OIL DISPERSING PERFORMANCE OF A BINARY MIXTURE OF SURFACTANT

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Abstract

An investigation on the dispersing performance of a mixed surfactant on Spiked Bintulu oil was carried out using ultraviolet spectrometry. Result indicate a hyperchromic effect occurring at λ_{max} 234 mm having an aromatic $\pi > \pi^*$ transition. The effect is optimal at 0.5 mole fraction of the mixed surfactant indicating a good composition for the formulation of dispersant.

1. Introduction

During the last two decade the price escalation of oil has been a major driving force to focus the attention of industry and researchers on oil related matter. It has equally been a powerful stimulus to the identification of creative solution for better utilisation as well as for the development of alternative products. Today with increase frequency in oil spill endangering the marine life and polluting the seawater add another dimension to the oil related problem and rapid steps should be taken to overcome this wastage. One of the steps is to look into the dispersing property of surfactant.

Surface active agent or surfactant [1] has gained growing awareness of the diversity of industrial application outside the area of domestic detergent and personal care product. In the industrial application the surfactants are used either as essential additive or processing aids and in many cases as only a minor part of a particular system or formulation. Here the surfactant may be regarded as a "performance" or "effect" chemical where detailed knowledge of a surfactant composition and surface active properties is essential for selection of the optimum product for a particular enduse. In many cases a single surfactant cannot provide all the properties required and therefore two or more mixtures must be formulated to afford the desired effect [3-5]. The superiority in performance for mixture of surfactant is largely attributed to the synergistic interaction among the mixture molecules [4].

In this paper the dispersing performance of singular and binary mixture of cationic surfactant on Spiked Bintulu oil will be presented by employing ultraviolet spectrometry technique. The phase equilibria and micellar solution of binary mixture of tetradecyltrimethylammonium bromide(TTAB) and cetyltrimethy ammonium bromide(CTAB) was recently constructed and investigated [6]. Results indicated that the longer hydrocarbon chain CTAB was geometrically favourable for the micelle formation. These studies is imperative in formulation of product such as dispersant or handling an oil spill related problems.

2. Experimental Method

2.1 *Materials*

The chemicals source and purity are given in Table I and were used without further purification.

Chemical	Source	Purity
Cetyltrimethylammonium bromide (CTAB)	Merck	>99 %
Tetradecyltrimethylammonium bromide (TTAB)	Sigma	>99 %
Dichloromethane (DCM)	Merck	>99 %

Table I. List of chemicals

The Spiked Bintulu crude oil was obtained from Petroleum Research Institute PETRONAS. Doubly distilled water was used.

2.2 *Preparation of sample*

Samples of 0.002 mol/dm^3 was prepared at 0.0, 0.09, 0.28, 0.48, 0.68, 0.89 and 1.0 mole fraction, a of cetyltrimethylammonium bromide (CTAB). 1 ml of oil was then added to 30 ml of the sample solution in a 50 ml separatory funnel. The resulting mixture was vortexed and left to equilibrate for 30 minutes. The oil in the surfactant solution was then extracted twice using dichloromethane(DCM) and filter through an IPS grade filter paper containing anhydrous sodium sulphate.

2.3 *Ultraviolet Spectrometry*

The resulting solution was placed in a 1 cm^2 quartz cell and the ultraviolet-visible spectra was obtained from a Shimadzu UV-Visible Spectrophotometer Model 160A.

3. Results and Discussion

The single and mixed surfactants of CTAB and TTAB form a homogenous isotropic solution at the concentration of 0.002 mol dm^{-3} . The spectra of the Spiked Bintulu oil observed in the ultraviolet range, Figure 1, shows two peaks at a wavelenght 234 nm and 274 nm respectively.

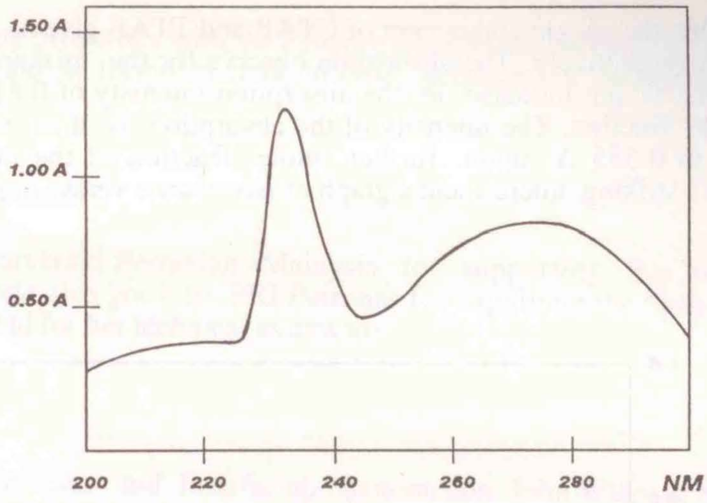

Figure 1: The ultraviolet spectra of Spike Bintulu crude oil at 200-400 nm.

These are typical peaks due to the absorption of the conjugated chromophores transition of $\pi \longrightarrow \pi^*$. This is indicative of the presence of aromatic molecules in the oil composition. These peaks or bands are also referred to as the K- and B-Bands respectively and is largely attributed to the conjugated π-systems [7] present. The bands are however observed at a shorter wavelength and it maybe due to solvent used which causes a hypsochromic shift of about 10 nm.

To illustrate the dispersing performance at variable mole fraction,a of the surfactant solution the absorption at λ_{max} 234 nm is highlighted. The mole fraction, a is defined as described by Clint [2]. Extraction of oil by the pure components and the mixtures are shown as in Figure 2.

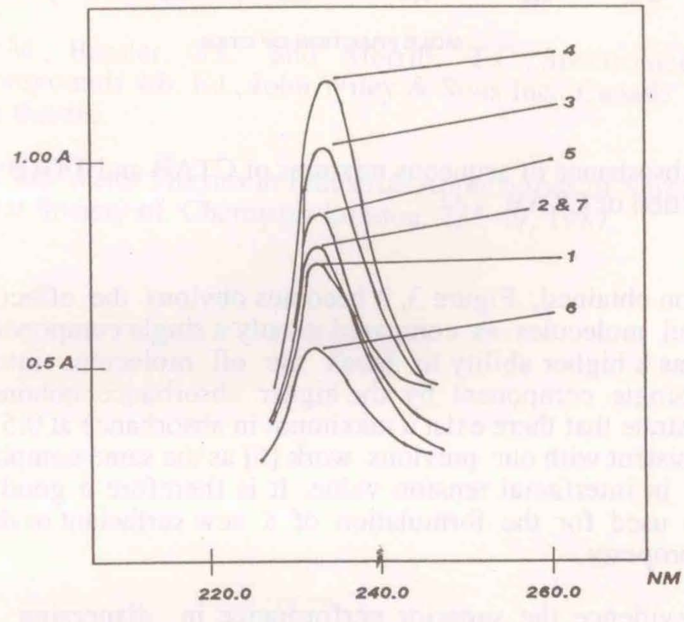

Figure 2 : UV spectra at (1) 0, (2) 0.09, (3) 0.28, (4) 0.48, (5).0.68, (6).0.89 and (7) 1.0 mole fraction of CTAB at 234 nm.

The extraction by the single component of CTAB and TTAB give an absorbance of 0.818 A and 0.760 A respectively. The absorption observe for the mixture is interesting in the sense that there is an increase in the absorption intensity of 0.811 A to 1.224 A up to about 0.5 mole fraction. The intensity of the absorption is then seen to be decreasing from 1.244 A to 0.555 A upon further mole fraction of the mixed surfactant. This behaviour form a striking interest and a graph of absorbance versus mole fraction, a is plotted as in Figure 3.

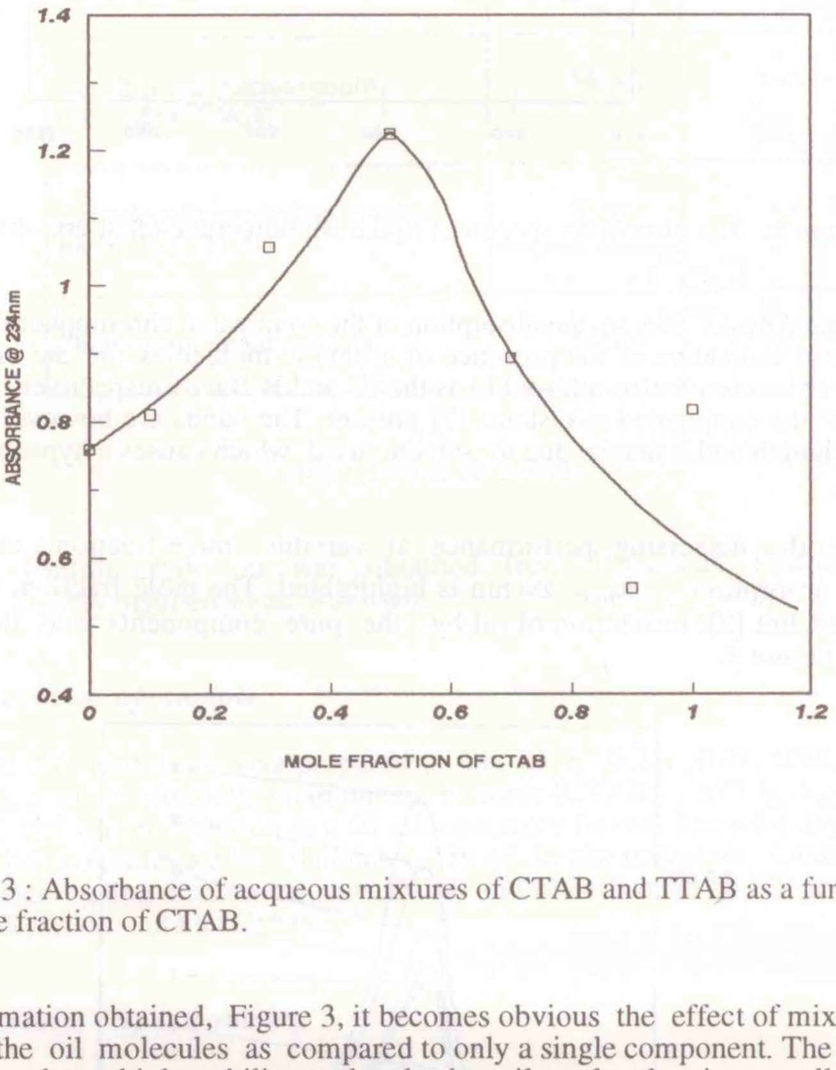

Figure 3 : Absorbance of acqueous mixtures of CTAB and TTAB as a function of mole fraction of CTAB.

With the information obtained, Figure 3, it becomes obvious the effect of mixed surfactant in dispersing the oil molecules as compared to only a single component. The result show that the mixture has a higher ability to break the oil molecules into smaller droplets if compared to their single component by the higher absorbance obtained (Figure 3). The result also demonstrate that there exist a maximum in absorbance at 0.5 mole fraction. This composition is consistent with our previous work [6] as the same composition exhibited the lowest reduction in interfacial tension value. It is therefore a good indication for the composition to be used for the formulation of a new surfactant or dispersant possessing a good dispersing property.

The results gave evidence the superior performance in dispersing property of mixed surfactants which the authors speculate due to the synergistic behaviour of the mixed molecules having a higher β^s value. It is also important to note that nonionic (ethoxylated) and anionic (sulphonated) surfactant has been vastly formulated and exhibit superior dispersing property [8] and it is not the intention of the authors to compare the dispersing properties with the existing dispersents. Nevertheless this finding is a good practise as an aid in formulation of oil-base surfactant or "performance" chemical as described earlier.

4. Acknowledgement

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