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Studies on Demulsification of Crude Oil Emulsion Using Plant Extracts as Green Demulsifiers

Venkatesham V, Nasal Marshoom, Robin Mathew Joy, Ginto George and Murshid

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ABSTRACT

The breaking of crude oil emulsion is an important part of crude oil processing. The most commonly used method to break the water in oil emulsion is to use a chemical demulsifier. But chemical demulsifiers have adverse effect on the environment. In this study we have investigated the usage of plant extracts such as coconut oil, olive oil, bio-furfural, lemon seed oil, pine oil, cotton seed oil, and papaya extract as a suitable green demulsifier and further tests were carried out to determine the eco friendliness of the extracts. Results have shown that coconut oil and cotton seed oil gives the best results while cotton seed oil is more economic than coconut oil.

1. INTRODUCTION

When 2 immiscible liquid is in contact there is a chance for the formation of emulsion. An emulsion is a solution between 2 immiscible liquids where one liquid is dispersed in other liquid. Crude oil is extracted in the form of emulsion and hence there is a need for demulsification. The water content present in the emulsion will cause problems for the production facilities at the surface.

There are many methods for demulsification process such as chemical, mechanical, heat. The method we are focusing here is chemical demulsification. chemical demulsifiers are found to have methyl benzene in them, which is found to have an adverse effect on the environment. The water extracted from the emulsion is discharged into water bodies after further processing, and this will effect the aquatic life adversely and are even found to be toxic to the marine life. This project focuses on replacing the chemical demulsifier with demulsifier prepared from natural plant extracts.

2. LITERATURE REVIEW

An emulsion is a mixture of 2 or more liquids that are immiscible. In an emulsion one liquid is finely dispersed in another liquid. There are two basic types of emulsion; oil in water emulsion and water in oil emulsion. In every emulsion there is a continuous phase that suspends the droplets of other element which is called dispersed phase. In an oil in water emulsion, the continuous phase is water and dispersed phase is oil, while in a water in oil emulsion, oil is the continuous phase.

The dispersed water droplets inside the oil field emulsion has films that surround them which helps the emulsion to stabilize. The films are believed to be formed by adsorption of high molecular weight polar molecules. These polar molecules exhibit surfactant like behaviour. These films increase the interfacial viscosity and thereby increase the stability of the emulsion. Highly viscous interfacial film helps in decreasing the coalescence of water droplets by providing a barrier. The interfacial film is also strengthened by the presence of fine solids, further stabilizing the emulsion.

3. MATERIALS AND METHODS

3.1. PLANT EXTRACTS

The plant extracts selected were on the basis of two plant compositions, the hexane group and octadecanoic acid. Both of which are able break water in oil emulsion using specific approaches. Fig 1 shows the different plant extracts selected.

3.2. BLEND DEMULSIFIER MATERIALS

The materials used in the blend demulsifier were camphor powder, paraffin wax, cassava starch, liquid soap and distilled water. Each of the material fulfilled a specific requirement. Camphor powder formed the lipophilic end of the demulsifier produced. Paraffin wax was used as a bulking agent.

Cassava starch formed the hydrophilic end. Liquid soap acts as a binder while distilled water was the solvent for starch solution. Fig 1 shows the different composition of the demulsifier

3.3. PREPARATION OF SYNTHETIC CRUDE OIL EMULSION

The brine used to prepare the water in oil emulsion was of 90000 ppm salinity. The synthetic water in oil emulsion was formulated by mixing 40% brine and 60% crude oil. It was stirred for 20 minutes and filled in a centrifuge tube of 10 ml for testing purpose

3.4. STATIC TEST

Before the test, the emulsion is placed in a water bath at 60℃ to stimulate the actual conditions. O.25 ml of demulsifier was injected into 10 ml of emulsion sample and labelled according to the demulsifier.

The centrifuge tube is closed and shaken for 2 minutes continuously. After shaking, the sample was kept in the water bath again and the separation of water was noted down at 0, 10, 20, 30, 120 minutes, the experiment was repeated with 0.5, 0.75, 1, 1.5 ml of demulsifier.

3.5. DYNAMIC TEST

In this test, 0.25 ml of demulsifier was added into the centrifuge tube, then the centrifuge tube was placed into the water bath for 10 minutes(60℃), then the sample is placed in bench centrifuge and spun for 10 minutes at 2000 rpm. The separation of water was noted down immediately after the centrifuge was stopped. The experiment was repeated with 0.5, 0.75, 1, 1.5 ml of demulsifier.

Table 1 Demulsifier Formulations

NO. EXPERIMENTAL CODE FORMULATIONS

NO.	EXPERIMENTAL CODE	FORMULATIONS
1	E1	Coconut oil extract
2	E2	Olive oil extract
3	E3	Bio-Furfural from corn cobbs
4	E4	Papaya seed extract
5	E5	Lemon seed extract
6	E6	Pine oil(Turpentine)
7	E7	Cotton seed oil
8	B1	10 % E1 + 10 % starch + 20 % camphor + 20 % Ca(OH)2 + 20 % paraffin wax + 20 % liquid soap
9	B2	10 % E2 + 10 % starch + 20 % camphor + 20 % Ca(OH)2 + 20 % paraffin wax + 20 % liquid soap
10	B3	10 % E3 + 10 % starch + 20 % camphor + 20 % Ca(OH)2 + 20 % paraffin wax + 20 % liquid soap
11	B4	10 % E4 + 10 % starch + 20 % camphor + 20 % Ca(OH)2 + 20 % paraffin wax + 20 % liquid soap
12	B5	10 % E5 + 10 % starch + 20 % camphor + 20 % Ca(OH)2 + 20 % paraffin wax + 20 % liquid soap
13	B6	10 % E6 + 10 % starch + 20 % camphor + 20 % Ca(OH)2 + 20 % paraffin wax + 20 % liquid soap
14	B7	10 % E7 + 10 % starch + 20 % camphor + 20 % Ca(OH)2 + 20 % paraffin wax + 20 % liquid soap

3.6. TOXICITY LEVEL TEST

The toxicity was tested by using two techniques. The first test was by using aquatic toxicology test and the second method was pH test. For the aquatic toxicology test, a container was filled with 100 ml of tap water and a fish was placed inside the container, it is then injected with 0.5 ml of demulsifier. The time taken for the fish to die was recorded in minutes.

4. RESULTS AND DISCUSSIONS

The results obtained was divided into 4 parts. The static test for extracts, static test for blend demulsifier, dynamic test for extracts, and dynamic test for blend demulsifier

Table 2 Static test for extracts

EXTRACTS	OPTIMUM DOSAGE	WATER CUT = Amount of water separated / initial amount of water	WATER SEPARATION (%)
E1	0.75	2.2/4	55
E2	0.75	2/4	50
E3	0.5	1.5/4	37.5
E4	1.5	1.8/4	45
E5	1.00	1.6/4	40
E6	0.5	2.2/4	55
E7	0.5	2.1/4	52.5

Table 3 Static test for blend demulsifiers

BLEND	OPTIMUM DOSAGE(ml)	WATER CUT = Amount of water separated / initial amount of water	WATER SEPARATION (%)
B1	0.75	3.5/4	87.5
B2	0.75	3.2/4	80
B3	1.0	2.9/4	72.5
B4	0.75	3.0/4	75
B5	0.75	3.2/4	80
B6	0.75	3.3/4	82.5
B7	1.0	3.4/4	85

Table 4 Dynamic test of extracts

EXTRACTS	OPTIMUM DOSAGE(ml)	WATER CUT = Amount of water separated / initial amount of water	WATER SEPARATION (%)

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E1	1.0	3.5/4	87.5
E2	1.0	3.1/4	77.5
E3	0.5	3.1/4	77.5
E4	0.75	2.9/4	72.5
E5	0.75	2.8/4	70
E6	0.5	3.0/4	75
E7	1.0	3.3/4	82.5

Table 5 Dynamic test for blends

BLEND	**OPTIMUM DOSAGE(ml)**	**WATER CUT = Amount of water separated / initial amount of water**	**WATER SEPARATION (%)**
B1	0.75	3.7/4	92.5
B2	0.75	3.2/4	80
B3	0.5	3.0/4	75
B4	1.5	3.2/4	80
B5	0.75	3.4/4	85
B6	1.0	3.6/4	90
B7	0.75	3.6/4	90

Table 6 Toxicology test

Demulsifier	E1	E2	B1	B2
Time taken for the fish to die (mins)	110	106	43	37
pH value	6	7	8	7

4.1. STATIC TEST

Based on table 2 E1, E6 and E7 gave the best separation of water compared with other extracts and E1 gave the best results when 0.75 ml of demulsifier was used while E6 and E7 gave the best results when 0.5 ml of demulsifier was used. From the table 3 B1, B6, and B7 gave the best separation of water. B1 and B6 gave the best result for 0.75 and B7 gave the best result for 1 ml of demulsifier

4.2. DYNAMIC TEST

Dynamic test gave much better results than the static test. The formulation that gave the best results were E1, E7, B1 and B7. E1 and E7 gave the best results for 1 ml of demulsifier added while B1 and B7 gave the best result for 0.75 ml of demulsifier.

4.3. TOXICITY LEVEL TEST

Table 6 shows the time taken for the fish to die. The fish died relatively faster in the case of B1 and B7 demulsifier at 41 minutes and 37 minutes respectively. While the fish was found to be alive for more than 100 minutes in the case of E1 and E7. all of them were found to have neutral pH.

5. CONCLUSION

Based on the results obtained we concluded that the B7 demulsifier was the best demulsifier in order to break the emulsion. B1 gave us the highest water separation but B7 was more economic than B1.

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