

I. S. A. Bhawani¹, O. Sulaiman¹, R. Hashim² and M. N. Mohamad Ibrahim²

Analysis of Surfactants by Thin-Layer Chromatography: A Review

Thin-layer chromatographic analysis of surfactants is presented in this review. Various chromatographic systems useful for the identification, separation and quantification of surfactants are reported. New approaches in thin-layer chromatography enable analysts to separate and determine surfactants in complex mixtures (in various environmental samples). Thin-layer chromatographic methods are mainly used for the separation of surfactants either in the separation of different classes or separation of different groups within the same class.

Key word: Surfactants, thin-layer chromatography, analysis

Tensidanalyse mittels Dünnschichtchromatographie. Eine Übersicht. Dieser Übersichtsartikel behandelt die Analyse von Tensiden mittels Dünnschichtchromatographie. Es wird über verschiedene chromatographische Systeme zur Identifikation, Trennung und Quantifizierung von Tensiden berichtet. Aufgrund neuer Entwicklungen in der Dünnschichtchromatographie kann der Analytiker Tenside in komplexen Mischungen (in verschiedenen Umweltproben) trennen und bestimmen. Dünnschichtchromatographische Methoden sind hauptsächlich zur Trennung verschiedener Klassen oder verschiedener Gruppen innerhalb einer Klasse von Tensiden geeignet.

Schlagwörter: Tenside, Dünnschichtchromatographie, Analyse

1 Introduction

Surfactants are amphiphilic compounds containing a hydrophilic part (polar group) and a hydrophobic part (often hydrocarbon chain). A surfactant is briefly defined as a material that can greatly reduce the surface tension of water when used in very low concentrations. These molecules form oriented monolayers at interfaces and show surface activity. These molecules are also capable to form aggregates called micelles. The unusual properties of aqueous surfactant solutions can be due to the amphipathic nature of these compounds. The polar or ionic head group interacts strongly with an aqueous environment, via dipole-dipole or ion-dipole interactions [1]. Surfactants reduce the surface tension of water by adsorbing at the liquid-gas interface. They can also reduce the interfacial tension between oil and water by adsorbing at the liquid-liquid interface. Depending on the nature of the hydrophilic residue or charge on the hydrophilic group surfactants can be classified into four types; anionic, cationic, amphoteric and nonionic. Surfactants find diverse applications in every chemical industry, including detergents, paints, dyestuffs, cosmetics, pharmaceuticals, agrochemicals, fibres, plastics [2]. They can also be found

in a wide spectrum of biological systems and medical applications, soil remediation techniques, petroleum, mineral ores, fuel additives and lubricants, coatings and adhesives, in photographic films and other environmental health and safety applications [1].

The analysis of commercial surfactants is complicated because of the fact that these products are mixtures. These are often comprised of a range of molar mass structures of a given structural class and are often supplied dissolved in mixed organic solvents or complex aqueous salt solutions. Many procedures used for the quality control and quality assurance of these products are based on classical methods of analysis. However, need for improved precision and accuracy have led to increased use of instrumental analysis. Thus, the development of fast and reliable analytical methods for the quality control, including the identification of synthesis products and purity tests, are both important and challenging.

This review presents the contribution of thin-layer chromatography to the analysis of surfactants. It includes almost all the aspects of thin-layer chromatography including, detection, separation and quantification of surfactants. The Figure 1 presents the work done on the different classes of surfactants from 1980–2009. The nonionic surfactants have been analyzed mostly with respect to the other types. The order of analysis of surfactants by thin-layer chromatography follows the trend as: nonionics > anionics > cationics > amphoteric.

2 Thin-layer chromatographic analysis

Thin-layer chromatography has been found to be an useful analytical technique in the analysis of surfactants from characterization to interaction studies. Both polar and non-polar layer materials are used for the chromatography of surfactants. The most frequently used materials are silica and RP-18. The other chemically modified phases like alumina, RP2 or aminopropyl-modified silica are less frequently used. The separation on a polar phase leads to either a group separation of the different surfactant classes (cationic, anionic etc.) or to a separation of different types within one class, but the separation of surfactants according to the alkyl chain length requires a less polar stationary phase like RP2, RPS or RP18 [5]. Our main focus was to divide the thin-layer



Figure 1 Publications on analysis of four different types of surfactants (1980–2009)

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