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Silica Thin-Layer Chromatographic Studies of Surfactants with Mixed Aqueous-Organic Eluents Containing Thiourea: Simultaneous Separation of Co-existing Cetyltrimethylammonium Bromide, Dodecyltrimethylammonium Bromide, and Polyoxyethylene (20) Sorbitan Monolaurate

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Abstract

Silica thin-layer chromatography of three surfactants using various solvent systems is described. The mutual separation of coexisting cetyltrimethylammonium bromide (CTAB), dodecyltrimethylammonium bromide (DTAB), and polyoxyethylene (20) sorbitan monolaurate (Tween 20) is achieved on silica layer using 5% aqueous thiourea–acetone–methanol (60:20:20,v/v/v) as the mobile phase. The effect of the carbon chain length of alcohols (methanol, ethanol, *n*-propanol, and *n*-butanol) on the mobility of these surfactants is examined on silica layers. The comparative study is performed with sulfur- (thiourea) and oxygen- (urea) containing compounds in the eluent on the mobility as well as on the separation of co-existing CTAB, DTAB, and Tween 20. The interference on the resolution of the mixture of CTAB, DTAB, and Tween 20, due to presence of metal cations as impurities, is also examined. The limits of detection of CTAB, DTAB, and Tween 20 are estimated.

Introduction

Separation by thin-layer chromatography (TLC) is mainly controlled by a mutual action of the stationary and mobile phases on the analyte. As a general practice, the composition of mobile phases is usually altered to obtain a desired separation on a particular adsorbent. According to the literature on the TLC analyses of surfactants, several mixed organic or aqueous-organic mobile phases are currently in use, including methanol in combination with dichloromethane, 0.1M aqueous glutamic acid, chloroform, water, acetone, 2N NH_3, 0.1N sulfuric acid, 3.84% ammonium acetate, etc. (1–8); ethanol in combination with 20% sodiumtetraphenylborate, methylethylketone, benzene, water, etc. (9–12); propanol in combination with 4-methyl-2-pentanone, acetic acid, etc. (10); butanol in combination with acetic acid, water, EDTA, etc. (13); acetone in combination with benzene, water, methylethylketone, ethylacetate, etc. (14–18); acetic acid in combination with 4-methyl-2-pantanone, 1-propanol, acetonitrile, chloroform, water, butanol, EDTA, ethylacetate, isooctane, etc. (10,13,19,20); chloroform in combination with methanol, water, 0.1N sulfuric acid, etc. (3–5); carbon-tetrachloride in combination with acetonitrile (21); and benzene in combination with acetone, water, etc. (10,15,17). Alcohols (methanol, ethanol, and 1-propanol) have generally been used as organic modifiers of the aqueous mobile phases (22).

From what has been previously mentioned, it is clear that most of the mobile phase systems comprised of pyridine, benzene, chloroform, or carbon tetrachloride as one of the components are not especially useful due to their strong toxic nature. Therefore, any attempt to develop new mobile phases for TLC analyses of the surfactants seems to be of interest for chromatographers. With this perspective, we have identified a new TLC system comprised of silica gel G as stationary phase and aqueous thiourea (5%)–acetone–methanol (60:20:20, v/v/v) as mobile phase for the detection and identification of coexisting cetyltrimethylammonium bromide (CTAB), dodecyltrimethylammonium bromide (DTAB), and polyoxyethylene (20) sorbitan monolaurate (Tween-20) surfactants with preliminary TLC separation. Thiourea was used, as it has been reported that it forms inclusion complexes with

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