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Synthesis and emulsification properties of novel modified polyoxyethylenated stearylamine surfactants

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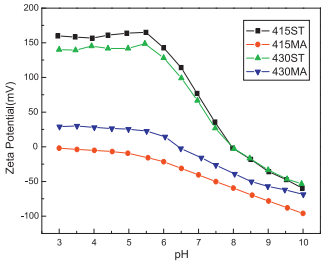
HIGHLIGHTS

- The modified surfactants featured ester bonds reflected by signals at 1734 cm^{-1} in FTIR spectra.
- The modified surfactant 415MA had the lowest surface concentration and surface area per molecule.
- The foam height of the modified surfactants was lower than unmodified surfactants.
- The modified surfactants exhibited more-negative zeta potentials than unmodified surfactants.

GRAPHICAL ABSTRACT

The modified surfactants have possessed more negative zeta potential and less isoelectric point values. The electrical charge density of modified surfactants droplets was less negative than those of unmodified surfactants droplets. We expected the surface potential to also increase upon increasing the surface concentration because an increase in surface concentration would lead to compression of the electrical double layer and a corresponding reduction in zeta potential.



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ABSTRACT

We have prepared a series of novel modified polyoxyethylenated stearylamine surfactants from two polyoxyethylenated stearylamines (415ST, 430ST), maleic anhydride (MA), and sodium hydrogen sulfite. We measured the surface activities of these compounds in terms of their critical micelle concentrations (CMCs), effectiveness at minimizing surface tension (γ_{CMC}), surface excess concentrations (Γ_{CMC}), minimum average areas per surfactant molecule (A_{CMC}), and standard free energies of micellization (ΔG_m°). We studied the CMCs of the modified polyoxyethylenated stearylamine derivatives through measurements of their surface tensions, conductivities, and fluorescence (namely, the intensity ratio of the pyrene emissions at 374 and 394 nm) with respect to their concentration. In addition, we also studied the surface activity in terms of the emulsification of 10% (w/w) soybean oil in the presence of these surfactants. The smallest emulsion droplets (i.e., the most stable emulsions) were obtained using the modified surfactant 415MA.

1. Introduction

Conventional single-chain surfactant molecules feature hydrophobic and hydrophilic parts. With increasing concentrations, they form micelles and, ultimately, lyotropic mesophases. Above the critical micelle concentration (CMC), surfactants in aqueous solutions can form a variety of microstructures, including spherical, ellipsoidal, vesicular, rod-like, and thread-like forms [1,2]. The microstructures of surfactant aggregates depend on the molecular structures of the surfactants and the solution conditions (e.g., concentration, temperature) [3].

In a previous paper, we reported a novel series of ethoxylated hydroxysulfobetaines prepared from polyoxyethylenated stearylamine. We demonstrated that these surfactants had

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