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Synthesis and Characterization of Cationic Gemini Surfactants and Study its Applications as Dispersions and Biological Activity

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Abstract: ***Two new cationic Gemini surfactants were prepared to separate Oil – in –Water emulsions, the cationic Gemini surfactants are (A_3 and B_3) that have alkyl chain length of 12 carbon atoms with different spacer . The new compounds were synthesized and characterized by FTIR, and ^1H NMR spectroscopy. The basic surface properties of these novel Gemini surfactants were investigated through measuring the relationship between the electrical conductivity and the surfactant concentration to determine critical micelles concentration (CMC). The new compounds are in many practical applications as treatment O/W emulsion in environmental technology. And Study its efficiency in Biological Activity.***

Keywords: Cationic Gemini surfactants, electrical conductivity, critical micelle concentration, Dispersion, oil in water emulsion

1. Introduction

Geminis are special class of surfactants where two monomeric surfactants (two hydrophilic and two hydrophobic groups) are coupled together by a spacer. Because of the unique structure, gemini surfactants have some superior properties, such as higher surface activity, lower critical micelle concentration (CMC)[1, 2] a higher efficiency in reducing the oil/water interfacial tension, unusual aggregation morphologies, and better wetting, solubilizing, foaming, and antibacterial activities [3 - 5]. The wide application of cationic surfactants in chemical industries, as well as in daily cosmetic and cleaning products, have led to their widespread occurrence in wastewater, groundwater and soils. Moreover, cationic surfactants have been proposed as additive reagents in the mitigation and remediation of organic contaminated soils [6, 7].

In these investigations, we have found that novel quaternary ammonium Gemini surfactants with hydroxyl groups [8-10]. Alkyltrimethyl ammonium bromide is one of the types cationic surfactants that were used to determine the effect on water and oil separation[11].Herein we report the synthesis and the efficiency of dispersing the emulsions of oil in water (O/W) of these Gemini surfactants.

2. Experimental

A. Materials and instruments

The following materials purchased from Sigma – Aldrich company: ethylen glycol (99.5 % purity), Sodium hydrogen sulfate (98% purity), Epichlorohydrin (99.5% purity), petroleum ether dist. Potassium hydroxide (99 % purity), 33% aqueous dimethyl amine, chloroform (99% purity), anhydrous magnesium sulfate (99.5 % purity), methanol (99.8 % purity), 1-bromo dodecane (98 % purity), resorcinol Twice distilled water was used in the preparation of all solutions.

The characterization by ^1H NMR were recorded on a Bruker AM 500 spectrometer. The NMR spectra of the prepared gemini surfactants were recorded in DMSO and chemical shifts recorded were internally referenced to TMS (0 ppm) and Fourier transform infrared (FTIR) verified the structural characters of these new gemini surfactants on a Thermo Electron Corporation Nicolet 380 FTIR spectrophotometer. The CMC values of the surfactant solution were determined from Electrical conductivity with a Jenway PCM3 conductivity meter.

B. Synthesis of (A_3) and (B_3)

There are three steps to get the target compounds:

Synthesis of (A_3):

1) Synthesis of (A) / 3, 3'- (ethane-1, 2-diylbis(oxy))bis(1-chloropropan-2-ol)

To a mixture consisting of ethylene glycol (27.04 g, 0.3 mol), Sodium hydrogen sulfate NaHSO4 (1.00 g, 8 mmol) and water (0.6 ml) in round bottom flask, then added Epichlorohydrin (47.1g, 0.6 mol) drop wise 0 °C. The mixture was stirred for 5 hours and heated to 90 - 100 °C. Until the liquid is transparent yellow which represents the compound (A) [12, 13].

2) Synthesis of (B) / 2, 13-dimethyl-6, 9-dioxa-2, 13-diazatetradecane-4, 11-diol

To a flask containing (0.67 g, 12 mmol) Potassium hydroxide was added 33% aqueous dimethyl amine (0.90 g, 0.02 mol) , then added compound (A) (2.80 g, 0.01 mol) as drop wise with a magnetic stirrer at room temperature to produce precipitate. The mixture was filtered then the filtrate was extracted with chloroform and dried over anhydrous magnesium sulfate The output then evaporates to remove the residual solvent for the purpose of obtaining the compound (B) Which is oil-colored Its is yellow.