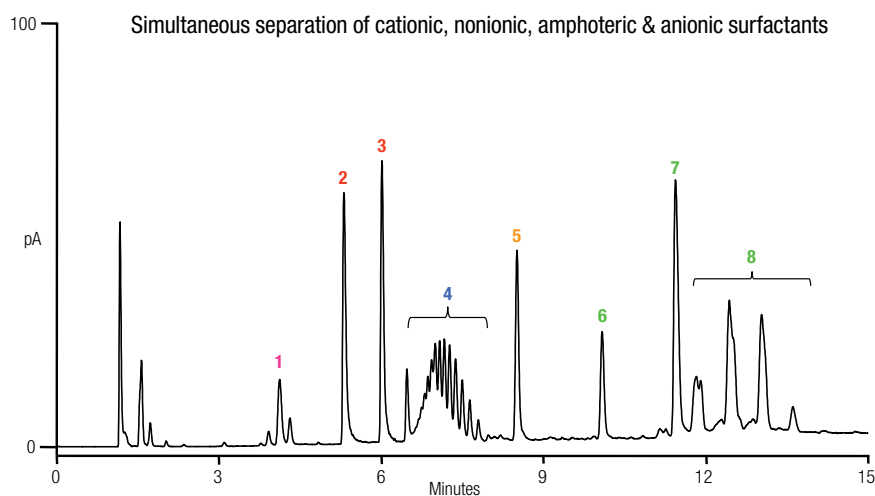


# Thermo Scientific Acclaim Surfactant Plus Column

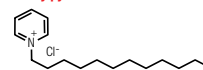
Performance, Versatility, Throughput



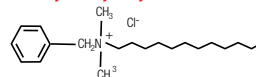
1. Sodium Xylene Sulfonate



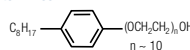
2. Laurylpyridinium Chloride



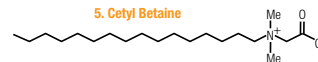
3. Lauryldimethylbenzyl Ammonium Chloride



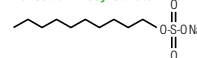
4. Triton X-100



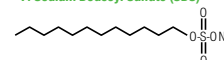
5. Cetyl Betaine



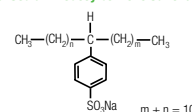
6. Sodium Decyl Sulfate



7. Sodium Dodecyl Sulfate (SDS)



8. Sodium Dodecylbenzene Sulfonate (LAS)



The Thermo Scientific™ Acclaim™ Surfactant Plus column is a state-of-the-art, high-efficiency, silica based, HPLC column family designed for the determination of different types of surfactants, including anionics, nonionics, cationics, and amphoteric, in a wide range of samples, such as consumer products, pharmaceuticals, food & beverages, environmental samples.

It offers the following features:

- Ideal selectivity for simultaneous separation of anionic, nonionic, cationic, and amphoteric surfactants
- Well suited to the determination of cationic surfactants
- Excellent resolution for ethoxylated surfactants
- Capable of retaining highly hydrophilic compounds, such as hydrotropes
- Compatible with various detection methods, including charged aerosol detection, mass spectrometry (MS), evaporative light scattering detection (ELSD), suppressed conductivity detection (SCD), UV-Vis detection (UV).

## Ideal Selectivity for Simultaneous Separation of Anionic, Nonionic, Cationic and Amphoteric Surfactants

Surfactants are widely used in industrial, agricultural, and pharmaceutical markets, in products as diverse as pesticides, detergent powders, petroleum products, cosmetics, and pharmaceuticals. Their separation and identification can be challenging due both to the diversity of surfactants and complexity of the sample matrix. Although many HPLC columns are available and have been used for the analysis of surfactant formulations, none of these columns have been designed specifically for this application, nor are they capable of separating anionic, nonionic, cationic and amphoteric surfactants in a single analysis.

The Acclaim Surfactant Plus column, based on novel mixed mode chromatography technology and advanced surface chemistry, provides both reversed-phase and anion-exchange retention mechanisms. The column chemistry is designed in such way that it elutes in the order of cationic, nonionic, amphoteric and anionic surfactants. Figure 1 shows the Acclaim Surfactant Plus column provides ideal selectivity for simultaneous separation of anionic, nonionic, cationic and amphoteric surfactants, whereas the C18 column fails to resolve them under the same condition.

## Well Suited to the Determination of Cationic Surfactants

Cationic surfactants are widely used as corrosion inhibitors, fabric softeners, and antimicrobial agents. The most popular cationic surfactants include alkyl quaternary ammonium, benzylalkylammonium, alkyl pyridinium, and alkyl imidazolium salts. When analyzing cationic surfactants, using a reversed phase C18 column, it is often difficult to obtain sharp, symmetrical peaks due primarily to the strong undesired ion-exchange interaction between the surface silanols and quaternary analytes. To improve the peak shape of a cationic surfactant, a high concentration of salt (such as perchlorate) is added to the mobile phase, which causes the analytical method to be incompatible with MS detection.

The surface chemistry of Acclaim Surfactant Plus column effectively deactivates the surface silanol activity so that cationic surfactants elute as symmetrical and efficient peaks compared to those obtained on the reversed-phase columns. The advanced surface modification process also ensures hydrolytically stable and reproducible surface, resulting in excellent compatibility with MS, charged aerosol detection and SCD. Figures 2 and 3 demonstrate the separations on an Acclaim Surfactant Plus column for mixtures of cationic surfactants and alkyl quaternary amines with excellent resolution and symmetrical peaks.

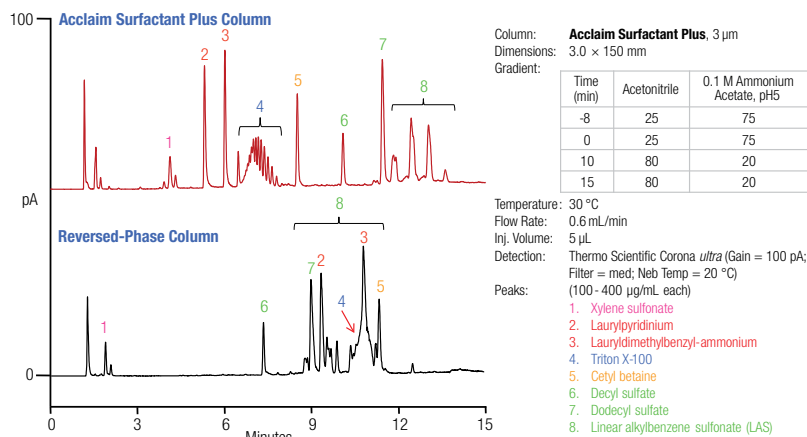


Figure 1. Simultaneous separation of cationic, nonionic, amphoteric and anionic surfactants

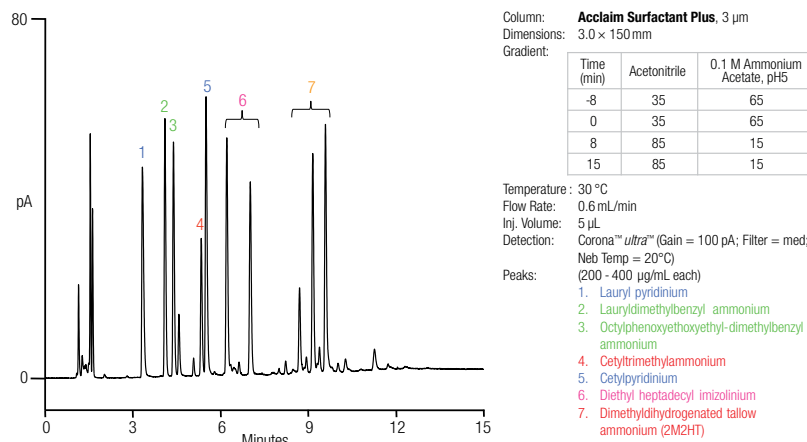


Figure 2. Separation of cationic surfactants

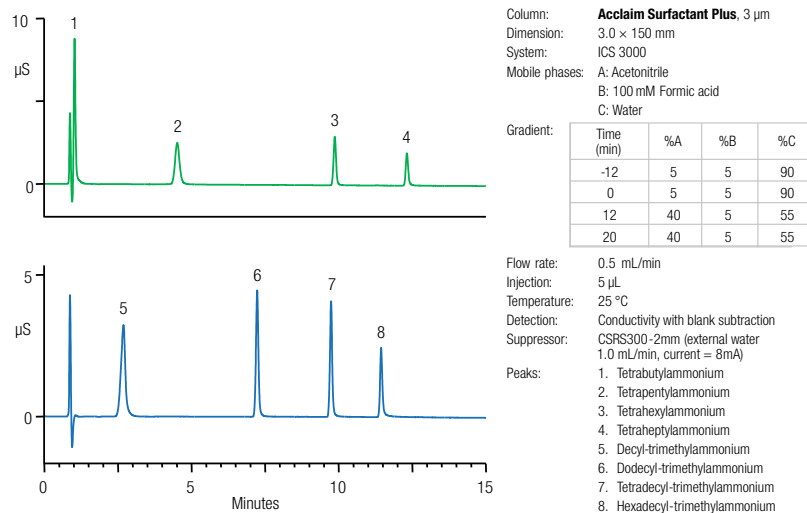


Figure 3. Separation of alkyl quaternary amines using conductivity detection

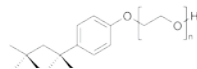
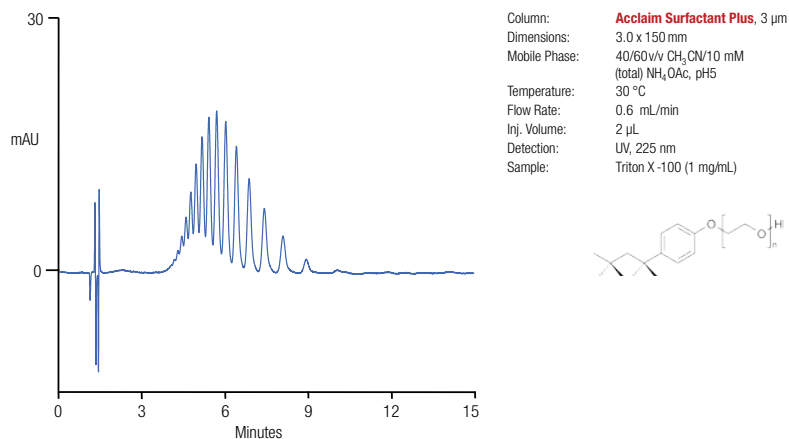


Figure 4. Triton X-100

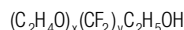
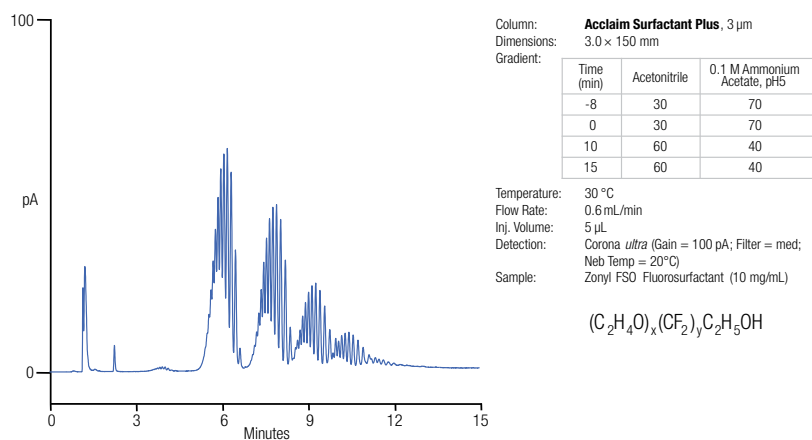


Figure 5. Zonyl FSO Fluorosurfactant

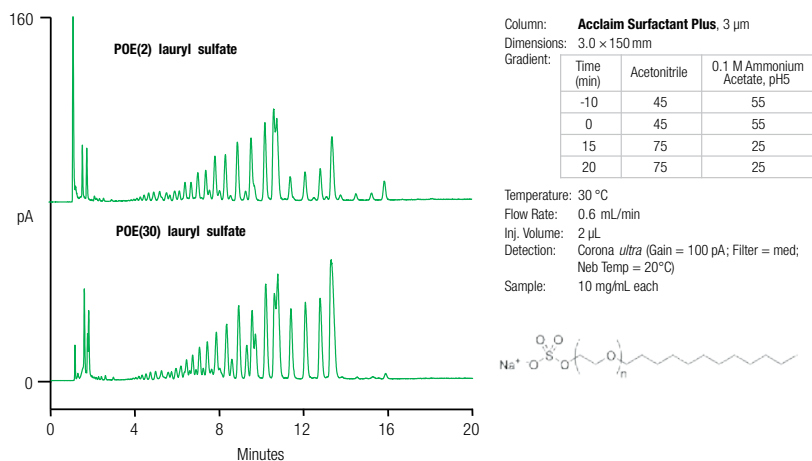


Figure 6. Profile of Ethoxylated Lauryl Sulfates

## Excellent Resolution for Ethoxylated Surfactants

The novel column chemistry of Acclaim Surfactant Plus column offers excellent resolution for individual oligomers of ethoxylated surfactants.

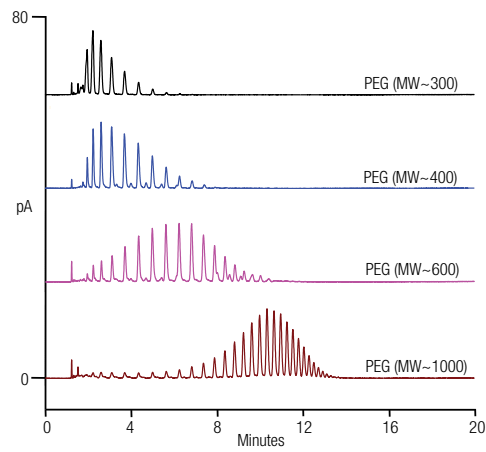
Nonionic ethoxylated surfactants account for about 40% of the surfactants consumption worldwide. Most nonionic surfactants are considered low-foaming products, have good cold water solubility, and low critical micelle concentration. Their compatibility with cationic fabric softeners makes them preferable in certain formulations. Figures 4 and 5 demonstrate that the Acclaim Surfactant Plus column provides excellent resolution between individual oligomers in two nonionic ethoxylated surfactants.

Ethoxylated lauryl sulfates, also called laureth sulfates, are prepared by adding oxyethylene groups to an alcohol that is then sulfated. Ethoxylation enhances water solubility and foaming, making these surfactants ideal components in shampoos and detergents. Figure 6 shows the profiles of laureth sulfates obtained on an Acclaim Surfactant Plus column using a charged aerosol detector.

Polyethylene glycols (PEGs) are often non surfactant impurities found in ethoxylated surfactants, typically in the range of 1–10%. The oligomer distribution is similar to, but broader than that of the surfactant. Figure 7 illustrates the exceptional resolution of the Acclaim Surfactant Plus column for individual oligomers in various PEGs.

### Compatible with Highly Aqueous Mobile Phase Conditions

High-density C18 columns often fail to retain highly hydrophilic hydrotropes, such as sodium naphthalene sulfonate and xylene sulfonate. The problem arises because these analyses require a highly aqueous mobile phase that will lead to undesirable “dewetting” – sudden drop of retention and deformed peak shape. As illustrated in Figure 8, the Acclaim Surfactant Plus column provides adequate retention of xylene sulfonate, while under the same condition it would elute close to the void on a conventional C18 column.



Column: **Acclaim Surfactant Plus**, 3  $\mu$ m  
Dimensions: 3.0  $\times$  150 mm

Time (min)	Acetonitrile	0.1 M Ammonium Acetate, pH5
-8	2	98
0	2	98
20	20	80

Temperature: 30  $^{\circ}$ C  
Flow Rate: 0.6 mL/min  
Inj. Volume: 2  $\mu$ L  
Detection: Corona *ultra* (Gain = 100 pA; Filter = med; Neb Temp = 20 $^{\circ}$ C)  
Sample: (2.5 mg/mL each)  
PEG (MW~300)  
PEG (MW~400)  
PEG (MW~600)  
PEG (MW~1000)

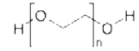
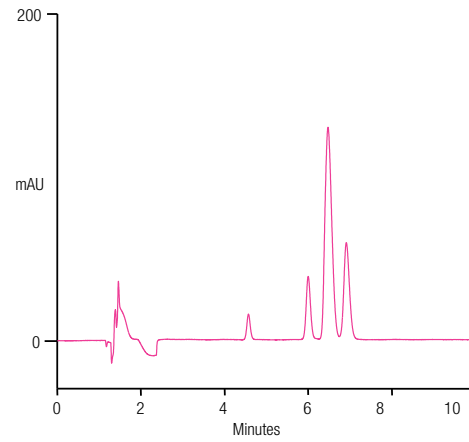
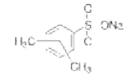


Figure 7. Polyethylene Glycols (PEGs)



Column: **Acclaim Surfactant Plus**, 3  $\mu$ m  
Dimensions: 3.0  $\times$  150 mm  
Mobile Phase: 30/70v/v CH<sub>3</sub>CN/20 mM (total) NH<sub>4</sub>OAc, pH5  
Temperature: 30  $^{\circ}$ C  
Flow Rate: 0.6 mL/min  
Inj. Volume: 2  $\mu$ L  
Detection: UV, 225 nm  
Sample: Sodium xylene sulfonate (1 mg/mL)



## Compatible with Various Detection Methods

The Acclaim Surfactant Plus column provides optimum selectivity for various types of surfactants using volatile mobile phases (e.g., ammonium acetate). Detection methods include charged aerosol detection, ELSD, UV, SCD, and MS. Other HPLC mobile phases, such as phosphate buffers, can also be used when the surfactants of interest have chromophore and UV detection is employed.

The Corona *ultra* charged aerosol detector uses a unique and innovative detection method to detect nonvolatile analytes like surfactants, and offers performance benefits

unequaled by RI, UV and ELSD. Its benefits include high sensitivity (sub to single digit nanogram), excellent injection-to-injection reproducibility, wide dynamic range, and gradient compatibility. Therefore, the Corona *ultra* charged aerosol detector is the preferred detector to accompany Acclaim Surfactant Plus columns for determinations of various types of surfactants. Figure 9 demonstrates the superior sensitivity of the Corona *ultra* charged aerosol detector compared to an ELS detector. In addition, methods developed with charged aerosol detection can be easily transferred to LC-ESI-MS methods with little or no modifications, because both detectors

share the same mobile phase requirements. Figure 10 illustrates simultaneous separation and identification of a mixture of cationic, nonionic, amphoteric, and anionic surfactants on an Acclaim Surfactant Plus column by LC-ESI-MS.

SCD provides excellent sensitivity and selectivity for ionic analytes, making it suitable for detecting ionic surfactants in a wide range of sample matrices with greatly reduced interferences from other components in the sample. Figures 3 and 17 demonstrate selective and sensitive detection of cationic surfactants on an Acclaim Surfactant Plus column using SCD.

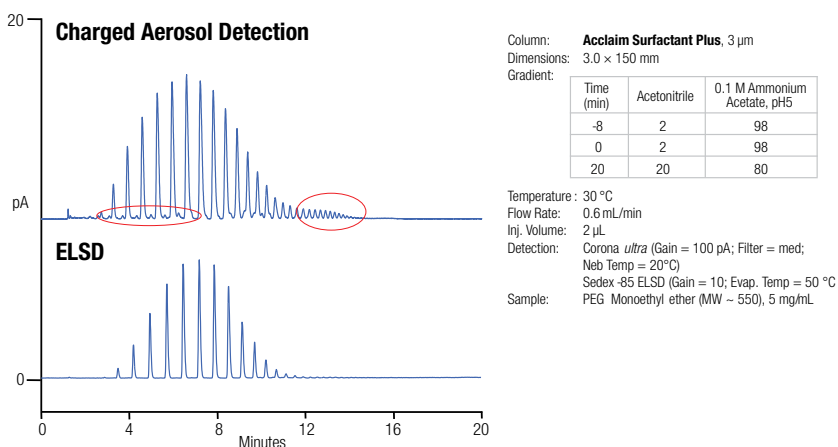


Figure 9. Sensitivity comparison of charged aerosol detection vs ELSD

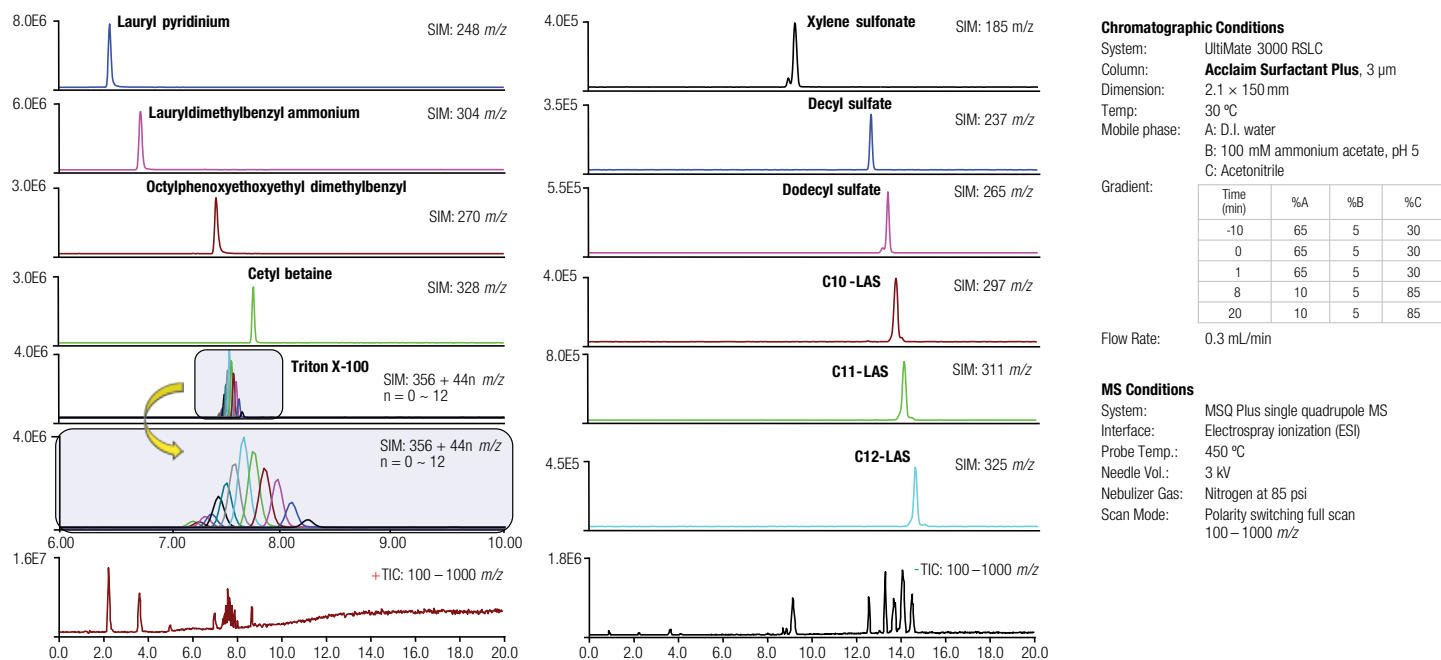


Figure 10. Simultaneous analysis of cationic, nonionic, amphoteric and anionic surfactants by LC-ESI-MS

## Broad Range of Applications

The Acclaim Surfactant Plus column can be used for analyzing a variety of consumer and personal care products, such as laundry detergent, fabric softener, shampoo, dish washing liquid, nasal spray, eye drops, mouthwash, etc.

### Laundry Detergents

Laundry detergents contain many components, including bio-degradable surfactants. While dodecyl benzene sulfonate (LAS), a petroleum derived bio-degradable anionic surfactant, has been widely used in laundry detergents, the modern formulation prefer to use plant-derived surfactants for their environmental and consumer safety benefits. Figure 11 shows the profiles of two laundry detergents – one is 100% plant-derived and the other contains LAS.

### Fabric Softener

Cationic surfactants are often used in fabric softeners to neutralize the detergents, eliminate static electricity and soften clothes. The Acclaim Surfactant Plus column, as shown in Figure 12, provides excellent resolution and symmetrical peaks when used to analyze a fabric softener.

### Shampoo

Shampoos contain various combinations of anionic, cation, nonionic, and amphoteric surfactants, designed to influence the essential characteristics of the shampoo: cleansing, foam, conditioning, and viscosity. Laureth sulfates are commonly used in shampoos to provide lather and cleansing. As shown in Figure 13, the individual oligomers in laureth sulfate are well resolved using the Acclaim Surfactant Plus column.

### Liquid Hand Soap

While various surfactants are used in liquid hand soaps, the hydrotrope xylene sulfonate is the main component in a high foaming liquid hand soap, determined with a Acclaim Surfactant Plus column (Figure 14).

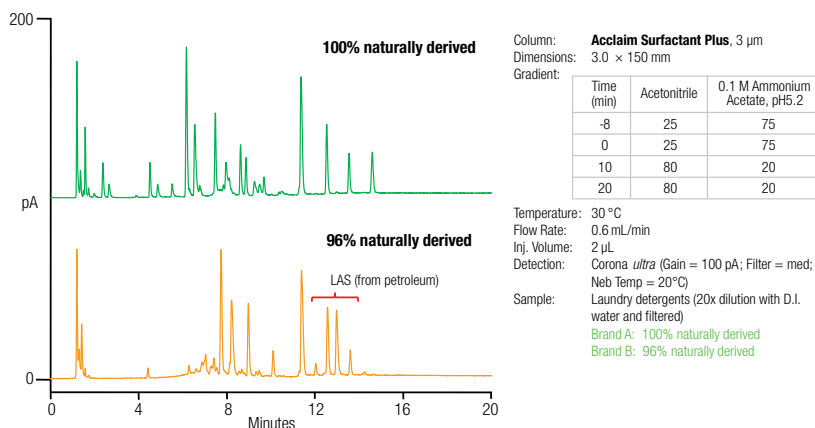


Figure 11. Laundry detergents

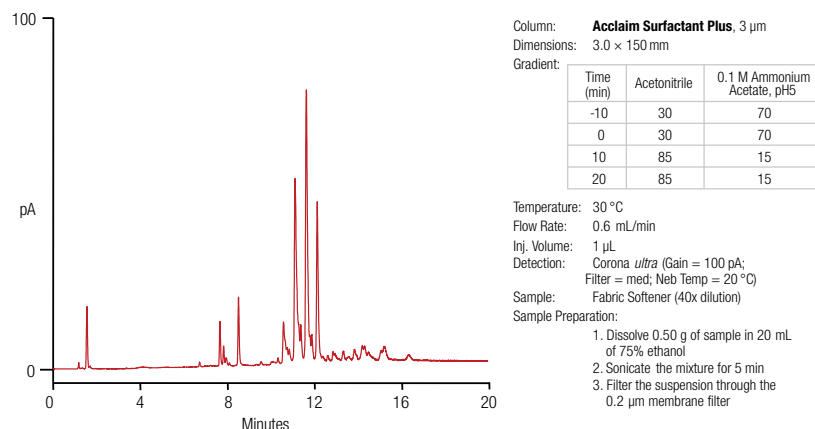


Figure 12. Fabric softener

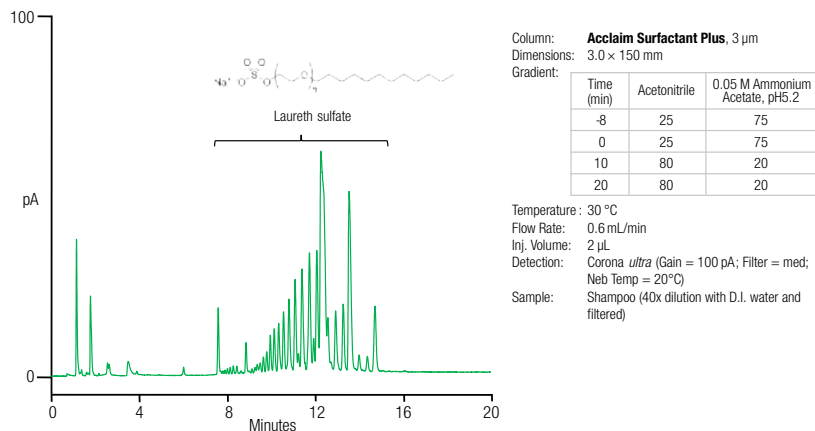


Figure 13. Shampoo

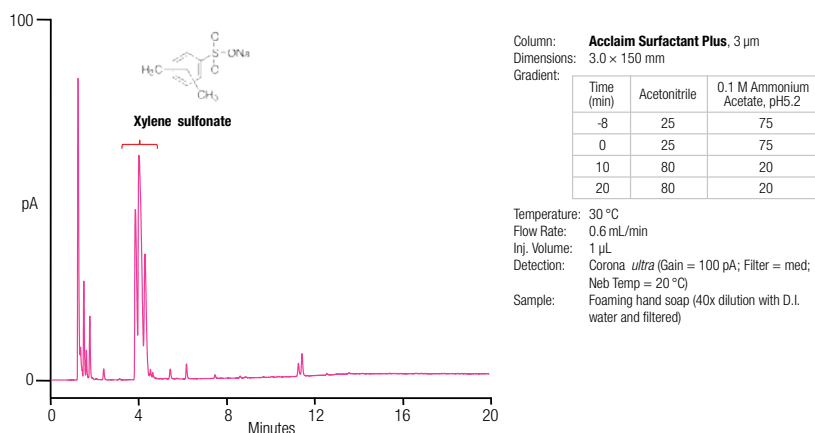


Figure 14. Liquid hand soap

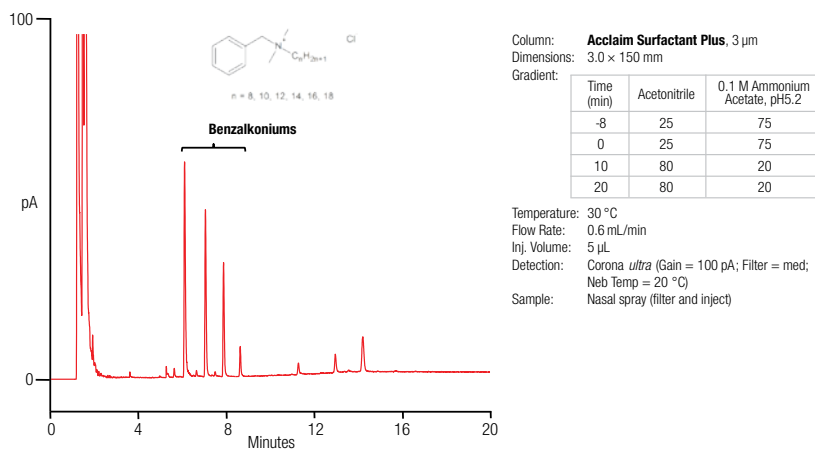


Figure 15. Nasal spray

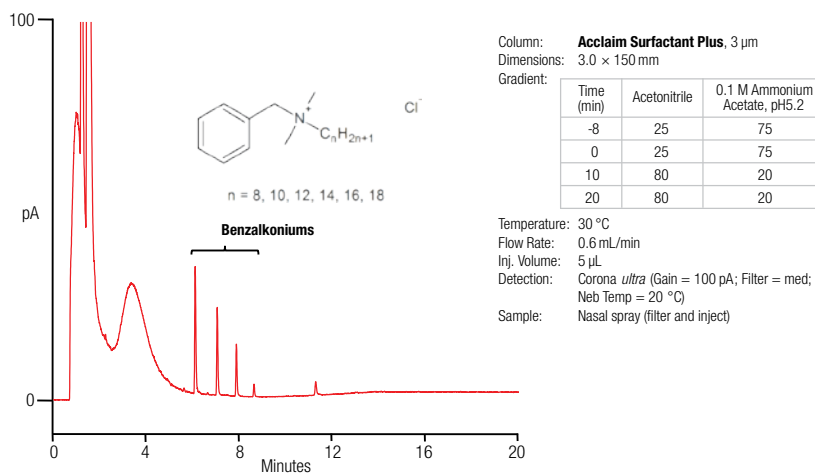


Figure 16. Eye drops

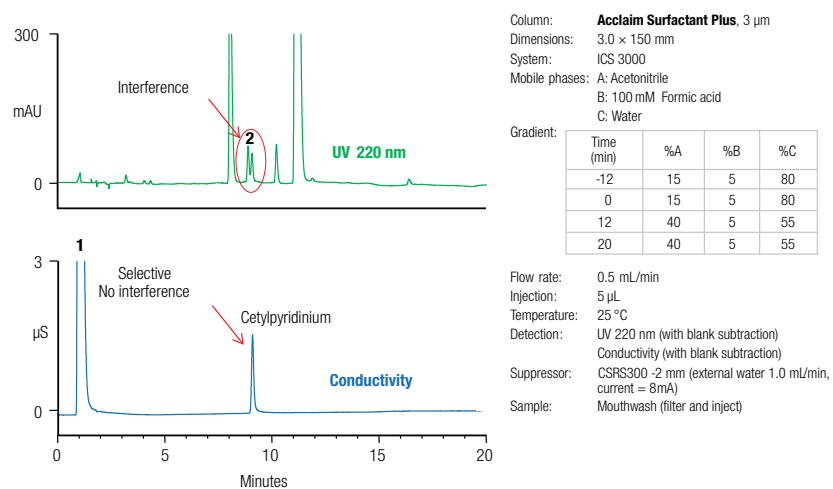


Figure 17. Selective detection of the cationic surfactant in mouthwash with SCD

## Nasal Spray and Eye Drops

Benzalkonium salts are widely used preservative in nasal sprays and ophthalmic formulations because of their antimicrobial effects. Figure 15 and 16 show the chromatographic separation of the major homologs of benzalkonium salts in nasal spray and eye drops, respectively, with excellent separation and symmetrical peaks.

## Mouthwash

Alkyl pyridinium salts are mild antibacterial agents used in various pharmaceutical products such as mouthwash, cough drops, and so forth. As shown in Figure 17, the Acclaim Surfactant Plus column, combined with cation suppressor and conductivity detector, can selectively and sensitively determine cetyl pyridinium in a mouthwash product.

## Specification and Operating Conditions

Operating pH range:	2.5 – 7.5 (3.0 – 6.0 recommended)
Operating temperature:	Up to 50 °C
Operating pressure:	Up to 6000 psi, except for 3 µm, 2.1 × 250 mm P/N 078953 (Up to 10,000 psi) and 5 µm, 4 × 150 mm (PEEK) P/N 078956 (Up to 4,000 psi)
Flow rate:	0.60 – 1.80 mL/min for 4.6 mm i.d. column 0.30 – 0.90 mL/min for 3.0 mm i.d. column 0.15 – 0.45 mL/min for 2.1 mm i.d. column
Storage solution:	Acetonitrile/20 mM NH <sub>4</sub> OAc, pH5 v/v 90/10 or 100% Acetonitrile
Aqueous compatibility:	0 – 100% aqueous mobile phase
Organic compatibility:	Fully compatible with common HPLC solvents THF and Acetone are incompatible with PEEK column body thus should be avoided when using P/N 078956

**Caution: always use buffered solution for analysis and storage; avoid sudden pressure surge**

## Reproducible Manufacturing

To meet the exact needs of our customers, each Acclaim Surfactant Plus column is manufactured to stringent specifications to ensure column-to-column reproducibility. Each column is shipped with a lot validation sheet showing the test results and specifications for the lot of bonded silica packed into the column. In addition, each column is individually tested and shipped with an individual test chromatogram validating the column performance, with respect to selectivity, retention, and efficiency.

## Ordering Information

Description	Part Number
Acclaim Surfactant Plus column, Analytical, 5 µm, 4.6 × 150 mm	082768
Acclaim Surfactant Plus column, Analytical, 5 µm, 4.6 × 250 mm	082767
Acclaim Surfactant Plus column, Analytical, 5 µm, 4 × 150 mm (PEEK)	078956
Acclaim Surfactant Plus column, Analytical, 3 µm, 4.6 × 150 mm	078950
Acclaim Surfactant Plus column, Analytical, 3 µm, 3.0 × 150 mm	078951
Acclaim Surfactant Plus column, Analytical, 3 µm, 3.0 × 100 mm	078952
Acclaim Surfactant Plus column, Analytical, 3 µm, 2.1 × 250 mm	078953
Acclaim Surfactant Plus column, Analytical, 3 µm, 2.1 × 150 mm	078954
Acclaim Surfactant Plus column, Analytical, 3 µm, 2.1 × 100 mm	078955
Acclaim Surfactant Plus column, Guard, 5 µm, 4.6 × 10 mm	082773
Acclaim Surfactant Plus column, Guard, 5 µm, 3.0 × 10 mm	078959
Acclaim Surfactant Plus column, Guard, 5 µm, 2.1 × 10 mm	078960

Accessories	Part Number
Guard Holder (V-2)	069580
Guard Holder kit V-2 (Holder V-2 and Coupler)	069707
Guard Coupler	074188

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