

Influence of CTAB and SDS on the properties of oil-in-water nano-emulsion with paraffin and span 20/Tween 20

Xia Xin^{a,b}, Hongxing Zhang^b, Guiying Xu^{a,b,*}, Yebang Tan^{a,b}, Jian Zhang^c, Xin Lv^c

^a National Engineering Technology Research Center for Colloidal Materials, Shandong University, Jinan, 250100, PR China

^b Key Laboratory of Colloid and Interface Chemistry (Shandong University), Ministry of Education, Jinan, 250100, PR China

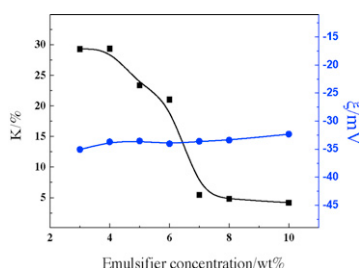
^c Technology Research Department CNOOC Research Center, State Key Laboratory of Offshore Oil Exploitation, Beijing 100027, PR China

HIGHLIGHTS

- ▶ We used emulsion inversion phase method to prepare nano-emulsions.
- ▶ The stability of the nano-emulsions was enhanced with the addition of SDS.
- ▶ SDS and CTAB induce a decreased droplet size but have opposite trends of stability.
- ▶ The electrostatic interactions are responsible for the stability of the nano-emulsions.
- ▶ This method might find significant applications in various industrial areas.

GRAPHICAL ABSTRACT

Water removal (K , squares) and zeta potential (ζ , circles) as a function of the concentration of mixed emulsifier Span 20/Tween 20.



ARTICLE INFO

Article history:

Received 25 August 2012

Received in revised form 26 October 2012

Accepted 30 October 2012

Available online 24 November 2012

Keywords:

Nano-emulsion

CTAB

SDS

Stability

Zeta potential

Interfacial tension

ABSTRACT

Oil-in-water (o/w) nano-emulsions with paraffin as an oil phase and Sorbitan monooleate (Span 20)/polyoxyethylene sorbitan monooleate (Tween 20) as emulsifiers were prepared using the emulsion inversion phase (EIP) method at 25 °C. The properties of the nano-emulsions were investigated in detail as a function of emulsifier content and the addition of ionic surfactants including cetyltrimethylammonium bromide (CTAB) and sodium dodecyl sulfate (SDS). The droplets of the nano-emulsions become smaller with the increasing concentration of Tween 20/Span 20 and the polydispersity of the droplets decreases. Similarly, the mean droplet size also decreases with the addition of both CTAB and SDS. The zeta potential of the nano-emulsion droplet without SDS or CTAB was found to be negative. Upon the addition of SDS, a more negative value was obtained which leads to an increased electrostatic interactions between droplets and improves the stability of the nano-emulsions via lowering the Ostwald ripening rate. Upon the addition of CTAB, however, a less negative zeta potential was induced which weakens the electrostatic interactions between droplets and lowers the stability of the nano-emulsions. These results indicate that electrostatic interaction is the main factor determining the stability of the nano-emulsions. Interfacial rheological measurements indicated that the maximum values of dilational moduli of both Tween 20/SDS and Tween 20/CTAB mixed adsorption layers at paraffin oil/water interface are lower than that of single adsorption layer of Tween 20. Our results give new insights of the nano-emulsions containing mixed surfactants and may serve as guidelines for preparation of new nano-emulsion systems for practical applications.

© 2012 Elsevier B.V. All rights reserved.

* Corresponding author at: National Engineering Technology Research Center for Colloidal Materials, Shandong University, Jinan, 250100, PR China. Tel.: +86-531-88365436; fax: +86-531-88564750.

E-mail address: xuguiying@sdu.edu.cn (G. Xu).