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Advancing green technology: demulsifier preparation and evaluation for crude oil emulsion treatment using corn oil

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Abstract

Globally, oil production has steadily increased which causes a rise in the coproduction of oil and water emulsions. These emulsions pose significant challenges in transportation and the oil refinery industry, causing high-pressure drops and corrosion problems due to chlorides in the water. Despite advancements in renewable energy, crude oil remains a primary energy source. The crude oil industry faces numerous challenges, including cost emulsion issues. This study developed a corn oil bio-demulsifier (MFK). A unique demulsifier was tested using FTIR, GC-MS, and TGA. Using the bottle test method, the produced demulsifier MFK was tested with Basrah oil and East Baghdad S1 oil. The emulsion-breaking processes have been studied under several factors, such as settling time, dosage, temperature, pH, water content, and mixing time after demulsifier addition. At 2000 ppm Basrah oil, water separation efficiency reached 75%. For East Baghdad S1 oil, the highest separation result was 43.3% at 4000ppm, after 5 h of settling time at 70°C, with a 30/70 water-to-oil ratio. When studying the pH, the best water separation rate was 86.5% at a pH of 10. The best water content was 92% when the water-to-oil ratio was 50/50, and the best demulsifier mixing time with the emulsion was 2 min with a separation rate of 74.5%. When mixing was increased, undesirable results occurred. This study demonstrated that biodemulsifiers may replace conventional biodemulsifiers in early units while reducing environmental and economic impacts with further study and development.

Keywords: Biosurfactant; Demulsification; Emulsion; demulsifier; Water-in-oil emulsion.

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1- Introduction

Water in oil (W/O) emulsions are ubiquitous in many different sectors, especially in the production of petroleum, coal chemicals, metalworking, and waste oil treatment [1, 2]. They are produced when water and oil mix together, commonly during extraction [1]. Pipeline turbulence and the presence of natural surface-active substances including surfactants, asphaltenes, resins, and waxes combine to create these emulsions. [2,3]. Many scientists believe that the asphaltenes in these substances serve as the principal stabilizer for water-oil emulsions. The coalescence of water droplets is impeded by the asphaltene particles adsorbed at the water-oil interface, which forms a hard interfacial covering [4,5]. Three main types of emulsions are water-in-oil, oil-in-water, and complicated emulsions. Oil industry water-in-oil emulsions are more common [6]. The stability of W/O emulsions depends on factors such as the rheological properties of the emulsion, asphaltene and resin content concentration, temperature, water content [7], pH, solid particles [8], density ratio [9], viscosity, Shear intensity, and the presence of natural emulsifiers, droplet's size and distribution [7,10].

Emulsions develop stable compositions if they are not correctly managed, which causes several challenges, especially in refining, for transporters and producers. Pumping and transporting water–oil through pumps and pipes costs more, water's salt content promotes corrosion and scaling, and high-pressure drop development in flowlines may result from petroleum well crude oil extraction. At low API oil gravity, downstream processing plant catalysts are being degraded and crude oil viscosity is difficult to increase due to water drops [11, 12]. Emulsion stability can be broken by mechanical, thermal, electrical, or chemical demulsification [13]. Using mechanical equipment for demulsification or breaking down of the interfacial barrier between oil and water phases, is called mechanical demulsification [13]. An electric field is used in electrical demulsification to break up the interfacial layer and accelerate droplet coalescence [14]. Thermal demulsification (microwave or traditional) speeds droplet coalescence and reduces emulsion viscosity [15].

Chemical demulsification, which involves the use of chemical additives to destabilize emulsifying agents, is the main method for breaking oil-in-water and water-in-oil emulsions [13,16]. Demulsifiers are a subclass of surfactants with the ability to destabilize emulsions by adsorbing onto the surfaces or interfaces of the system

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*Corresponding Author: Email: mohammed.abd2107m@coeng.uobaghdad.edu.iq and changing the surface or interfacial free energy [17]. Additionally, the surfactants that keep the emulsion from becoming unstable are rendered ineffective by these chemicals, and the chemicals themselves are removed from the interfacial layer surrounding the droplets. The right demulsifier must be chosen for the right emulsion (emulsion qualities vary from reservoir to reservoir), and then the right amount of demulsifier must be added, properly mixed, and retaining the demulsifier for long enough [1].

Toxic demulsifiers pose health risks to workers and create environmental hazards by introducing new toxins into the water supply. So, demulsification techniques are required because they are less costly and harmful to the ecosystem [13,18]. Many environmentally friendly demulsifier formulations perform poorly compared to less friendly ones. Demulsifiers harming the environment may be outlawed. Thus, eco-friendly demulsifier formulations with comparable or better characteristics are needed. When compared to chemical surfactants, biosurfactants are made from biological materials and have great stability, low toxicity, straightforward synthesis, structural variety, and are eco-friendly [19].

They are non-toxic, biodegradable, and eco-friendly. Renewable sources produce them [20]. They froth and work well at different pH, salinity, and temperatures [21]. Amphiphilic biodemulsifiers have several structural variations [20]. They can also manage tough conditions and complicated crude oil emulsions, bio adsorb aromatic and hydrocarbon emulsions [22], and reduce costs [21]. Multiple microorganisms, such as bacteria, yeasts, and fungi, can be used to produce biosurfactants [23]. Surfactants have increasingly been synthesized from vegetable oils due to their many positive characteristics as a renewable resource, wide availability, high-quality physicochemical attributes, low production cost, ease of use, and low environmental impact [24].

Recently, biomass materials have received a lot of attention for their application in many industrial and refinery processes because they have many advantageous criteria, such as low cost and environmental friendliness [25]. For instance, to make a demulsifier for use in emulsion treatment, biosurfactants are made with coconut oil [28], while others use soybean oil [26], linseed oil [27], castor oil [18], or corn oil [18]. The development of bio-surfactants and bio-demulsifiers using vegetable oils is a topic of study that is expected to be utilized to improve demulsification. The current study involved the preparation of demulsifiers made from commercial corn oil (MFK). The demulsifier was subjected to a series of characterization tests, including GC-MS, FTIR, and TGA, to determine its properties. The demulsifiers were then tested on two different oils sourced from Iraqi fields by the bottle test procedure at several parameters including temperature, settling time, dosage, pH, and water content.

2- Experimental work

2.1. Materials

This study used compounds from several producers without purification. Ether Petroleum 40-60°C (98%, Alpha Chemika, India), sodium chloride (99.5%, Alpha Chemika, India), diethanolamine (DEA) (98%, Thomas Baker, India), P-toluensulphonic acid monohydrate (98.5%, HIMEDIA, India), and corn oil from local markets. The present work was carried out on selected two types of petroleum (Basrah, and East Baghdad Oil Field/Southern Part S1). The physical properties of these Iraqi crude oil types were supplied by Al-Dura Refinery and Midland Oil Company. Table 1 shows the crude oil properties.

Table 1. Physical Characteristics of Crude Oil

Property	**Basrah Crude Oil**	**East Baghdad S1 Oil**
Sp.Gr. at 15.6ºC	0.88490	0.8911
API	28.40	27.29
Viscosity (Cst) at 26.7C	19.4	21.4320
Sediment and Water content (%vol.)	0.050	0.1233
Asphaltenes (%wt.)	2.220	3.5
Wax (%wt.)	4.3	1.94
Salt contents (ppm)	0.00060	5.444
Sulfur content (% wt)	3.43	3.10
Nickel content (ppm)	4.03	23.359
Vanadium content (ppm)	2.76	66.645

2.2. The process of synthesizing demulsifier

Esterification can modify surfactant characteristics. Fatty acids and alcohols create ester-based surfactants. Based on fatty acid and alcohol, these surfactants can have varied hydrophilic-lipophilic balancing values (HLB). The esterification process includes heating acid and alcohol with a catalyst. Ester and water resulted from the reaction. Other chemicals like amides or sulfonates can be surfactants, but not all surfactants are esters.

Corn oil (300 mL) and diethanolamine (100 mL) were mixed with a base catalyst (2.5 g and 98.5%) to prepare demulsifier. Fig. 1 shows the laboratory reaction flask (1000 mL) with a reflux condenser, magnetic stirrer, and thermometer which were charged with corn oil and catalyst p-toluene sulfonic acid monohydrate (2.5 g). The mixture was heated to 140 °C and stirred for about an hour to dissolve the catalyst.

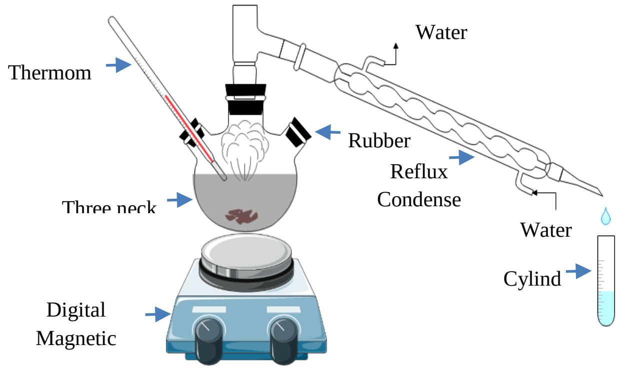

Fig. 1. The Scheme Shows the Process of Preparing the Demulsifier

Diethanolamine was slowly added to the mixture and the temperature was gradually raised to 180 ℃ for 1 h. The reaction was stirred for two more hours to obtain the necessary water. The result was collected after 12 ml of water. The sample was then removed from the heating magnetic and cooled [29]. After cooling the reaction result, extra ether petroleum is added and stirred for 20 minutes to remove contaminants from the purified demulsifier. Evaporation and removal of solvents, impurities, and unreacted components completed demulsifier preparation. The rotary evaporator was used for this purpose under vacuum, at 50℃ temperature, and 100 rpm rotation.

2.3. Emulsion preparation

An emulsion system was produced using brine in this investigation. 0.5 M NaCl solution ppm is preferable and crude oil 30/70 v/v % was used to obtain a 3% saline aqueous solution for crude oil field salinity. To create a one-phase emulsion was added. For 30 minutes, 10000 rpm and temperature room homogenized crude oil. To achieve a stable emulsion, water was gradually added to the oil. Fig. 2 shows the preparation of the emulsion.

Fig. 2. The Image Shows the Preparation of the Emulsion

2.4. Demulsification efficiency tests

This was conducted using bottle test demulsification. Water volume was changed over time during the bottle test are used to assess emulsion separation. To achieve the emulsion separation, the bottle was checked. The demulsifier should separate the emulsion's water and oil components. Emulsion separation time determines how effective a demulsifier is. The bottle test determines the appropriate demulsifier dosage and effectiveness for an emulsion. However, bottle test results may not reflect field demulsifiers [30].

After mixing the emulsion, it was charged to a 100 ml glass container and placed in a water bath at 50, 60, or 70 ºC for 15 min to reach equilibrium. After reaching equilibrium, the five bottles were expelled from the water bath and a demulsifier was added at 1000, 2000, 4000, and 6000 ppm. They returned to the water bath after 2 min of electric shaking. At 0, 1, 2, 3, 4, and 5 h, water was separated from the crude oil emulsion, measured, and recorded. The efficiency of the demulsifier in separating water (WSE) from crude oil emulsion under various conditions was determined using Eq. 1.

$$\text{WSE}\ \% = \frac{\text{V of separated water (ml)}}{\text{Total V of water in the sample (ml)}} * 100\% \qquad (1)$$

3- Results and discussions

3.1. Tests of characterization

3.1.1. Fourier transform infrared spectroscopy (FTIR)

The synthesis of surfactant compounds may be examined using FTIR. The stretching asymmetric and symmetric vibrations of CH_3 and CH_2 groups, as well as their deformation vibrations, may be seen in surfactant FTIR spectra. The liquid cell wavelength of FTIR spectra was 400–4000 cm^{-1}. The test used FTIR (8400S, Shimadzu/Japan). This test detected demulsifier bonding. Fig. 3 shows the test result, the large peak at 3395 cm^{-1} in the spectrum of the surfactant MFK may be a result of O-H stretching in secondary aliphatic alcohols. This indicates that OH groups are present in the surfactant's molecular structure. The disappearance of two NH_2 stretching peaks at 3394.7 cm^{-1} is strong evidence for the interactions of hydroxyl groups with amine groups. The NH_2 stretching peaks are seen in the FTIR spectrum between 3100 and 3400 cm^{-1} [31]. Alkenes ($=CH_2$) and symmetrical and asymmetrical alkane stretching ($-CH_3$) in aliphatic hydrocarbon groups are responsible for the significant absorption peaks at 3008-2854 cm^{-1}, Ester fatty acid (C=O) stretching is shown by the peaks in 1735 and 1739 cm^{-1}. [32]. The major aliphatic alcoholic (C–OH) is at 1053 and 1049 cm^{-1}. FTIR spectrum results detected carboxyl, hydroxyl, lipids, alkanes, and aliphatic alcoholic chemicals in the surfactants.

3.1.2. Gas chromatography-mass spectrometry (GC-MS)

GC-MS is a strong analytical tool used in scientific research to identify and measure chemical components in complicated combinations. GC-MS can detect and measure many chemical substances, even in very small amounts, making it important in scientific study. This makes it useful in environmental science, forensic investigation, drug discovery, and demulsifier preparation research. Operation specifications for GC/MS are Analytical Column Agilent HP 5 MS (30 m x 0.25 mm x 0.25 µm), Injector-Port Split (80:1), Carrier-Gas was a Helium, and GC Inlet Temp was 260 ℃. The MFK demulsifier is a complicated combination of several chemicals, as can be seen in Table 2 and Fig. 4, which are taken from an examination of the GC mass values.

The most abundant demulsifiers is 1,4-Bis(2-Hydroxyethyl)-Piperazine (BHEP), whereas MFK has a

22.16% area. BHEP breaks emulsions and aids separation. Corrosion inhibitors, polyurethane catalysts, and surfactants use hydroxyethyl piperazine as an intermediary [33]. Fatty acids appeared clearly, as Linoleic acid was 21.45 and n-hexadecanoic acid was 6.36, It is considered a natural surfactant [34]. However, hydroxyl and amine groups, such as 4-Morpholineethanol, present in various substances have been shown to aid in breaking emulsions [35]. Ethanol, 2,2'-iminobis-, 1-piperazineethanol, dodecanamide, n-(2-hydroxyethyl)-, 2-methyl-2-pentenoic acid 2, 1-naphthalenamine.

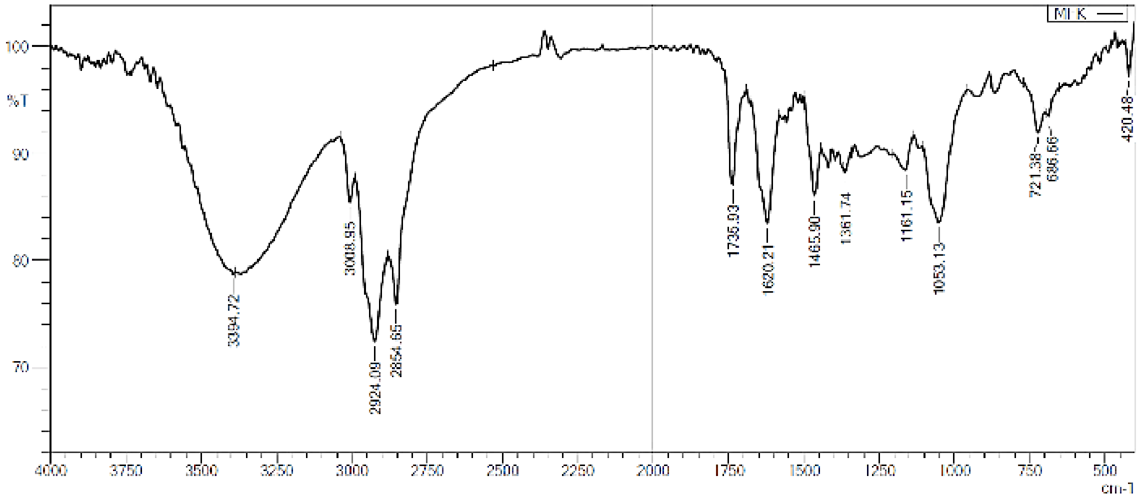

Fig. 3. The Demulsifiers FTIR

Table 2. Full GC/MS Analysis for MFK

No.	RT (min)	Name	Chemical formula	Area%
1	6.551	Triethylenediamine	$C_6H_{12}N_2$	0.07
2	7.382	Acetone dimethylhydrazine	$C_5H_{12}N_2$	0.05
3	8.45	4-Morpholineethanol	$C_6H_{13}NO_2$	0.03
4	9.566	Ethanol, 2,2'-iminobis-	$C_6H_{13}NO_6$	0.09
5	9.986	1-Piperazineethanol	$C_6H_{14}N_2O$	0.08
6	10.272	4-Terpineol	$C_{10}H_{18}O$	0.26
7	10.593	Xylitol	$C_5H_{12}O_5$	0.06
8	18.547	1,4-BIS(2-HYDROXYETHYL)-PIPERAZINE	$C_8H_{18}N_2O_2$	22.16
9	22.397	Benzyl benzoate	$C_{14}H_{12}O_2$	1.07
10	24.717	2H-1-Benzopyran-2-one, 3,4-dihydro-	$C_9H_8O_2$	2.12
11	26.388	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	6.36
12	28.375	Dodecanamide, N-(2-hydroxyethyl)-	$C_{14}H_{29}NO_2$	0.07
13	29.329	Linoleic acid	$C_{18}H_{32}O_2$	21.45
14	29.838	Sordinol	$C_{22}H_{25}ClN_2OS$	1.19
15	30.938	Bicyclohexyl-2,3'-dione	$C_{12}H_{18}O_2$	0.18
16	31.016	Mepivacaine	$C_{15}H_{22}N_2O$	0.14
17	33.662	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	$C_{19}H_{38}O_4$	1.35
18	36.178	OCTADECA-9,12-DIEN-1-OL	$C_{18}H_{34}O$	16.81
19	36.713	Oxazolidine, 2-butyl-2-ethyl-3-methyl-	$C_{10}H_{21}NO$	0.18
20	36.993	Diisopropylethylamine	$C_8H_{19}N$	0.33
21	37.149	3,6-Dimethoxy-1a,2,2a,3,6,6a,7,7a-octahydro-1-oxacyclopropa[b]naphthalene	$C_{12}H_{18}O_3$	0.24
22	37.751	4-Octanamine, 4-ethyl-	$C_{10}H_{24}ClN$	0.53
23	37.88	3-Piperidinol, 1-ethyl-	$C_7H_{15}NO$	0.06
24	38.456	(N-1,3O4-2H3)-3-deazauracil	-	0.05
25	39.473	2-METHYL-2-PENTENOIC ACID 2	$C_6H_{10}O_2$	0.08
26	40.127	5-hydroxyacronycine	-	1.02
27	40.392	2-Cyclopropen-1-one, 2-cyclopropyl-3-(dichlorocyclopropylmethyl)-	$C_7H_{10}O$	3.28
28	40.739	3,6-Dimethoxy-1a,2,2a,3,6,6a,7,7a-octahydro-1-oxacyclopropa[b]naphthalene	$C_{12}H_{18}O_3$	0.26
29	41.004	(N-1,3O4-2H3)-3-deazauracil	-	0.04
30	41.896	Cyclohexane-1,2-dione, hemihydrat	-	0.26
31	42.799	1-(p-Nitrophenyl)-4-(2-imidazolinyl)-5-(p-(methoxyphenyl)-1,2,3-triazole	-	8.31
32	43.007	Benzeneethanamine, 3,5-difluoro-4-trifluoroacetoxy-	-	11.02
33	43.287	(23S)-ethylcholest-5-en-3.beta.-ol	$C_{29}H_{50}O$	0.29
34	44.387	Pentanedioic acid, 3,3-dimethyl-, bis(1-methylpropyl) ester	$C_{15}H_{28}O_4$	0.03
35	46.436	Methyl 2-acetyl-2,3-dimethyl levulinate	-	0.03
36	48.019	1-Naphthalenamine	$C_{10}H_9N$	0.14
37	49.612	9,17-Octadecadienal, (Z)-	$C_{18}H_{32}O$	0.04

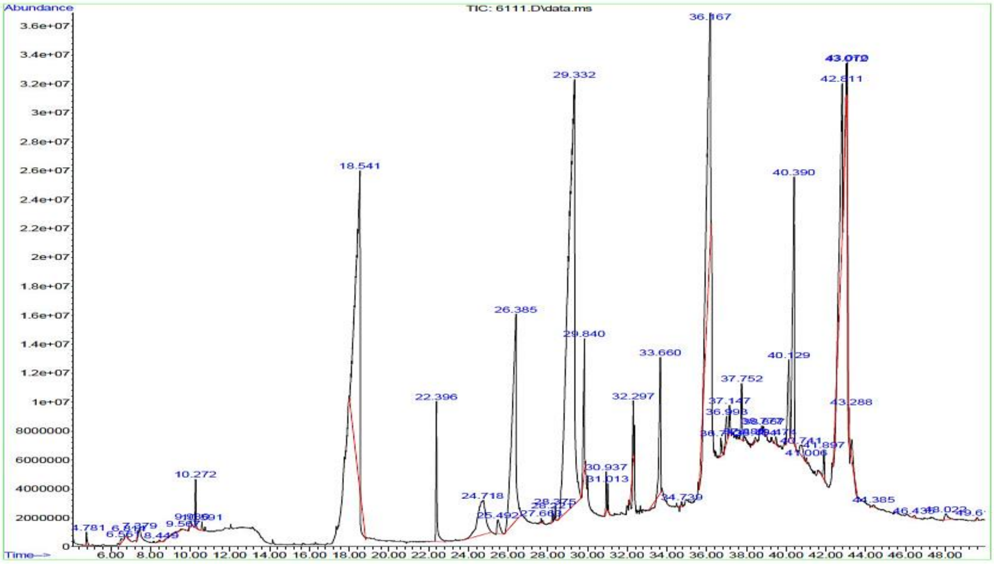

Fig. 4. MFK The Demulsifier (GC-MS)

3.1.3. Thermal gravimetric analysis (TGA)

A sample was placed in a controlled temperature program in a controlled environment and its mass is monitored with time or temperature in thermogravimetric analysis. TA Instruments SDT Q600 thermogravimetric analyzer (TGA) measured the surfactant's thermal stability after synthesis. TGA measures MFK surfactant mass loss due to temperature variations. The test was conducted in an Argon atmosphere at 25-800 ℃ and 20 °C/min heating rate. The results of the TGA of the MFK surfactant are depicted in Fig. 5. The mass loss occurred in three distinct phases. Mass decreased by 4.415% from ambient temperature to 150 °C in the first zone, which is associated with the loss of weakly connected water molecules. The second zone, between 150 and 390 °C, showed a significant mass loss (68.37%). Whereas the third zone, between 390 and 800 °C, showed a significant mass loss (25.91%). The molecular breakdown of MFK was observed at temperatures over 150 °C. At 50 °C to 120 °C that is typical of a reservoir's interior, however, the surfactant should retain 100% of its original mass and structure. This corresponded to [36].

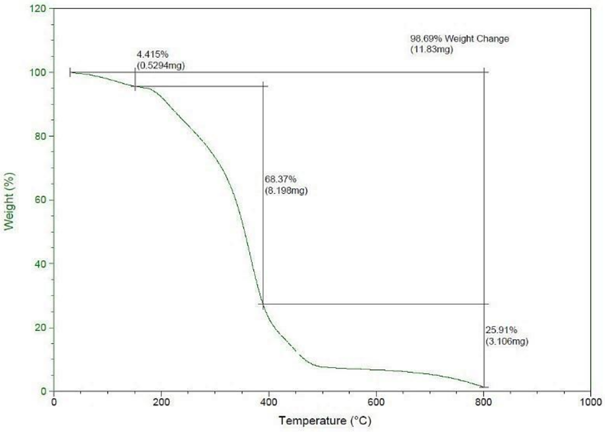

Fig. 5. The MFK demulsifier Thermal Gravimetric Analysis

3.2. Evaluation of the demulsification process

3.2.1. Effect of settling time and demulsifier dose

Fig. 6 and Fig. 7 show the effect of the settling time and demulsifier dose on the separation efficiency of the two crude oil emulsions. All investigations, which varied in duration from 0 to 5 h, showed that WSE rose with increasing time. This is because the existence of enough time increased the probability of water droplets colliding with one another, causing flocculation and coalescence of the oil into bigger droplets. As a result, demulsification and phase separation were both enhanced [37].

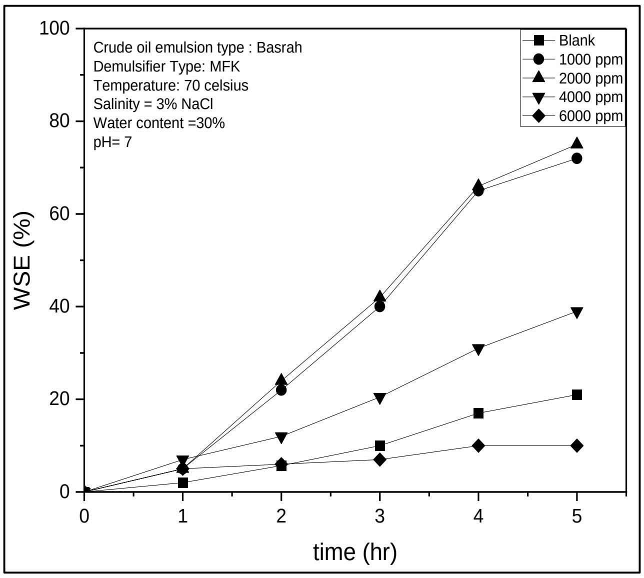

Fig. 6. Effects of Demulsifier Dosages and Settling Time on WSE in Basrah Crude Oil Emulsions

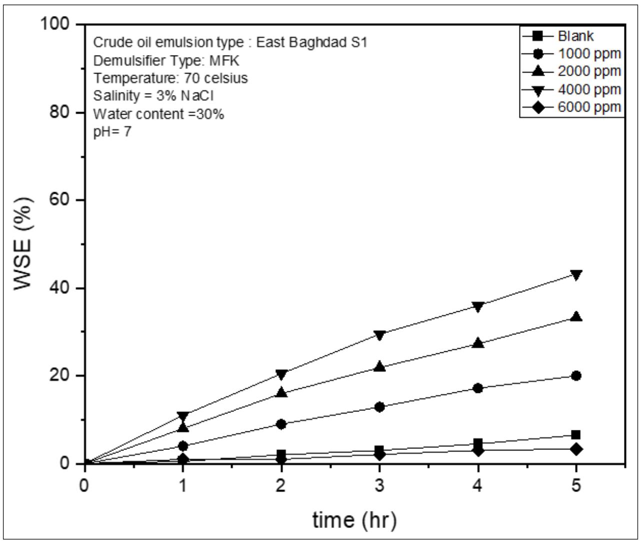

Fig. 7. Effects of Demulsifier Dosages and Settling Time on Wse in East Baghdad S1 Crude Oil Emulsions

High water content in crude oil emulsions promoted demulsification efficiency while decreasing the demulsifier dose and the time needed for the phase separation to reduce water content. The emulsions are likely to separate faster when the volume of the dispersed phase is increased as the distance between the droplets is reduced. Many researchers reported that decreasing the oil content in a surfactant-stabilized oil-in-water emulsion without a demulsifier resulted in reduced water separation [38]. The behavior of 1000 and 2000 ppm MFK was shown to be quite similar. Fig.6 shows that the maximum separation was at 2000 ppm by 75% of Basrah crude oil emulsion. In the case of treating east Baghdad S1 crude oil emulsion shown in Fig. 7, the use of MFK demulsifier at a concentration of 4000 ppm resulted in a separation efficiency of approximately 43.33%.

According to the results, increasing the MFK concentration led to a decline in separation efficiency due to overdosing. When the system was overloaded with demulsifier molecules, water separation decreased significantly. The misalignment of the hydrophobic regions of the extra demulsifier molecules at the oil/water (O/W) interface was responsible for the reduction. Thus, the demulsifier-water interface became reverse-oriented when the misaligned molecules joined with more water droplets. Consequently, a complicated emulsion, or secondary water-in-oil-in-water (W/O/W) emulsion was formed [38]. When demulsifiers were used in excess, emulsions might become stable again. The optimal amount of demulsifier to achieve maximum demulsification effectiveness depends on the hydrophilicity or lipophilicity of the demulsifier, and the molecular weight of the demulsifier [39].

3.2.2. Effect of temperature.

The effect of temperature on water separation efficiency (WSE) was studied through a set of experiments. 50, 60, and 70 ℃ were used for the tests as shown in Fig. 8. The results indicated that increasing temperatures were associated with higher WSE values. Specifically, MFK exhibited optimal performance at all tested temperatures when applied at a dosage of 2000 ppm. At 50, 60, and 70 ℃. WSE values correlated to these percentages were 63.3%, 68%, and 75%.

These results demonstrated the significance of temperature and demulsifier concentration for optimal water separation efficiency. The increase in temperature improved the efficacy of water removal. This is because an increase in temperature decreases the viscosity of the continuous phase, thereby accelerating the sedimentation of water particles. In addition, heating reduced the interfacial viscosity between the water and oil phases, which destabilized the existing film. In addition, the increase in particulate thermal energy accelerated coalescence in the dispersed phase. In addition, applying heat enhanced the Brownian motion occurring within emulsions, facilitating the rapid displacement of demulsifier molecules towards the emulsion interface and accelerating the demulsification phenomenon [39,40].

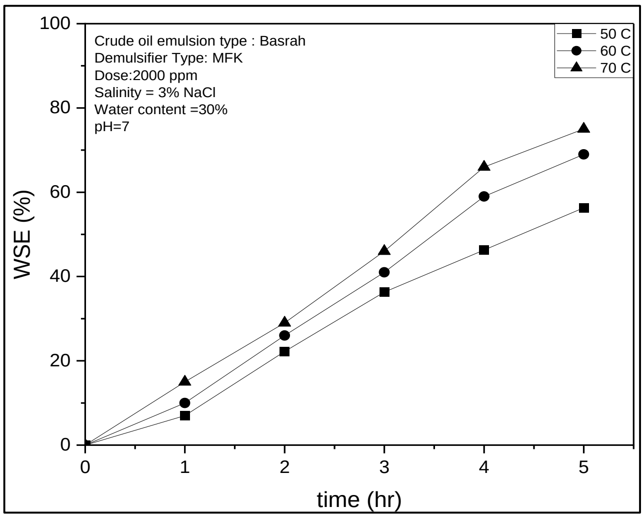

Fig. 8. Temperature and Emulsion Separation Efficiency

3.2.3. Effect of pH

The range of pH values tested was from 4 to 10. To adjust the pH of the aqueous phase before preparing the emulsion, solutions of sodium hydroxide (NaOH) and hydrochloric acid (HCl) were added. The main objective of these tests was to determine if changing the pH of water-in-oil (W/O) emulsions affects the efficiency of demulsifiers. Fig. 9 shows the pH effect on the separation of water from an emulsion.

The results showed that the separated water worked much better at high pH in the presence of demulsifiers. where the highest WSE is 86.5% at a pH of 10, 78% at a pH of 8, 74.5 at a pH of 7, 40 at a pH of 6, and the lowest WSE is 25% at a pH of 4. Emulsion stability depends on pH, soil type, and saline solution composition. Surfactant hydrophilicity raised with pH, generating water-in-oil and oil-in-water emulsions in acidic and alkali media. Asphalt films are stronger in acidic conditions and weak as the pH rises, whereas resin films gain strength as the pH rises [41].

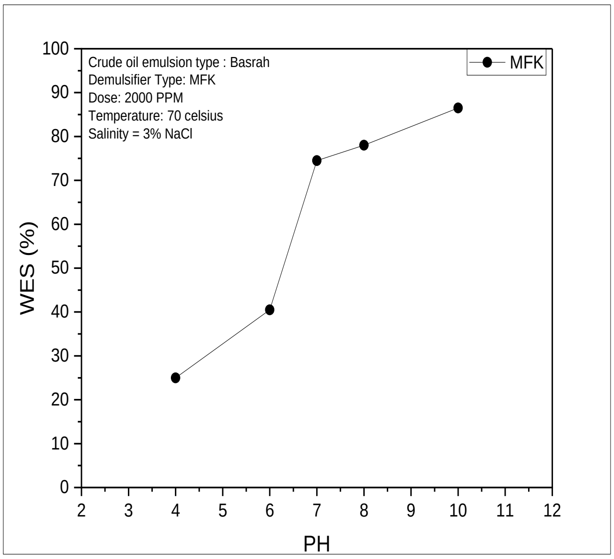

Fig. 9. The pH and Emulsion Separation Efficiency

3.2.4. Effect of water content

Water and oil contents have a major impact on the effectiveness and stability of water-in-oil emulsion separation. To investigate how the water content and demulsifier concentration impact the effectiveness of water separation (WSE), many experiments were conducted. Fig. 10 shows the evaluated water content values were 10%, 30%, and 50%. The results showed that when the water content increased, the efficiency of separated water greatly increased. The water separation efficiency (WSE) was 28%, 75%, and 92% at a water content of 10%, 30%, and 50%.

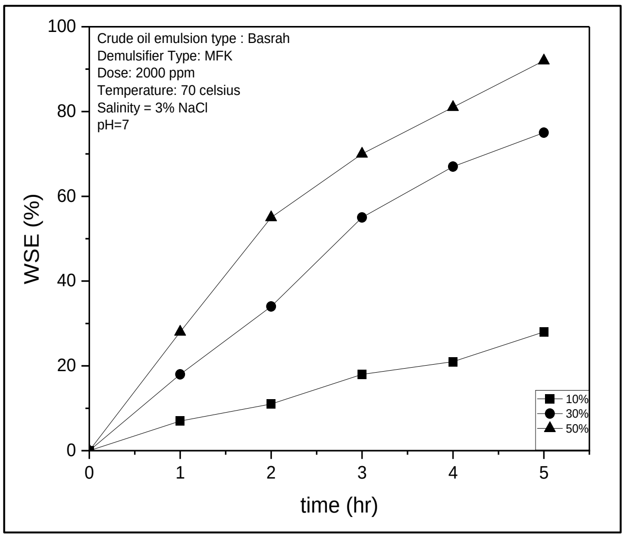

Fig. 10. Water Content and Emulsion Separation Efficiency

As the water content rose, the contact layer became thinner because of attracting water droplets. The rate of coalescence rises. However, limited asphaltene adsorption capability at the water-oil interface made the system unstable. With increased water content, asphaltene concentration spread per water molecule drop [38, 42].

3.2.5. The influence of emulsion mixing time after demulsifier addition

Demulsifiers must penetrate the emulsion and enter the water droplet film to work. The demulsifier won't work if it's not mixed. A series of tests examined how the emulsion mixing duration afterwards demulsifier addition by tables shaker. The study time was 0–4 minutes and two demulsifiers were used as shown in Fig. 11. The blending of longer the emulsion in the presence of the demulsifier was introduced, the more water separation was obtained. WSE was 30%, 71.50%, 74%, and 19% at 0, 1, 2, and 4 min.

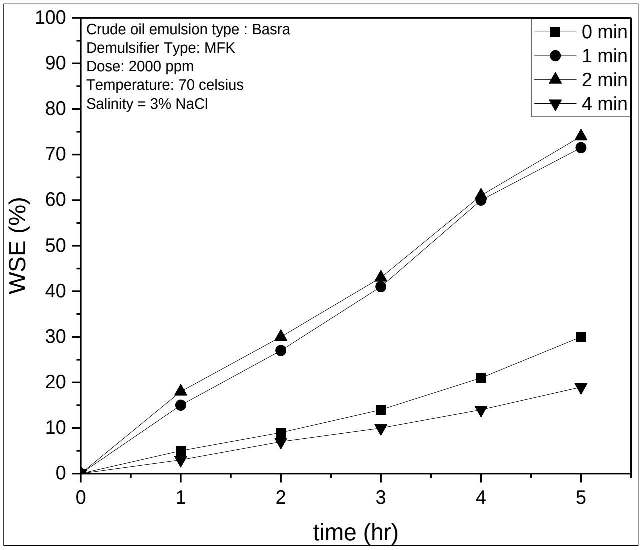

Fig. 11. Mixing Duration of the Emulsion After the Addition of the Demulsifier with WSE

If the demulsifier is mixed with the emulsified crude oil for longer, more WSE will be recovered from the water. This is because the demulsifier can penetrate the emulsion more easily and reach the oil-water interface that stabilizes the water ensuring coalescence and separation. Time of mixing slows water separation per minute. Water separation becomes harder after a certain period of stirring or mixing time, at 4 min, the results showed that the rate of separation reduced, which shows that MFK makes a reversible emulsion when mixing is done for longer than needed. These results corresponded to [43].

4- Conclusions

In this work, environmentally friendly biosurfactants were prepared as a demulsifier for O/W emulsions with the help of an emulsifier and the subsequent breakdown of the emulsion by using a biomass material. The results proved that this bio-demulsifier might reduce the environmental impact of conventional demulsifiers. Our bio-demulsifier assays were effective in describing its composition and identifying its functional groupings. The study also indicated that the greatest demulsification ratio was 75% at 2000 ppm Basrah oil emulsion and 43.3% at 4000 ppm east Baghdad S1 crude oil emulsion, 5 hours of settling time, 70 °C temperature, and 30% water content. These operational characteristics were highly affecting. However, additional research and development are needed to enhance the bio-demulsifier's performance and achieve 100% water separation efficiency. This shows that this alternative demulsifier needs more development and refinement to realize its full potential.

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تطوير التكنولوجيا الخضراء: إعداد مزيل استحلاب وتقييمه لمعالجة مستحلب النفط الخام باستخدام زيت الذرة

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الخلاصة

على الصعيد العالمي، زاد إنتاج النفط بشكل كبير، مما أدى إلى زيادة في الإنتاج المشترك لمستحلبات النفط والماء. تشكل هذه المستحلبات تحديات كبيرة في مجال النقل وصناعة تكرير النفط، مما يتسبب في انخفاض الضغط العالي ومشاكل التآكل بسبب الكلوريدات الموجودة في الماء. على الرغم من التقدم في مجال الطاقة المتجددة. إلا أنه مازال الاعتماد على النفط الخام كمصدر أساسي للطاقة في العالم الحديث. تواجه صناعة النفط الخام العديد من التحديات، بما في ذلك مشاكل المستحلبات المكلفة. طورت هذه الدراسة مزيلًا استحلاب عضوي باستخدام زيت الذرة. تم وصف مزيل الاستحلاب باستخدام FTIR وGC-MS وTGA. باستخدام طريقة اختبار الزجاجة، تم اختبار مزيل الاستحلاب المنتج MFK مع نفط البصرة ونفط شرق بغداد S1. تمت دراسة عمليات تكسير المستحلب تحت عدة عوامل، مثل زمن الترسيب، الجرعة، درجة الحرارة، الرقم الهيدروجيني، محتوى الماء، وزمن الخلط بعد إضافة مزيل الاستحلاب. عند ٢٠٠٠ جزء في المليون في مستحلب نفط البصرة وصلت كفاءة فصل الماء إلى ٧٥%. بالنسبة لنفط شرق بغداد S1، كانت أفضل نتيجة فصل هي ٤٣,٣% عند ٤٠٠٠ جزء في المليون، بعد خمس ساعات من زمن الثبات عند ٧٠ درجة مئوية، مع نسبة ماء إلى زيت ٣٠/٧٠، في كلتا الحالتين. عند دراسة الرقم الهيدروجيني تبين أن أفضل معدل لفصل الماء هو pH ١٠ بنسبة فصل ٨٦,٥%، وأفضل محتوى مائي ٩٢% عندما تكون نسبة الماء إلى الزيت ٥٠/٥٠، وأفضل مدة خلط لمزيل الاستحلاب دقيقتين بنسبة فصل ٧٤,٥%. عند زيادة الخلط، حدثت نتائج غير مرغوب فيها. توضح هذه الدراسة أن مزيلات الاستحلاب التي مصدرها مواد طبيعية قد تحل محل عمليات إزالة الاستحلاب التقليدية في الوحدات المبكرة مع تقليل التأثيرات البيئية والاقتصادية من خلال مزيد من الدراسة والتطوير.

الكلمات الدالة: عوامل الشد السطحي العضوية ،عملية إزالة الاستحلاب، مستحلب، مزيل الاستحلاب، مستحلب الماء في النفط.