Engineering Chemistry
ISSN: 2813-6535, Vol. 4, pp 1-6
doi:10.4028/p-aYNBt6

Submitted: 2022-10-23
Revised: 2023-03-19
Accepted: 2023-03-19
Online: 2023-08-11

Studying the Factors Affecting De-Emulsification of Crude Oil

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Keywords: De-emulsification, Crude oil, Centrifuge, Emulsion, Chemical method.

Abstract. The paper deals with highly stable emulsions. It is concentrated on de-emulsification of crude oil. In the petroleum industry, de-emulsification is an important and urgent task that is typically required for the treatment of crude oil. This work, suggests method using coupling device integrated centrifuge with chemical to strengthen the de-emulsification efficiency. A number of de-emulsification runs were conducted to determine how centrifuge and chemical components affected the effectiveness of de-emulsifying crude oil and the separation of water, Different types of de-emulsifiers the (ethylene glycol, choline chloride and ethyl cellulose), were used with different concentration of de-emulsifiers, de-emulsification time in centrifuge and centrifugal speed. Also studied at the same time. Studies on the de-emulsification of crude oil were conducted at room temperature. As the concentration of de-emulsifiers was increased, crude oil's de-emulsification efficiency rose, centrifuge time and centrifugal speed ,with de-emulsifier type effect on de-emulsification, which reached maximum (85.9%,84.4% and 74.07%) at rate 4% of ethylene glycol, choline chloride and ethyl cellulose respectively ,at 60 min and 4000 rpm . This method provides higher water separation from crude oil emulsion and quicker method.

Introduction

The petroleum business encounters several obstacles throughout manufacturing and delivery. The biggest problem with using saline water is producing highly stable emulsions (1). In an emulsion, one immiscible liquid phase (the dispersed phase) disperses as globules into another immiscible liquid phase (the continuous phase) in an emulsion. (2) . Emulsions must be avoided because the water in them consumes unnecessary space, accelerates corrosion in pipes and processing equipment, and increases costs (3).

There are many methods of de-emulsifying, including physical (thermal, mechanical, and electrical), chemical, and microbiological, but the chemical method remains the most widely used and commons method (4). The water-oil separation process of an emulsion can be greatly accelerated by combining two or more processes or operational units (5). Therefore, a coupling device integrated centrifugal and chemical are proposed (6).

Filipe X. Feitosa …at el of, (2019), worked to create all-natural de-emulsifiers based on cardanol as an alternative to the more widely used petroleum-based ones. There are two sections to this study. First, the creation and evaluation of cardanol-based surfactant additives that were produced through several chemical methods, Cardanol formaldehyde resin (CFR), hydrogenated cardanol (HC), ethoxylated cardanol (EC), and cardanol formaldehyde resin (ECFR) are just a few examples

Second, the effectiveness of these additives in terms of emulsion separation capability has been assessed (7).

Study Zhongwei L, ...at el ,2019 (10). practical modification of tannic acid polyether de-emulsifier, the pilot-scale tannic acid de-emulsifier was changed to include polyaryl polymethylene isocyanate (PAPI), a highly active isocyanate, in order to more efficiently break the aged crude oil emulsion of the offshore platform. Its molecular weight and viscosity significantly rose with the addition of PAPI, but its relative solubility, hydroxyl number, and cloud point showed a different pattern, indicating an increase in hydrophobicity. After applying the aforementioned modified de-emulsifier, noticeably better water removal of water-in-aged crude oil emulsion and a considerable decrease in the water content in the oil phase were observed (8).

Murtada Mohammed Abdulredha, at el, (2020), they looked into how different surfactant doses, temperatures, toluene concentrations, pressure drops, and sitting times affected the de- emulsification of water in synthetic oil. They focused on propargyl alcohol and triethylene glycol. The effectiveness of surfactants in dissolving the emulsion was evaluated using the bottle test method. Additionally, a Pareto chart using a factorial design (2k1) to characterize the variables. The mathematical model was then established using CCD based on RSM, and the study's parameters were optimized using statistical analysis based on ANOVA (9).

This study proposed combining chemical and centrifugal water-oil separation with de- emulsification. The droplets are simultaneously subjected to extreme shearing and electrostatic coalescence, which may change the droplet size distribution. To our knowledge, no research on the water-oil separation model has been published that takes into account droplet dynamic properties with the coupling effect of chemical and centrifugal. It investigated how three distinct de-emulsifier series, including ethylene glycol, choline chloride, and ethyl cellulose, affected breaking the emulsion of crude oils. De-emulsification is impacted by centrifugation time, centrifuge speed, and concentration of the de-emulsifier type

2. Materials and Experimental Techniques

2.1. Materials

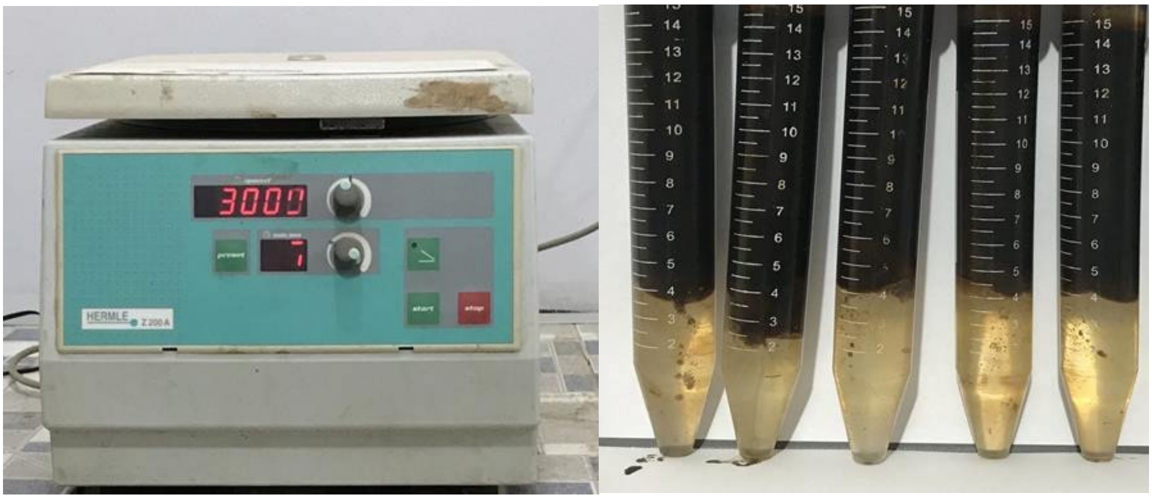
A sample of crude oil was received from the Basra Oil Company, show table (2.1). Three de-emulsifiers were used: ethylene glycol ($C_2H_6O_2$, Origin India), choline chloride ($C_5H_{14}NO.Cl$, Origin India) and ethyl cellulose ($C_{20}H_{38}O_{11}$, Origin India).

Table (2.1): Physical properties of crude oil

Property	Basrah crude oil
Density at 30° C	0.878
API	29.5
Salt content (%wt)	0.0021
Asphaltene (%wt)	2
Water and Sediment content(%vol)	0.05
Kinematic Viscosity (Cst) at 30° C	22.7
Sulfur content %wt	3.3785

2.2. De-emulsification

To determine whether these de-emulsifiers can successfully remove the water from crude oil emulsions, different concentrations(1%,2%,3%,and4%) of three different de-emulsifiers (ethylene glycol ,choline chloride and ethyl cellulose) were added to the prepared water in the temperature room emulsion of crude oil. By using a magnetic stirrer to mix the water (35 vol%) and crude oil (65 vol%) for 120 minutes, a 15-mL batch of each emulsion of crude oil was created. At were conducted series tests at various dosages using (ethylene glycol ,choline chloride and ethyl cellulose). After adding the de-emulsifier and mixing the emulsion by hand for three minutes, homogenization was carried out. After that, a centrifuge was used to spin the tube at (1000, 3000, and 4000) rpm. The samples were examined periodically in(15,30,45, and 60)min to record the amount of separated water , which is calculated from the measured water contents by minus water content after centrifuge water removal (vol %) $(Ct0 - Ct)/Ct0 \times 100$where:- Ct0 stands for the initial water content prior to settling, After centrifugation, water content isrepresented by Ct (10).
Subsequently, a crude oil sample was taken from the tube. show [figure.1]



(a) (b)

Fig (1): (a) Centrifuge and (b) Sample of water separation.

3. Measurements

3.1. Effect of De-emulsifiers Types

Investigate the effects of several types of de-emulsifiers (ethylene glycol, choline chloride, ethyl cellulose) on emulsified crude oil.

3.2. Effect of Different Concentration of Emulsifiers on Water Separation Efficiency

The influence of varying amounts of different types of de-emulsifiers on water separation efficiency for emulsified crude oil is investigated in these tests.

3.3 Effect of Time of centrifuge on Water Separation

To determine the best feasible separation time, the amount of water separation is measured at various times in centrifuge.

3.4 Effect of Different Rotational Speed of Centrifuge on Water Separation

The spinning speed of a centrifuge at which the best water separation is obtained is being investigated.

4. Results and Discussion

4.1 Effect of the Type of De-emulsifiers on Water Separation

Three types of de-emulsifiers were used (ethylene glycol ,choline chloride , and ethyl cellulose). The highest water separation rate for the ethylene glycol emulsifier was observed, reaching 83.5%, as well as choline chloride, reaching 84.4%, compared with ethyl cellulose, where the highest separation rate reached 74.07%. The rotation speed of the centrifuge reaches 4000rpm. Showfigures (2,3,4), in fig(2) the concentration of ethylene glycol giving a high separation rate , The centrifuge speed of ethylene glycol produces a high separation rate in[Fig .4] and the time of choline chloride in fig (3) respectively.

4.2 Effect of Different Concentration of De-emulsifiers on Water Separation Efficiency

Four different concentrations (1%, 2%, 3%, and 4%) were used for each type of de-emulsifier (ethylene glycol, choline chloride, and ethyl cellulose) is given in [Fig .2]. The presence of de-emulsifiers was obviously necessary in order to demulsify the stable water-in-crude oil emulsions. When de-emulsifiers are added to the emulsions, it is noticed that the stabilized water-in-oil emulsions demulsify. However, this is very dependent on the de-emulsifier type and concentration (8). +At 1%vol de-emulsifiers in 4000 rpm and 60 min, the dehydration ratios for the stabilized emulsions of ethylene glycol, choline chloride, and ethylene cellulose are 81.48%, 78.51%, and 66.66%, respectively. It is discovered that increasing the de-emulsifier concentration helps in de-emulsification up until the critical micelle concentration is reached. Maximum level of dehydration efficiency of ethylene glycol, choline chloride and ethylene cellulose, are found to be 85.9%,84.4% and 74.07%, respectively, at 6%vol de-emulsifiers in 4000rpm and 60 min.

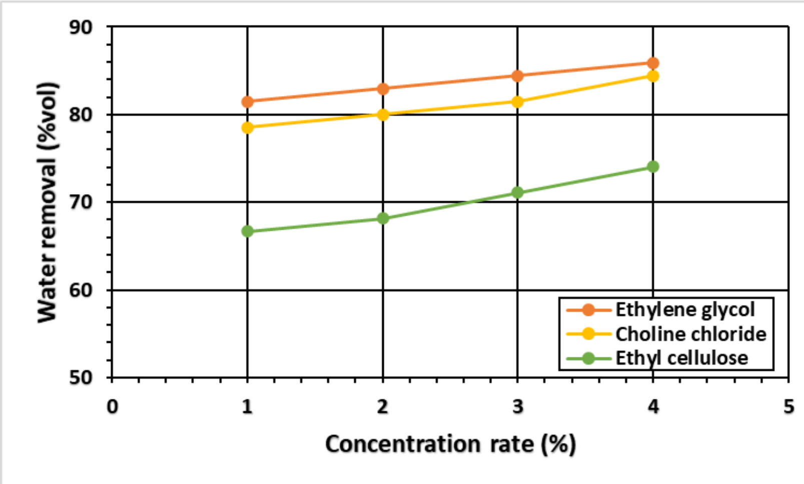


Fig (2): Effect rate de-emulsifier on water separation from crude oil at 4000 rpm and 60 min

4.3 Effect of Centrifuge Time on Water Separation

The centrifugation process was repeated four times, namely (15, 30, 45, 60) min at room temperature for different centrifuge speed (1000,3000,4000) rpm ,and different concentrations (1%,2%,3%, and 4%) of three de-emulsifiers(ethylene glycol , choline chloride , ethyl cellulose) . Figure (3) displays a plot of water removal yield across various centrifugation times. The best rateof water removal is found in ethylene glycol, which removes water at a rate of about 85.9% in 60 minutes at 4000 rpm and 4% de-emulsifier; ethyl cellulose, which removes water at a rate of about 74.07% in 60 minutes at 4000 rpm and 4% de-emulsifier; and choline chloride, which removes water at a rate of about 85.9% in 60 minutes at 4000 rpm and 4% de-emulsifier . The longer of centrifugation time, it gives higher yield of water removal. This is because the oil droplets will have more time to separate from the emulsion during the separation process. The figure shows that longercentrifugation times produce superior separation results (water removal yield)(5).

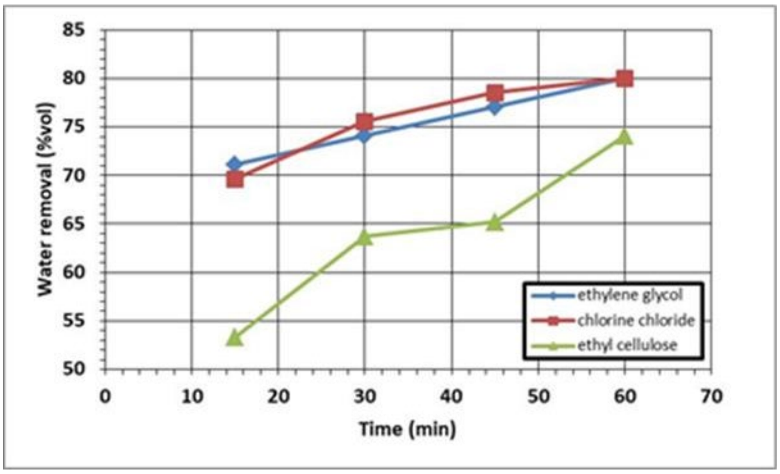


Fig (3): Effect time on water separation from crude oil at 1000 rpm and 4% de-emulsifier

4.4 Effect of Different Rotational Speed of Centrifuge on Water Separation

In this study, the effectiveness of de-emulsifying crude oil was examined at various centrifugal speeds (1000, 3000, and 4,000) rpm and centrifugal times (15, 30, 45, and 60) min, with the crude oil maintained at room temperature. Results are displayed in [Fig .4]. As can be seen, a higher centrifugal speed results in a higher de-emulsification efficiency since the smaller droplets migrate due to the improved centrifugal force at a higher speed. The improvement of the de-emulsification efficiency is widely known to be constrained by the centrifugal speed. Additionally, it should be noted that the de-emulsification efficiency steadily increased at first while maintaining a nearly constant level as centrifugal time increased. This is due to the fact that the centrifugal forcegenerated by a particular speed can only move droplets of the same size and is useless for smaller droplets (10).The highest yield of water removal is found in ethylene glycol about 85.9% in 4000 rpm at (30,45 and 60)min and 4%vol de-emulsifier, ethyl cellulose 74.07%vol in 4000 rpm at (45,60)min and 4%vol de-emulsifier ,and choline chloride 84.4%vol in 4000 rpm at 60 min 4%vol de-emulsifier . A longer centrifugation speed results in a higher yield of water removal.

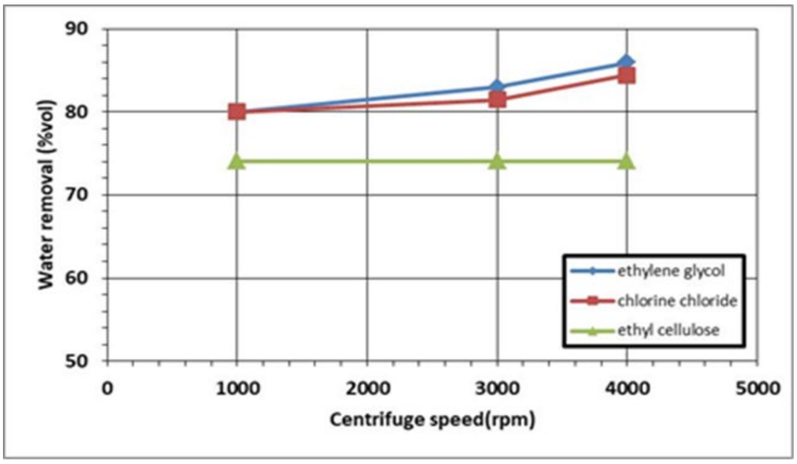


Fig (4): Effect centrifuge speed on de-emulsification at 60 min and 4% de-emulsifier

5. Conclusions

According to the current study, de-emulsifiers and centrifuges are both required for the de-emulsification of crude oil. The amount of the de-emulsifier in the mixture greatly influences how well the water and crude oil separate. According to the experiment's findings, the separation rate will increase as the de-emulsifier concentration is raised. The longer the centrifuge time, the greater the percentage of water separation, and this is what was observed from the results. The speed of rotation of the centrifuge has a significant effect on increasing the separation rate. The higher the rotation speed, the higher the separation rate. In addition to that, the de-emulsifier type has a great effect on de-emulsification process, ethylene glycol has maximum separation, second choline chloride and third ethyl cellulose.

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