Crude Oil Emulsion Treatment by the Application of Chemical Demulsifiers

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Abstract - *Crude oil production in most cases generate water as co-product of produced oil. Crude oil is mostly mixed with water to produce a water in oil emulsion due to increased shear rate at the production well head. The produced emulsion are very risky to the petroleum business and as such becomes unwanted and must be treated by the application of demulsifiers so as to meet pipeline and transportation specification. This research work is aimed at introducing an economically viable, sustainable and eco-friendly technique with the potentials of preventing the financial losses encountered during the treatment of crude oil emulsion which are regularly treated during production. In this research paper, five chemical demulsifiers were analyzed through the bottle test method to obtain the best and most economical demulsifier. The basis for selection of the best demulsifier are time of separation, quantity of demulsifier required to achieve separation at the shortest possible time, and clearness of oil and water separation. The result shows that lime demulsifier can be recommended for treating crude oil emulsion, as it with little quantity of 0.4 ml applied gave the best separation within the shortest encountered separation time of one minute. The crude oil emulsion samples analysed for the purpose of this research work were taken from the well head of Umuseti Well 6, Pillar Oil Limited in Delta state, and are classified as light and sweet crude.*

Key Words: **Emulsion, demulsifiers, demulsification, emulsion stability, Basic sediment and water.**

1.INTRODUCTION

Throughout the life of a well, dry oil and gas is produced, but as production proceeds over time, water is also produced with the oil, at first this water will be produced in a much smaller quantity, but with time this amount of water will generally increase. Consequently, a mixture of oil and water (emulsion) is produced which requires separation before further processing and transportation. The oil and water may exist as separable phase during fluid flow through production tubing at chokes, valves where there are serious turbulence and agitation forming emulsion [4].

An emulsion is the dispersion of droplets of one liquid (water) into another liquid (oil) where both liquid are not miscible with each other. Emulsion is usually not in the production process but is done when oil and water are produced alongside a large amount of vibration when oil and water in the oil reservoir rock enter the well by the aid of the casing perforations, a significant pressure difference is generated which when applied aggressively to oil and water leads to formation of emulsion [7]. Three phases exists in crude oil emulsion: the inner or non-continuous phase of well-separated droplets. The outer or continuous phase is the matrix that keeps the enables the droplets to be in suspension. The interphase contains a stabilizer or an emulsifier that ensures a stable emulsion, binds the inner and outer phases together and prevents droplets from approaching and bonding. Usually, emulsifiers are surfactants and soaps that are present alone or as part of the cleaning composition. The emulsifier contains a molecule with hydrophilic and hydrophobic effects. In the presence of liquid that are not miscible, the emulsifier migrates to the interface of the two phases (internal and external), forming protective droplets in the dispersed phase [7].

In crude oil production, the term “emulsion” is used to represent droplets of water in a continuous oil phase, also referred to as water-in-oil (w/o) emulsions. The two other types of emulsion are; oil-in-water emulsions (oil droplets in a continuous water phase, also known as “reverse” emulsions) and multiple emulsions (e.g. water droplets suspended in layer oil droplets that in turn are suspended in a continuous water phase). One major challenge often encountered during the production and transportation of crude oil in petroleum industries is the formation of complex and extremely stable emulsions with saline water [3]. In these emulsions, the dispersed or internal phase are water (brine) while the external or continuous phase is crude oil. As such, they are referred to as water-in-oil (W/O) emulsions [2]. The types of emulsion which the production engineers come across at the crude oil production stage are very complex, they can be categorized into oil in water emulsion, water in oil emulsion and multiple emulsion (water in oil in water) [5]. Water in oil emulsion happens to exist the most in all the emulsion types encountered during crude oil production, whereas the other emulsions are encountered as frequently as the water in oil emulsion [9]. The processing of crude oil is not without several disturbing challenges that possess threat to the oil and gas sector [1]. The fact that the oil is usually produced together with water is a reason why emulsions are seen in most phases of crude oil production and processing: Inside the reservoirs, well-bores, well heads, and wet crude-handling facilities; transportation through pipelines and crude storage, and during petroleum processing. Additives leaching, increased conductivity, corrosion, etc., are all unwanted consequences of crude oil emulsion [6].

Crude oil emulsion results to very expensive issues both from the supply of chemicals utilized to treat the emulsion to meet quality standard and the lost production resulting from shutdown and treatment operations or increased pumping cost resulting from increased pressure from increased viscosity. It is therefore vital to treat the emulsion so as to separate out the contained inorganic salts and the water present in the emulsion in order that the oil meet crude specifications from export, storage, transportation and to minimize corrosion and also catalyst poisoning that happens at the downstream processing facilities. With the existence of crude oil emulsion, there is a draw back in the profit of the oil and gas industry owing to the excess issues that accompanies the existence of crude oil emulsion. Therefore, in order to mitigate the operational challenges as well as the huge economic loss, there is the need to treat the emulsion or separate the mixture of crude oil and saline water into two separate phases by a process referred to as crude oil demulsification prior to the transportation or refining of crude oil [8].

There are several issues affecting crude oil production in the oil and gas sector, of all these problems, crude oil emulsion formation happens to be the most predominant and causes greater loss to the industry than the other problems that may arise. The crude oil reservoir in which oil is being extracted from contains some amount of water which tends to be produced along with the oil as production proceeds, this research paper therefore hopes to serve as a solution to the long lasting challenges of treating crude oil emulsion in the safest and most economical way using chemical demulsifiers.

2. MATERIALS AND METHODS

The method used for the demulsification of crude oil emulsion is the bottle test method which involves the use of thermal and chemical application. The bottle test can be described as the procedure in which different demulsifiers are added to bottle samples of a crude oil emulsion to determine which demulsifier is the most effective at breaking, or separating the crude oil emulsion into oil and water component giving a clear interface.

The conclusion is based on the volume of water separated from the emulsion sample by the individual demulsifiers at different concentration within different time intervals.

Other important considerations factors include; the quality of oil, water quality, interface quality as well as BS & W content.

METERIALS	FUNCTIONS
Carrot oil	It has a dehydrating property and also gives a good interface.
Alum	It is an adherent (it prevents adhesion between two surfaces-liquid surface). Alum increases the spreading efficiency of water and oil at the interface.
Detergent	It is a surfactant. It gives good interface and sediment resolution.
Camphor	It is a solid wetting and viscosity adjuster
Crude oil sample	The crude oil sample for this research is a sweet crude from Delta state in Nigeria, and is classified as light crude.

Table 1: Materials used in formulation of locally blended demulsifiers and their functions

3. RESULTS

DOSAGE RATE		1 Min	30 Mins	60 Mins	90 Mins	120 Mins	REMARKS
0.2ml	OIL	-	5ml	5ml	5ml	5ml	DIRTY OIL
	EMULSION	80ml	70ml	70ml	70ml	70ml	
	SLUDGE	-	-	-	-	-	
	WATER	20ml	25ml	25ml	25ml	25ml	MILKY WATER
0.4ml	OIL	-	5ml	5ml	5ml	5ml	DIRTY OIL
	EMULSION	80ml	75ml	75ml	75ml	75ml	
	SLUDGE	-	-	-	-	-	
	WATER	20ml	20ml	20ml	20ml	20ml	MILKY WATER
0.6ml	OIL	52ml	55ml	60ml	60ml	60ml	CLEAN OIL
	EMULSION	10ml	5ml	-	-	-	
	SLUDGE	-	-	-	-	-	
	WATER	38ml	40ml	40ml	40ml	40ml	MILKY WATER
0.8ml	OIL	55ml	60ml	60ml	60ml	60ml	CLEAN OIL
	EMULSION	5ml	-	-	-	-	
	SLUDGE	-	-	-	-	-	
	WATER	40ml	40ml	40ml	40ml	40ml	MILKY WATER
1.0ml	OIL	60ml	60 ml	60ml	60ml	60ml	CLEAN OIL
	EMULSION	-	-	-	-	-	
	SLUDGE	-	-	-	-	-	
	WATER	40ml	40ml	40ml	40ml	40ml	MILKY WATER
1.2ml	OIL	60ml	60ml	60ml	60ml	60ml	CLEAN OIL
	EMULSION	-	-	-	-	-	
	SLUDGE	-	-	-	-	-	
	WATER	40ml	40ml	40ml	40ml	40ml	MILKY WATER

TABLES 2: RESULTS FROM SERVO DEMULSIFIER

FIELD: UMUSETI WELL 6 TEMPERATURE: 60⁰C

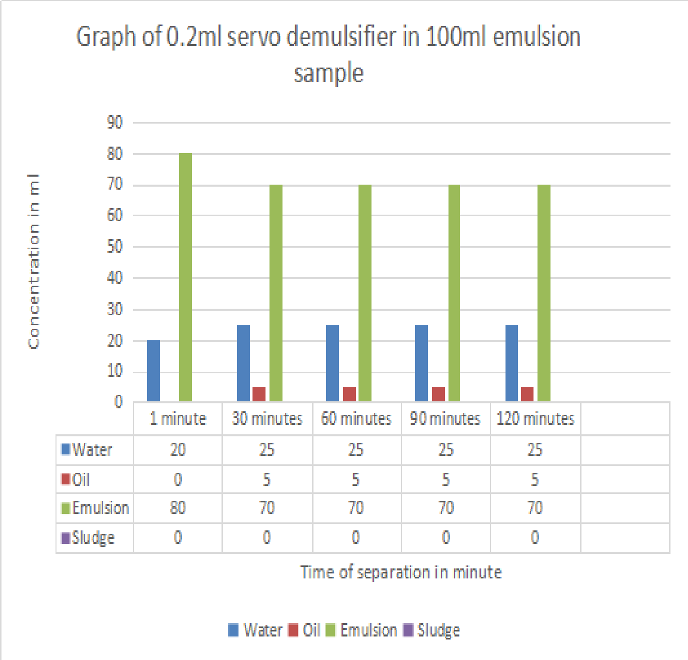


Figure 1: Graph of 0.2 ml Servo Demulsifier in 100 ml Emulsion Sample

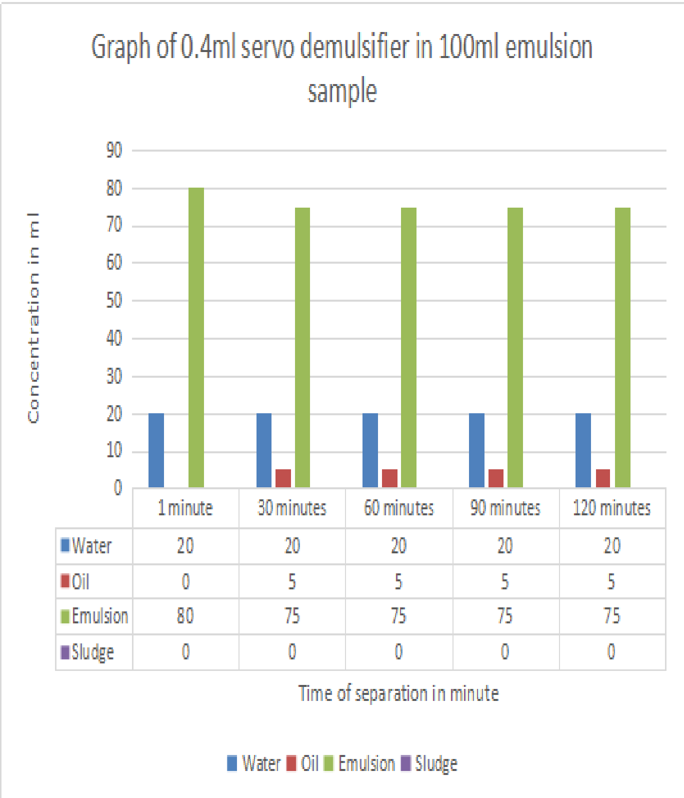


Figure 2: Graph of 0.4ml Servo Demulsifier in 100ml Emulsion Sample

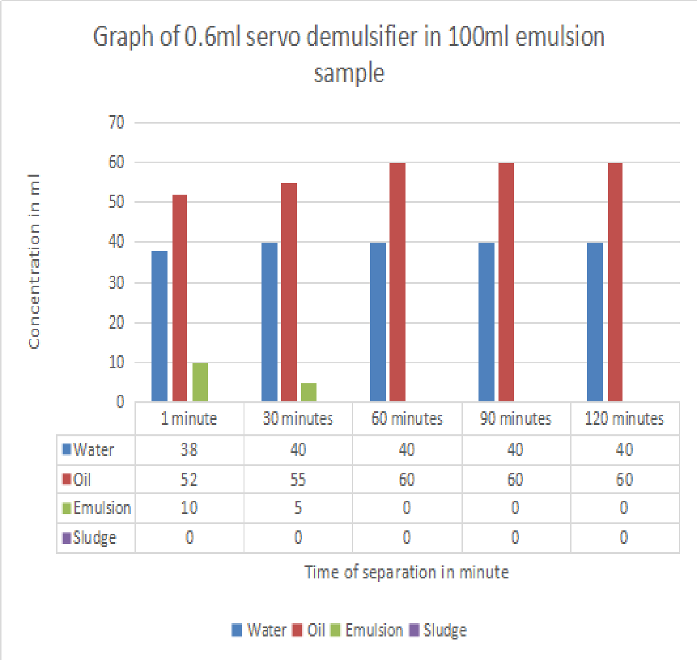


Figure 3: Graph of 0.6ml Servo Demulsifier in 100ml Emulsion Sample

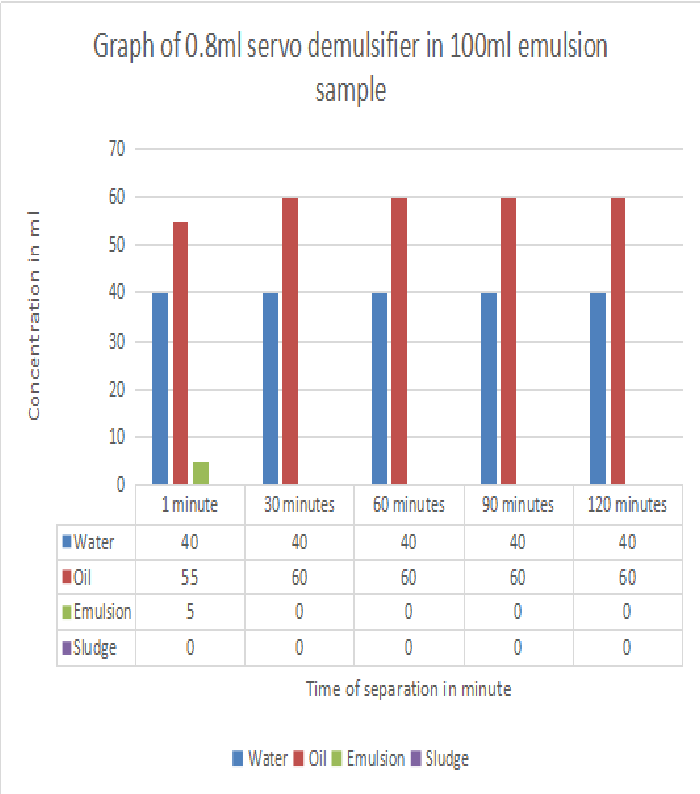


Figure 4: Graph of 0.8ml Servo Demulsifier in 100ml Emulsion Sample

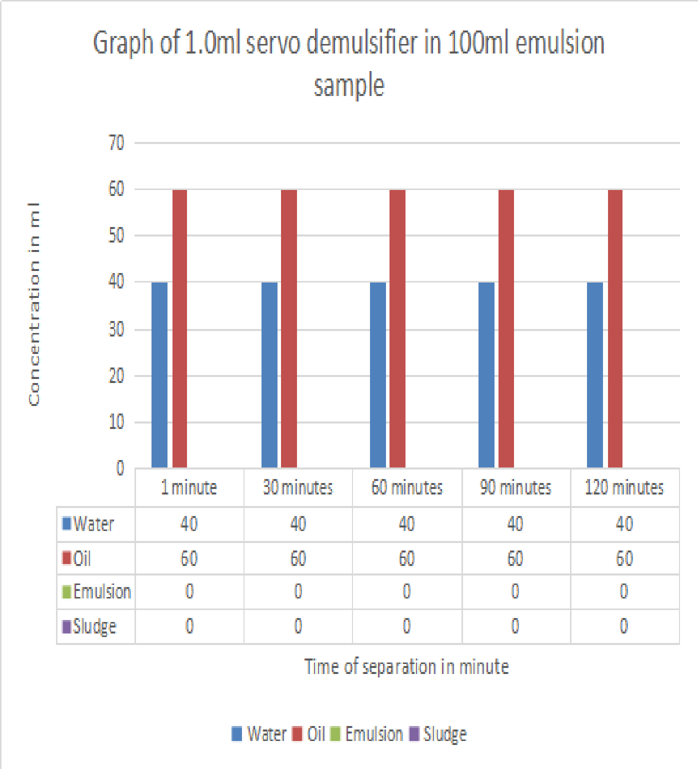


Figure 5: Graph of 1.0ml Servo Demulsifier in 100ml Emulsion Sample

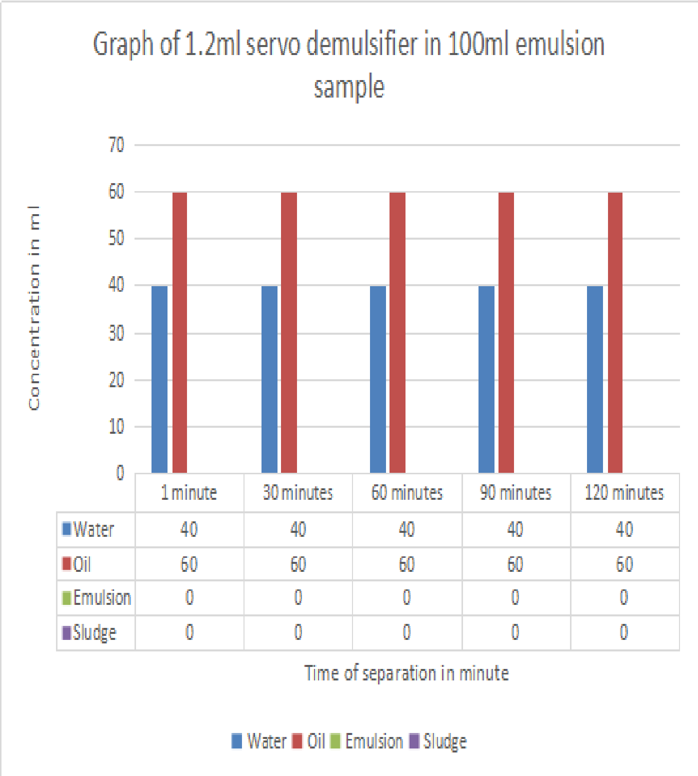


Figure 6: Graph of 1.2ml Servo Demulsifier in 100ml Emulsion Sample

TABLES 3: RESULTS FROM SEPAROL DEMULSIFIER

FIELD: UMUSETI WELL 6 TEMPERATURE: 60^{0}C

DOSAGE RATE		1 Min	30 Mins	60 Mins	90 Mins	120 Mins	REMARKS
0.2ml	OIL	55ml	55ml	55ml	55ml	55ml	CLEAN OIL
	EMULSION	15ml	15ml	15ml	15ml	15ml	
	SLUDGE	20ml	20ml	20ml	20ml	20ml	
	WATER	10ml	10ml	10ml	10ml	10ml	CLEAN WATER
0.4ml	OIL	55ml	60ml	60ml	60ml	60ml	CLEAN OIL
	EMULSION	-	-	-	-	-	
	SLUDGE	45ml	40ml	40ml	40ml	40ml	
	WATER	-	-	-	-	-	
0.6ml	OIL	50ml	50ml	50ml	50ml	50ml	CLEAN OIL
	EMULSION	45ml	45 ml	45ml	45ml	45ml	
	SLUDGE	-	-	-	-	-	
	WATER	5ml	5ml	5ml	5ml	5ml	CLEAN WATER
0.8ml	OIL	45ml	50ml	50ml	50ml	50ml	CLEAN OIL
	EMULSION	55ml	50ml	50ml	50ml	50ml	
	SLUDGE	-	-	-	-	-	
	WATER	-	-	-	-	-	
1.0ml	OIL	45ml	50ml	50ml	50ml	50ml	CLEAN OIL
	EMULSION	40ml	30ml	30ml	35ml	35ml	
	SLUDGE	-	5ml	5ml	-	-	
	WATER	15ml	15ml	15ml	15ml	15ml	CLEAN WATER
1.2ml	OIL	45ml	50ml	50ml	50ml	50ml	CLEAN OIL
	EMULSION	35ml	20ml	30ml	30ml	30ml	
	SLUDGE	-	10ml	-	-	-	
	WATER	20ml	20ml	20ml	20ml	20ml	CLEAN WATER

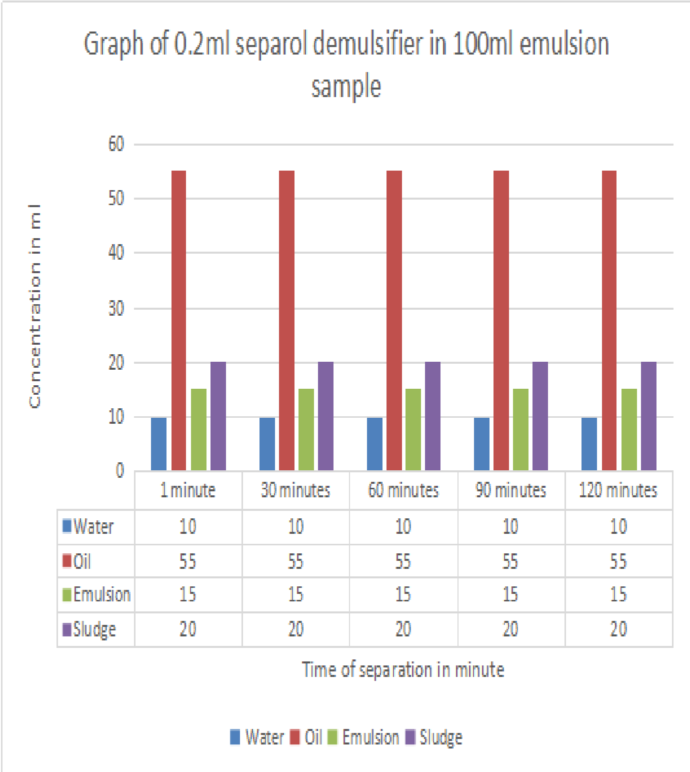


Figure 7: Graph of 0.2ml Separol Demulsifier in 100ml Emulsion Sample

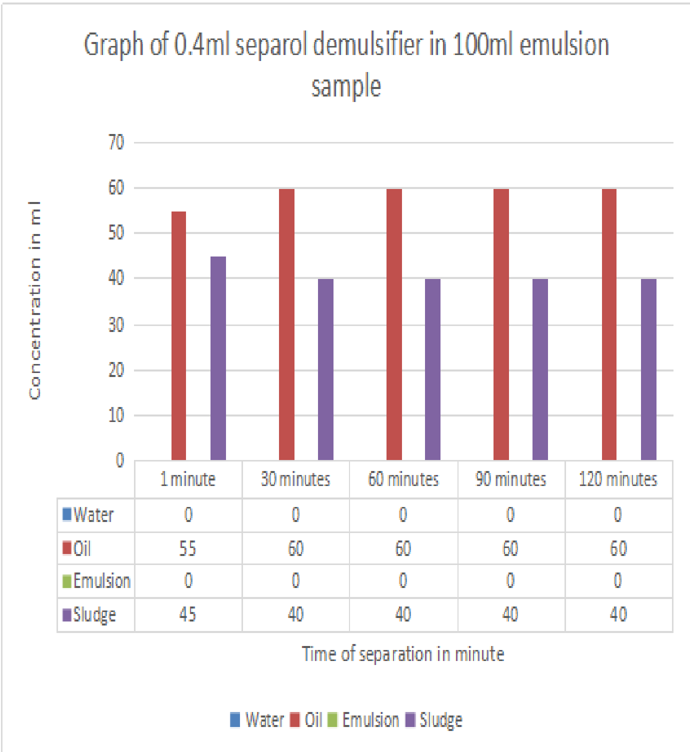


Figure 8: Graph of 0.4ml Separol Demulsifier in 100ml Emulsion Sample

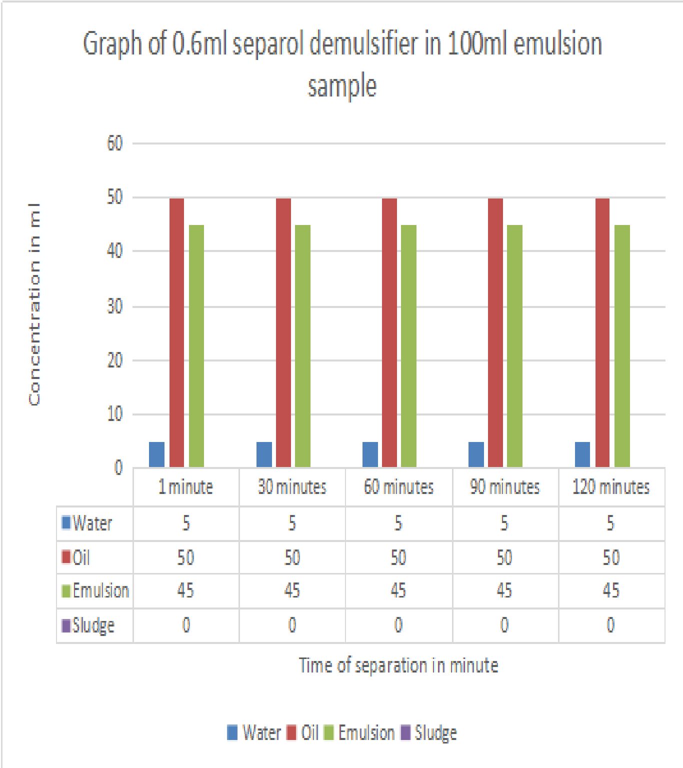


Figure 9: Graph of 0.6ml Separol Demulsifier in 100ml Emulsion Sample

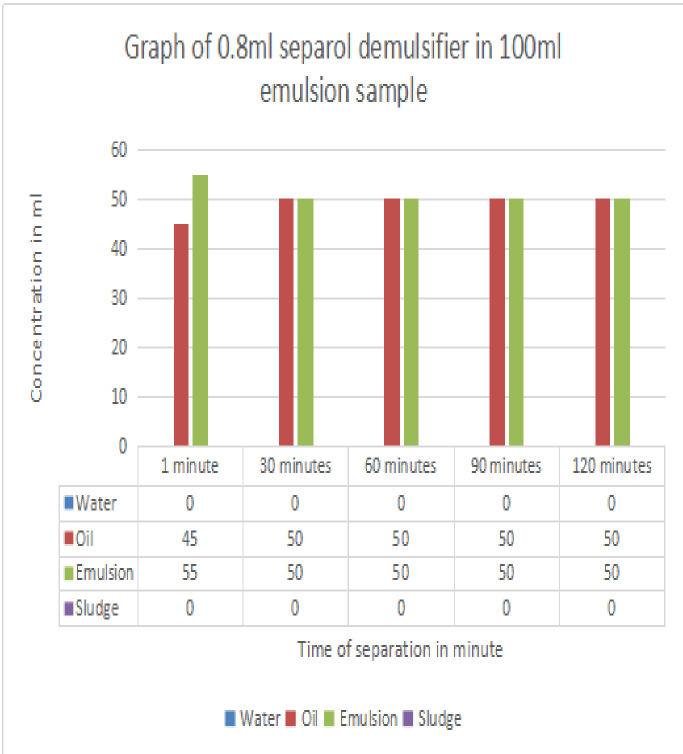


Figure 10: Graph of 0.8ml Separol Demulsifier in 100ml Emulsion Sample

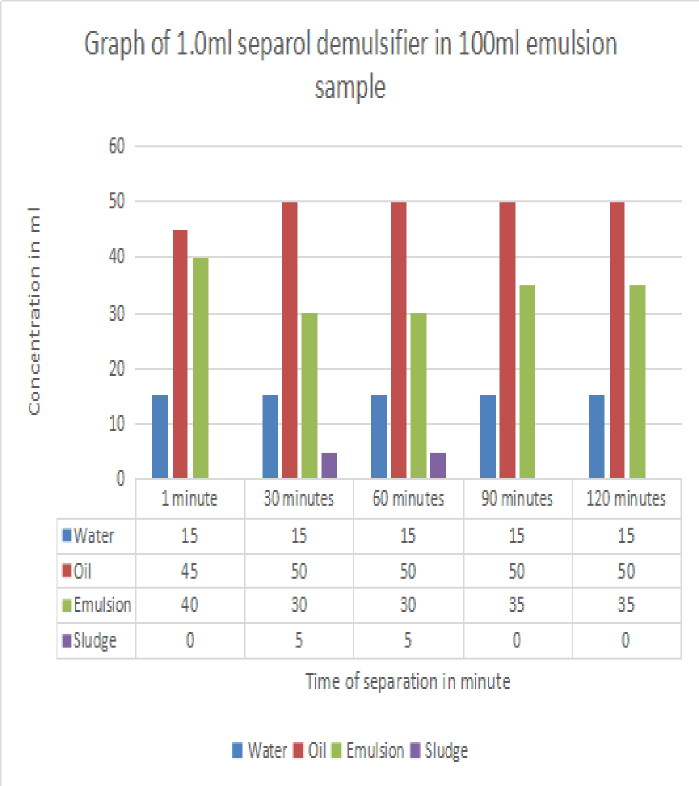


Figure 11: Graph of 1.0ml Separol Demulsifier in 100ml Emulsion Sample

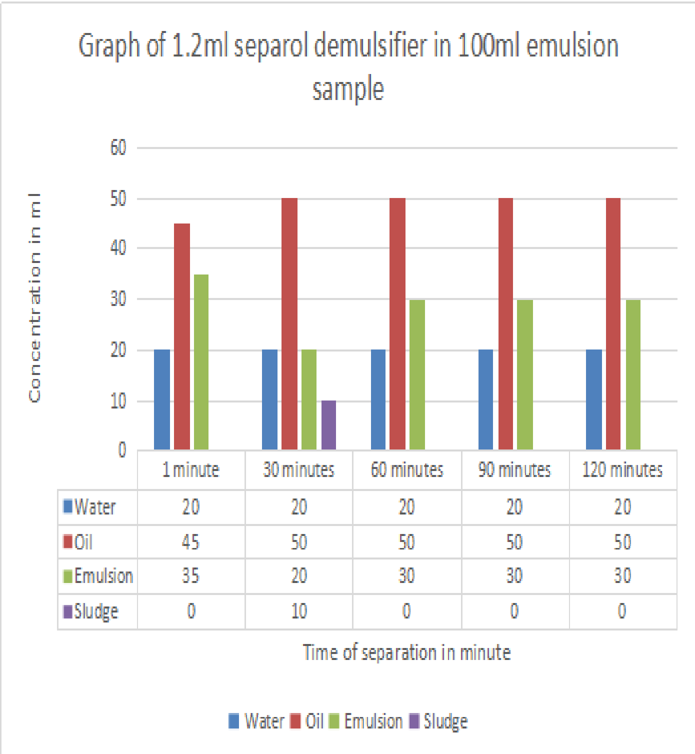


Figure 12: Graph of 1.2ml Separol Demulsifier in 100ml Emulsion Sample

TABLES 4: RESULTS FROM LIME DEMULSIFIER

FIELD: UMUSETI WELL 6 TEMPERATURE: 60^{0}C

DOSAGE RATE		1 Min	30 Mins	60 Mins	90 Mins	120 Mins	REMARKS
0.2ml	OIL	-	-	-	-	-	
	EMULSION	90ml	85ml	85ml	85ml	85ml	
	SLUDGE	-	5ml	5ml	5ml	5ml	
	WATER	10ml	10ml	10ml	10ml	10ml	CLEAN WATER
0.4ml	OIL	60ml	60ml	60ml	60ml	60ml	CLEAN OIL
	EMULSION	-	-	-	-	-	
	SLUDGE	5ml	5ml	-	-	-	
	WATER	35ml	35ml	40ml	40ml	40ml	CLEAN WATER
0.6ml	OIL	-	-	-	-	-	
	EMULSION	70ml	70ml	70ml	70ml	70ml	
	SLUDGE	-	-	-	-	-	
	WATER	30ml	30ml	30ml	30ml	30ml	CLEAN WATER
0.8ml	OIL	-	-	-	-	-	
	EMULSION	90ml	85ml	85ml	85ml	85ml	
	SLUDGE	10ml	5ml	5ml	5ml	5ml	
	WATER	-	10ml	10ml	10ml	10ml	CLEAN WATER
1.0ml	OIL	-	-	-	-	-	
	EMULSION	85ml	85ml	85ml	85ml	85ml	
	SLUDGE	-	5ml	5ml	5ml	5ml	
	WATER	15ml	10ml	10ml	10ml	10ml	CLEAN WATER
1.2ml	OIL	-	-	-	-	-	
	EMULSION	90ml	85ml	85ml	85ml	85ml	
	SLUDGE	-	5ml	5ml	5ml	5ml	
	WATER	10ml	10ml	10ml	10ml	10ml	CLEAN WATER

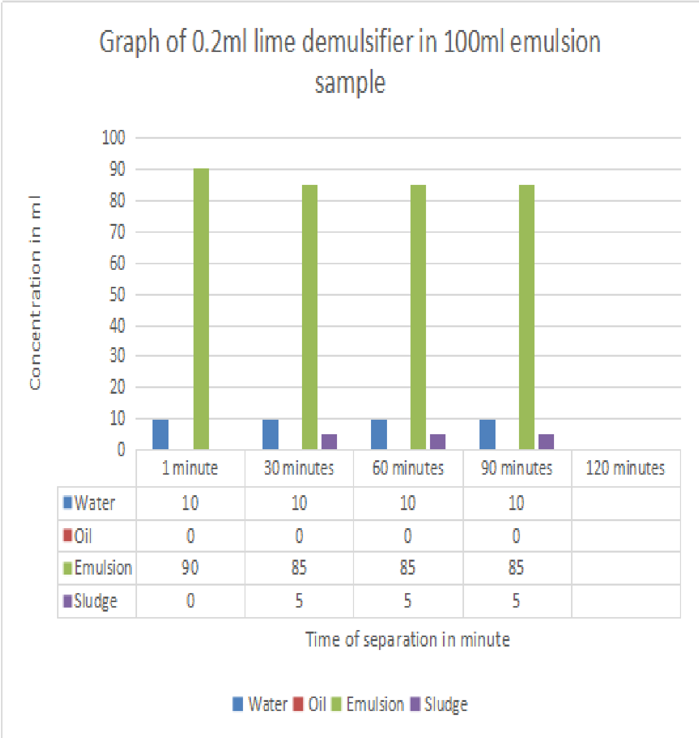


Figure 13: Graph of 0.2 ml Lime Demulsifier in 100 ml Emulsion Sample

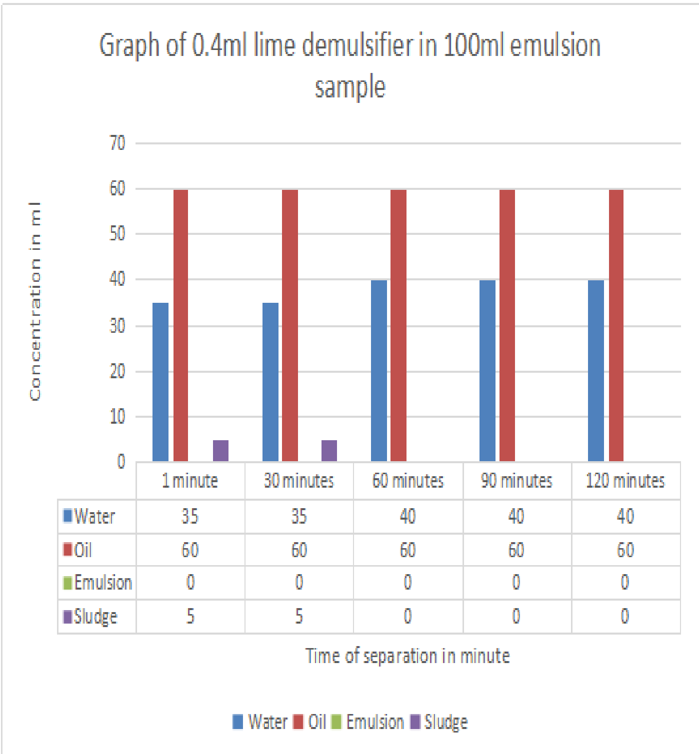


Figure 14: Graph of 0.4ml Lime Demulsifier in 100ml Emulsion Sample

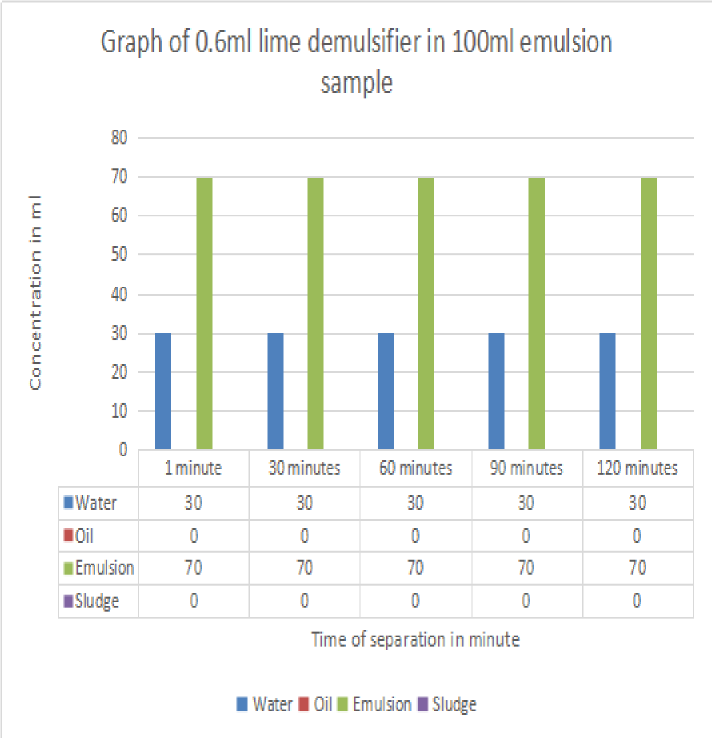


Figure 15: Graph of 0.6ml Lime Demulsifier in 100ml Emulsion Sample

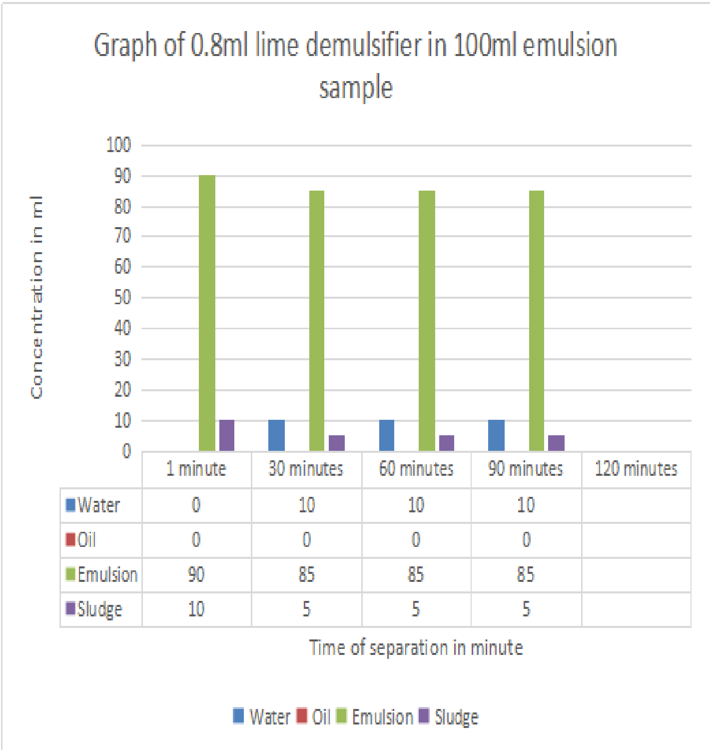


Figure 16: Graph of 0.8ml Lime Demulsifier in 100ml Emulsion Sample

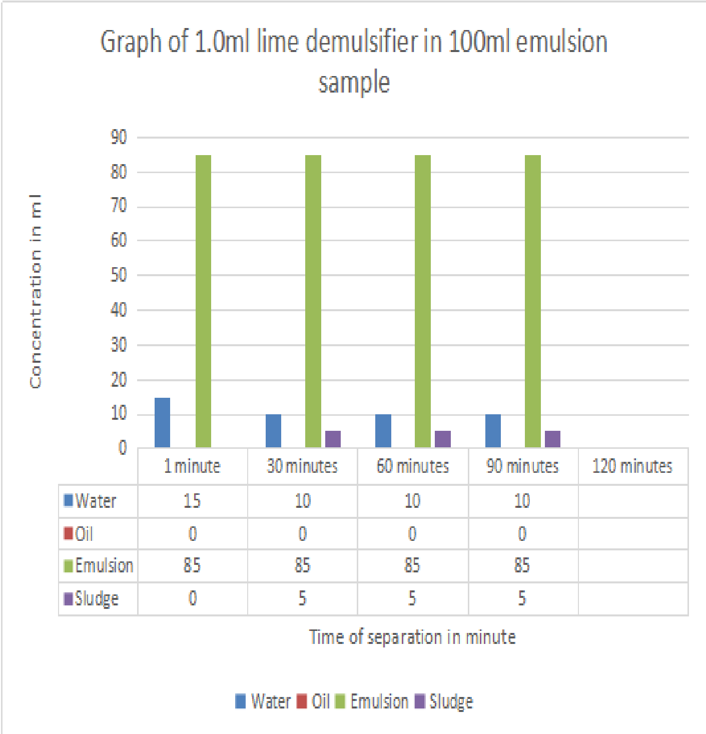


Figure 17: Graph of 1.0ml Lime Demulsifier in 100ml Emulsion Sample

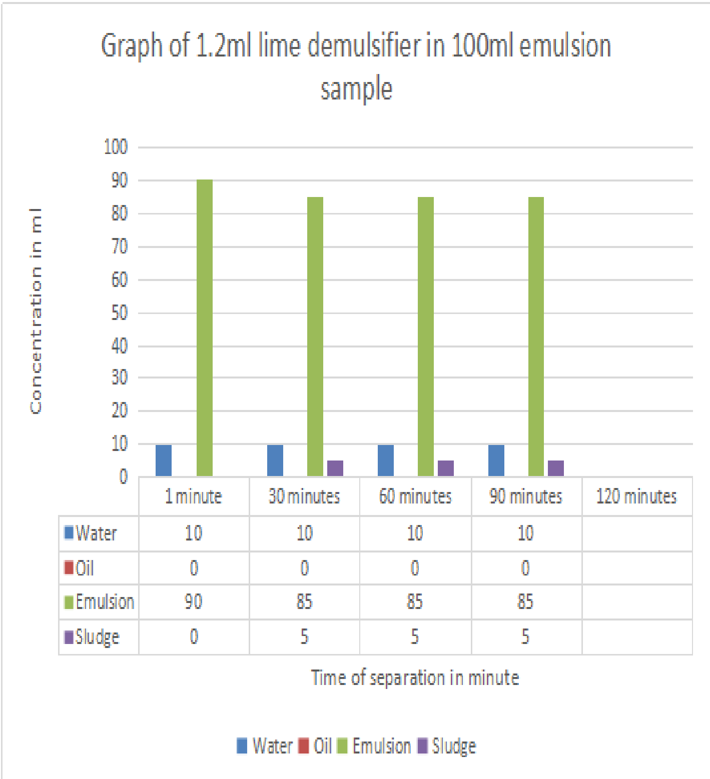


Figure 18: Graph of 1.2ml Lime Demulsifier in 100ml Emulsion Sample

TABLES 5: RESULTS FROM GRAPE DEMULSIFIER

FIELD: UMUSETI WELL 6 TEMPERATURE: 60⁰C

DOSAGE RATE		1 Min	30 Mins	60 Mins	90 Mins	120 Mins	REMARKS
0.2ml	OIL	-	-	-	-	-	
	EMULSION	100ml	100ml	100ml	100ml	100ml	
	SLUDGE	-	-	-	-	-	
	WATER	-	-	-	-	-	
0.4ml	OIL	-	70ml	70ml	70ml	70ml	CLEAN OIL
	EMULSION	70ml	-	-	-	-	
	SLUDGE	10ml	10ml	10ml	10ml	10ml	
	WATER	20ml	20ml	20ml	20ml	20ml	YELLOWISH WATER
0.6ml	OIL	-	-	-	-	-	
	EMULSION	90ml	90ml	90ml	90ml	90ml	
	SLUDGE	5ml	5ml	5ml	5ml	5ml	
	WATER	5ml	5ml	5ml	5ml	5ml	CLEAN WATER
0.8ml	OIL	-	-	-	-	-	
	EMULSION	90ml	90ml	90ml	90ml	90ml	
	SLUDGE	-	-	-	-	-	
	WATER	10ml	10ml	10ml	10ml	10ml	CLEAN WATER
1.0ml	OIL	-	-	-	-	-	
	EMULSION	90ml	90ml	90ml	90ml	90ml	
	SLUDGE	-	-	-	-	-	
	WATER	10ml	10ml	10ml	10ml	10ml	CLEAN WATER
1.2ml	OIL	-	-	-	-	-	
	EMULSION	90ml	90ml	90ml	90ml	90ml	
	SLUDGE	-	-	-	-	-	
	WATER	10ml	10ml	10ml	10ml	10ml	CLEAN WATER

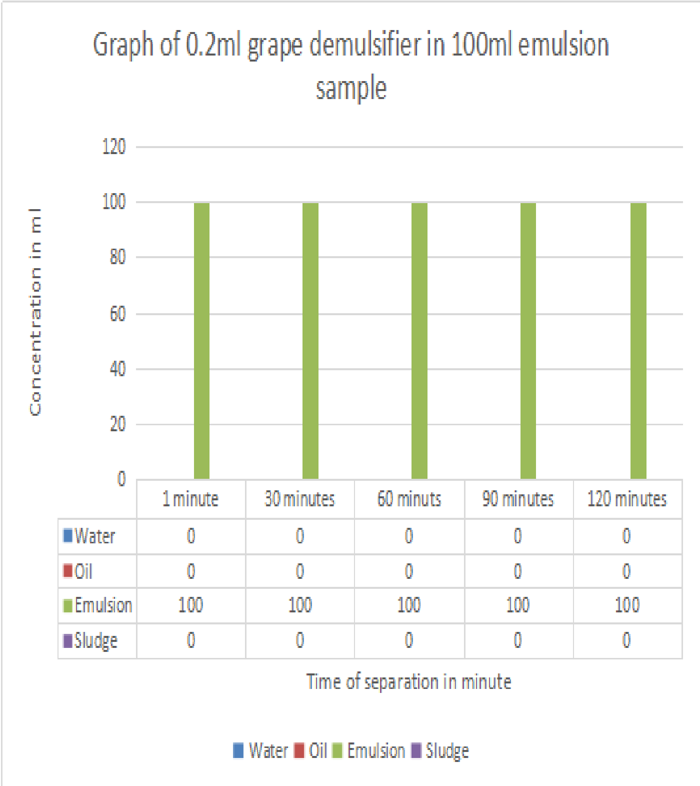


Figure 19: Graph of 0.2 ml Grape Demulsifier in 100 ml Emulsion Sample.

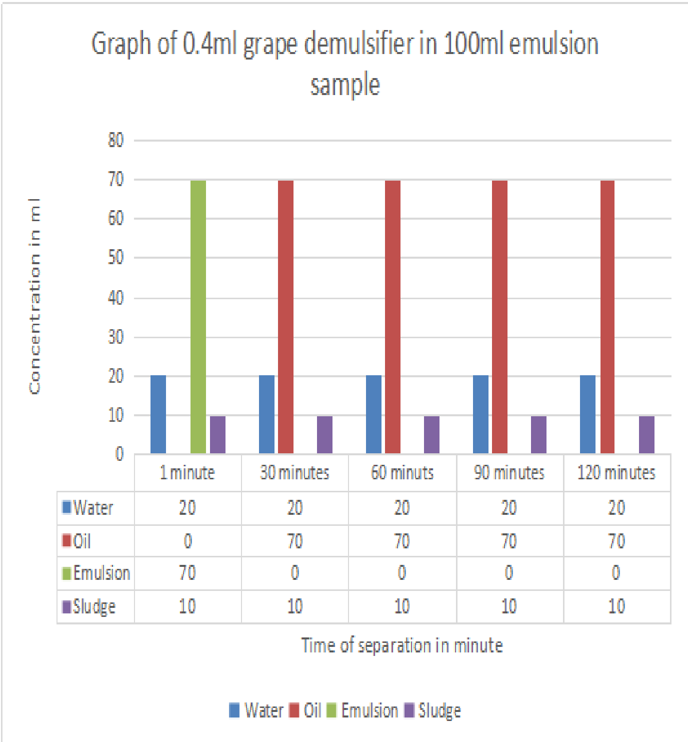
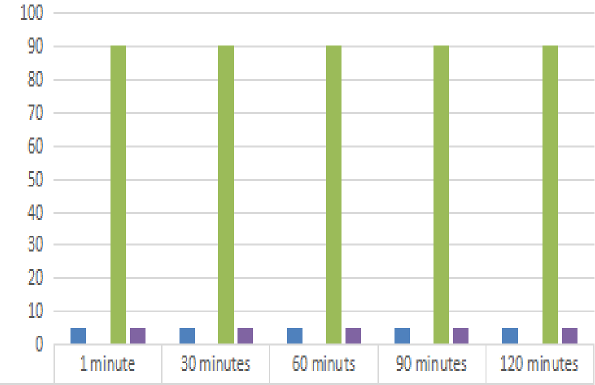
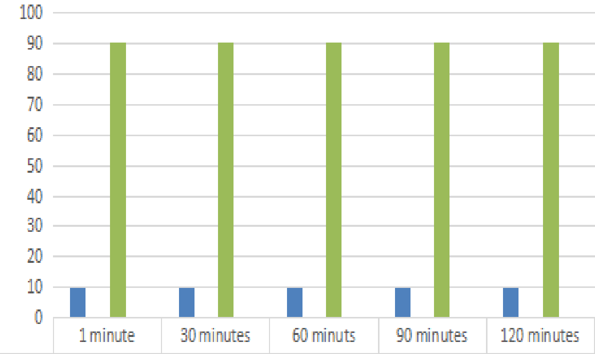


Figure 20: Graph of 0.4ml Grape Demulsifier in 100ml Emulsion Sample



	1 minute	30 minutes	60 minuts	90 minutes	120 minutes
Water	5	5	5	5	5
Oil	0	0	0	0	0
Emulsion	90	90	90	90	90
Sludge	5	5	5	5	5

Figure 21: Graph of 0.6ml Grape Demulsifier in 100ml Emulsion Sample



	1 minute	30 minutes	60 minuts	90 minutes	120 minutes
Water	10	10	10	10	10
Oil	0	0	0	0	0
Emulsion	90	90	90	90	90
Sludge	0	0	0	0	0

Figure 22: Graph of 0.8ml Grape Demulsifier in 100ml Emulsion Sample

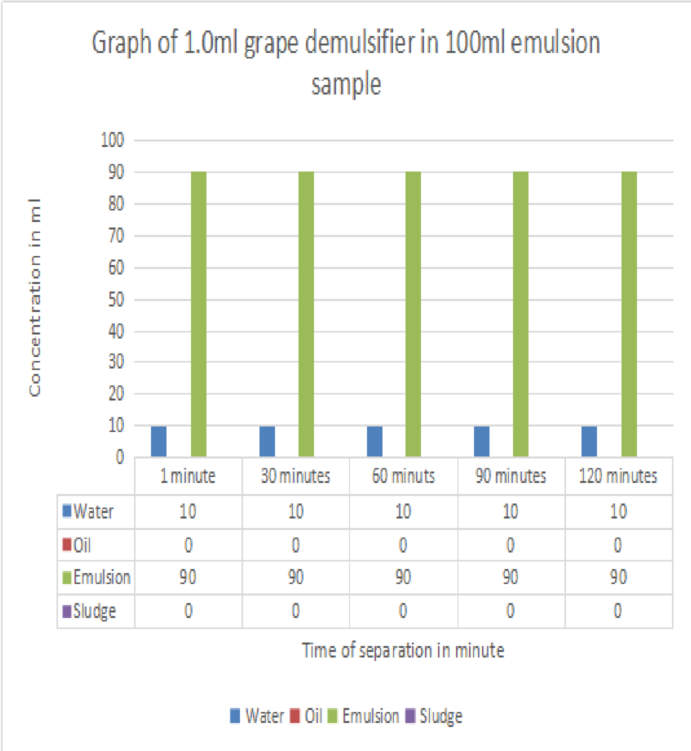


Figure 23: Graph of 1.0ml Grape Demulsifier in 100ml Emulsion Sample

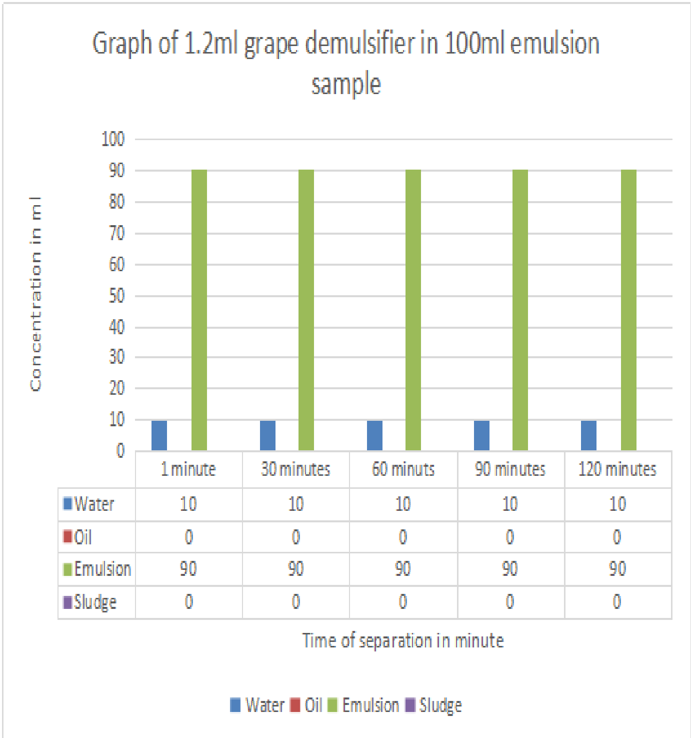


Figure 24: Graph of 1.2ml Grape Demulsifier in 100ml Emulsion Sample

FIELD: UMUSETI WELL 6 TEMPERATURE: 60^{0}C

TABLES 6: RESULTS FROM ORANGE DEMULSIFIER

DOSAGE RATE		1 Min	30 Mins	60 Mins	90 Mins	120 Mins	REMARKS
0.2ml	OIL	-	-	-	-	-	
	EMULSION	90ml	90ml	90ml	90ml	90ml	
	SLUDGE	-	-	-	-	-	
	WATER	10ml	10ml	10ml	10ml	10ml	CLEAN WATER
0.4ml	OIL	-	-	-	-	-	
	EMULSION	90ml	90ml	90ml	90ml	90ml	
	SLUDGE	-	-	-	-	-	
	WATER	10ml	10ml	10ml	10ml	10ml	CLEAN WATER
0.6ml	OIL	-	-	-	-	-	
	EMULSION	90ml	90ml	90ml	90ml	90ml	
	SLUDGE	-	-	-	-	-	
	WATER	10ml	10ml	10ml	10ml	10ml	YELLOWISH WATER
0.8ml	OIL	-	-	-	-	-	
	EMULSION	78ml	78ml	78ml	78ml	78ml	
	SLUDGE	2ml	2ml	2ml	2ml	2ml	
	WATER	20ml	20ml	20ml	20ml	20ml	YELLOWISH WATER
1.0ml	OIL	-	-	-	-	-	
	EMULSION	95ml	95ml	95ml	95ml	95ml	
	SLUDGE	-	-	-	-	-	
	WATER	5ml	5ml	5ml	5ml	5ml	YELLOWISH WATER
1.2ml	OIL	-	-	-	-	-	
	EMULSION	80ml	80ml	80ml	80ml	80ml	
	SLUDGE	-	-	-	-	-	
	WATER	20ml	20ml	20ml	20ml	20ml	YELLOWISH WATER

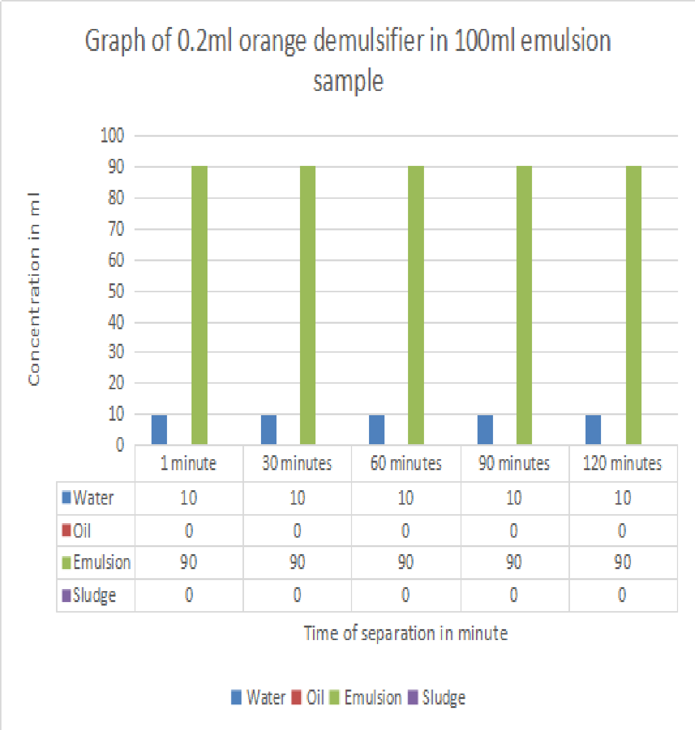


Figure 25: Graph of 0.2 ml Orange Demulsifier in 100 ml Emulsion Sample.

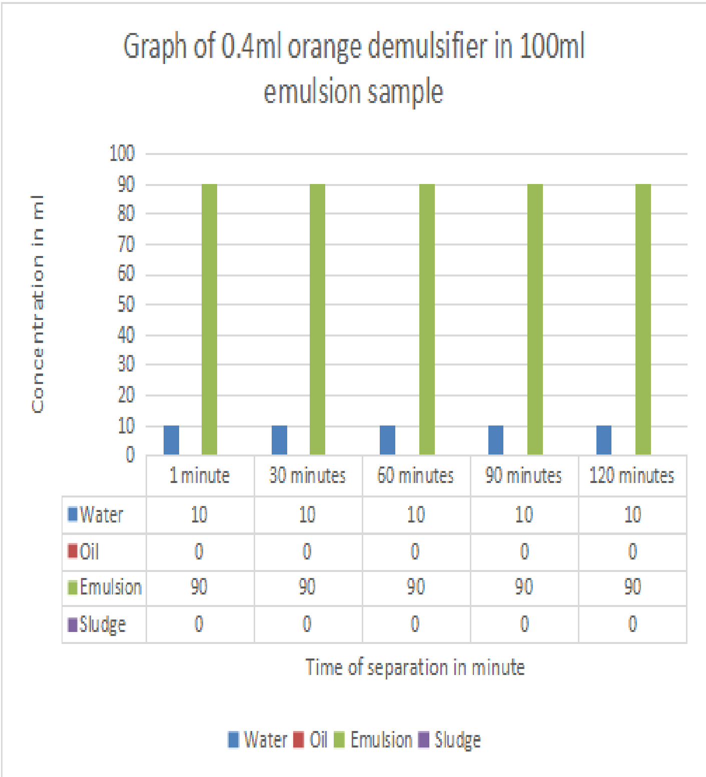


Figure 26: Graph of 0.4ml Orange Demulsifier in 100ml Emulsion Sample

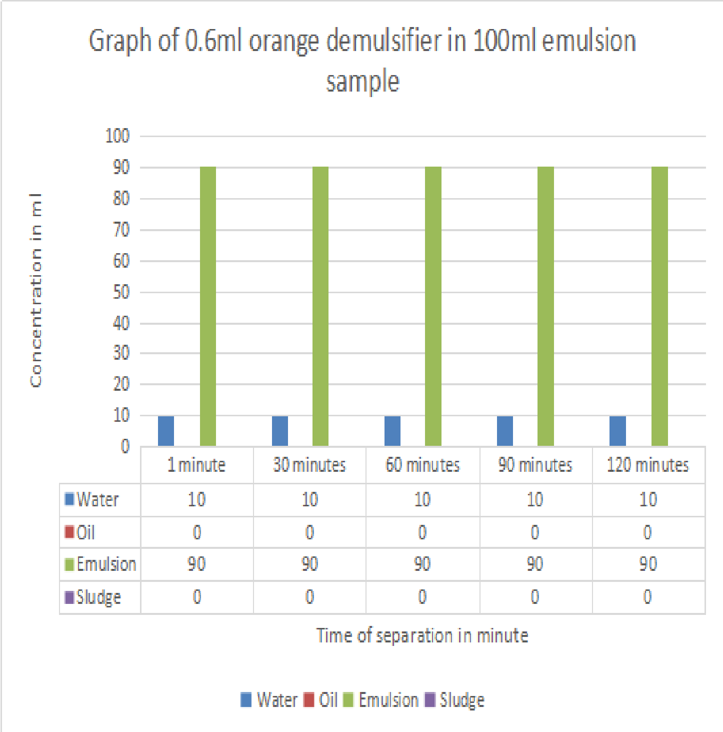


Figure 27: Graph of 0.6ml Orange Demulsifier in 100ml Emulsion Sample

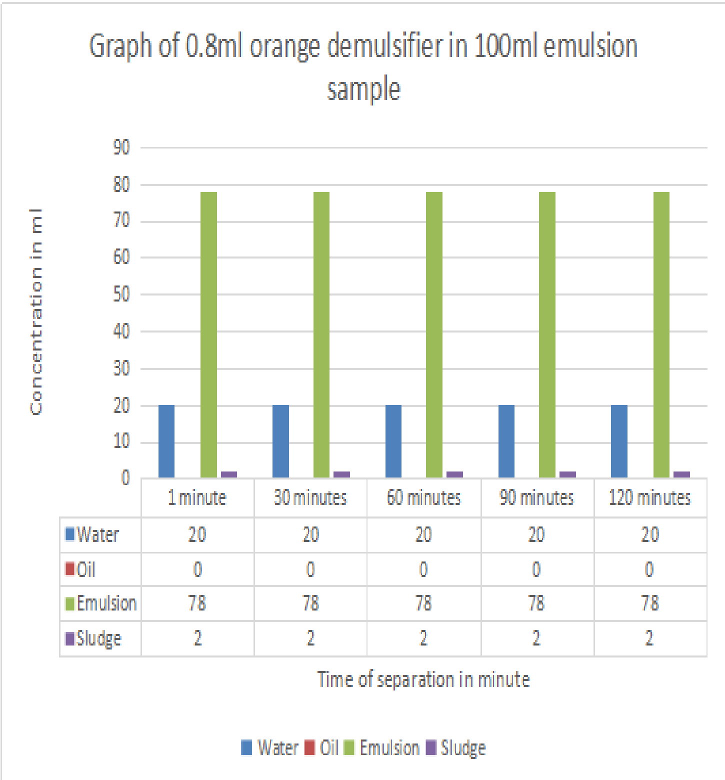


Figure 28: Graph of 0.8ml Orange Demulsifier in 100ml Emulsion Sample

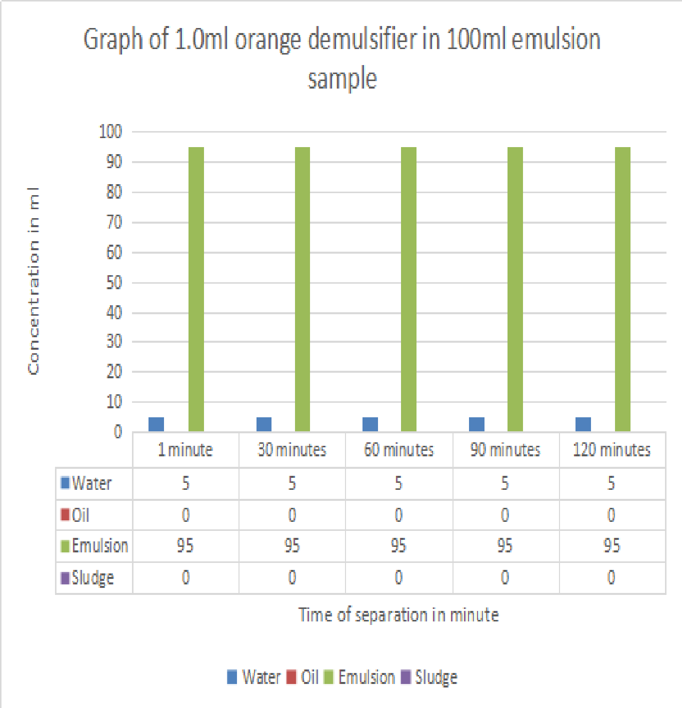


Figure 29: Graph of 1.0ml Orange Demulsifier in 100ml Emulsion Sample

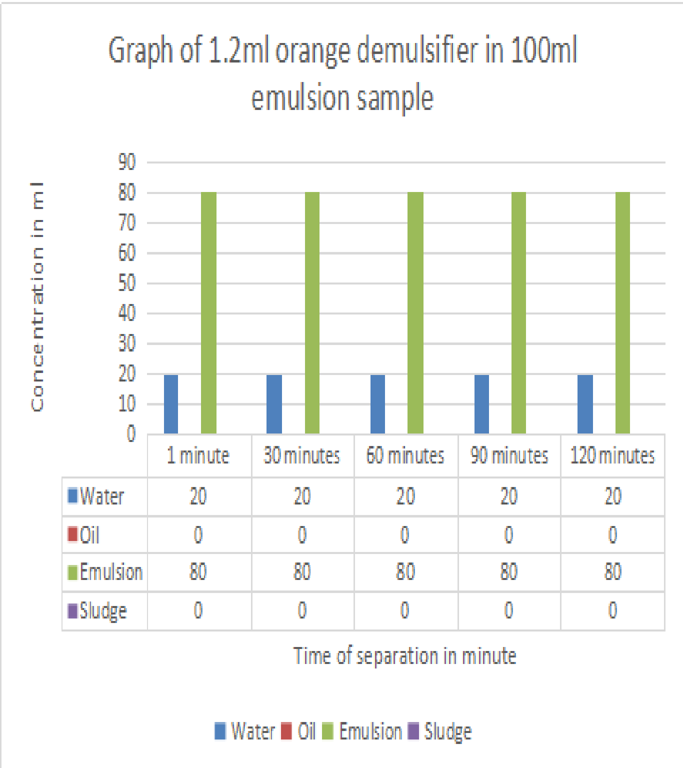


Figure 30: Graph of 1.2ml Orange Demulsifier in 100ml Emulsion Sample

TABLE 7: CONFORMATORY TEST FOR SERVO DEMULSIFIER

DOSAGE RATE	WATER VOLUME	BASIC SEDIMENT	TOTAL BS & W	TOTAL % BS & W
0.6ml	0.1ml	TRACE	0.1ml	1%
0.8ml	0.1ml	TRACE	0.1ml	1%
1.0ml	0.1ml	0.05ml	0.15ml	1.5%
1.2ml	0.1ml	0.05ml	0.15ml	1.5%

TABLE 8: CONFORMATORY TEST FOR SEPAROL DEMULSIFIER

DOSAGE RATE	WATER VOLUME	BASIC SEDIMENT	TOTAL BS & W	TOTAL % BS & W
0.2ml	0.1ml	TRACE	0.1ml	1%
0.4ml	0.1ml	TRACE	0.1ml	1%
0.6ml	TRACE	TRACE	TRACE	
0.8ml	0.15ml	0.1ml	0.25ml	2.5%
1.0ml	TRACE	TRACE	TRACE	
1.2ml	TRACE	TRACE	TRACE	

TABLE 9: CONFORMATORY TEST FOR LIME DEMULSIFIER

DOSAGE RATE	WATER VOLUME	BASIC SEDIMENT	TOTAL BS & W	TOTAL % BS & W
0.4ml	0.1ml	0.1ml	0.2ml	2%

TABLE 10: CONFORMATORY TEST FOR GRAPE DEMULSIFIER

DOSAGE RATE	WATER VOLUME	BASIC SEDIMENT	TOTAL BS & W	TOTAL % BS & W
0.4ml	0.2ml	0.5ml	0.7ml	7%

4. DISCUSSION

From the test that was carried out on the representative sample from Umuseti, Pillar Oil in Delta state Nigeria, the results were separated into different tables in order to examine and interpret them one after the other. It was found that the results in the tables above shows the real amount of oil, water and sludge separated from the respective emulsion sample after the bottle test treatment which were conducted at a set temperature of 60°C and time consideration as an important factor in the test.

From the results gotten on different demulsifiers at a temperature of 60⁰C, it can be seen that 0.8ml, 1.0ml and 1.2ml of servo demulsifier gave a good separation at the first 1minute, 0.6ml of servo demulsifier gave a good and clear separation after 60 minutes, while 0.2ml and 0.4ml of servo demulsifier gave little separation but no clear interface. (See Figure in Appendix).

All samples treated with Separol demulsifier gave a good separation of water and oil but had no clear interface (i.e., it contains some percentage of sludge and emulsion). (See Figure in Appendix).

The sample treated with 0.4ml concentration of lime demulsifier gave a good separation at the first 1minute but had a clear interface after 60minutes, other samples treated with different concentration of lime separated water but still contain sludge and emulsion. (See Figure in Appendix).

The sample treated with 0.4ml concentration of grape demulsifier gave a good separation after 30minutes but still contain some percentage of sludge, giving it no clear interface. (See Figure in Appendix). It was seen that samples treated with orange demulsifiers separated little percentage of water but contain high percentage of emulsion. (See Figure in Appendix).

Emulsion samples treated with grape demulsifier had the highest percentage of BS & W while others had less percentage.

Samples treated with 0.4ml concentration of lime, grape and separol demulsifiers had oil separation at the first 1 min, 30 mins and 30 mins respectively. While samples treated with the same 0.4ml concentration of servo and orange demulsifiers had little or no oil separation. 1.0 ml of servo demulsifier gave a good oil separation at the first one minute.

Demulsifier	Best separation time	Quantity applied	Oil quantity separated	Water quantity separated	Emulsion quantity left	Sludge quantity left
Servo	60 mins	0.4ml	5 ml	20 ml	75 ml	0 ml
Servo	60 mins	0.6 ml	60ml	40 ml	0 ml	0 ml
Servo	30 mins	0.8 ml	60ml	40 ml	0 ml	0 ml
Servo	1 min	1.0ml	60ml	40 ml	0 ml	0 ml
Separol	30 mins	0.4ml	60ml	0 ml	0 ml	40ml
Separol	30 mins	0.6ml	50ml	5 ml	45 ml	0 ml
Separol	30 mins	0.8ml	50ml	0 ml	50 ml	0 ml
Lime	1 min	0.4ml	60ml	35 ml	0 ml	5 ml
Lime	30 mins	0.6ml	0 ml	30 ml	70 ml	0 ml
Lime	30 mins	0.8ml	0 ml	10 ml	85 ml	5 ml
Grape	30	0.4ml	70ml	20 ml	0 ml	10ml

	mins					
Grape	30 mins	0.6ml	0 ml	5 ml	90 ml	5 ml
Grape	30 mins	0.8ml	0 ml	10 ml	90 ml	10ml

Table 11: Emulsion demulsifier effectiveness comparison based on time of separation

From the table of comparison, the efficiency trend for each demulsifier can be seen. Orange demulsifier was not included because it was totally ineffective irrespective of the quantity of demulsifier introduced. From the table, the efficiency of Servo demulsifier increased with increase in concentration of demulsifier in the emulsion. This reveals that increasing the quantity of servo demulsifier in the emulsion to be treated will increase the efficiency of separation. But for the purpose of optimization, this project seek to select a suitable and economically viable demulsifier that will be very efficient at the shortest possible separation time with a very small quantity applied. On the other hand, the trend in efficiency for Separol, Lime, and Grape demulsifier reveals that the higher the concentration of these demulsifiers in the emulsion, the lower their efficiencies. This implies that these set of demulsifiers are more effective if applied in smaller volume than in larger volume. This gives us the answer we seek towards actualizing the research objectives. The research aims at selecting the demulsifier that will give the best separation with the smallest quantity applied at the shortest possible separation time. Of these demulsifiers, lime demulsifier was able to give a clear separation at the shortest encountered separation time of one minute and required the least demulsifier quantity of 0.4 ml to separate a 100 ml emulsion sample into oil and water. The trend in lime demulsifier signifies that only a small volume of 0.4 ml is required for every 100 ml emulsion sample to give a clear oil and water separation. A further increase in the concentration of the lime demulsifier in the emulsion sample should also be reciprocated with an increase in the volume of the emulsion sample so as to balance the solubility of the lime demulsifier in the emulsion sample. If the volume of the emulsion is not increased as the demulsifier volume increase, it will lead to an increased concentration of lime demulsifier in the emulsion, which will reduce the efficiency of the demulsifier, as have been revealed from the result that lime demulsifier is more effective at lower concentration than at higher concentration. Haven seen the trend in efficiency of the different demulsifiers, lime demulsifier was selected as the best demulsifier for treatment of crude oil emulsion from Umuseti oil field because lime demulsifier requires a small concentration of 0.4 ml to react with a 100 ml emulsion sample, giving a clear separation at one minute, a further increase in the concentration of lime demulsifier does not favour the separation process, so in order to minimize operating cost that may result from cost of purchasing crude oil demulsifiers, lime demulsifier which does not require large volume to cause clear separation is considered the best choice. And also for the purpose of minimizing operating time, the lime demulsifier which works excellently within the first one minute of reacting with the demulsifier is the best choice and have shown that operating cost and operating time can be minimized by its usage while maximizing profit through maximizing crude oil production rate.

5. CONCLUSIONS

In every process industry, optimization of the process is an important aspect that deals with considerations for the best interest of the company and the end users of the products. For this reason, the best choice of demulsifier have been selected based on the ability to give the best separation at the shortest possible time and with the least quantity of demulsifier. This is done so as to obtain the demulsifier that will minimize operating time and cost as well as maximize profit. Therefore, it can be concluded that small concentration of Lime and grape demulsifiers work comparatively with servo demulsifier giving a good separation and a clear interface and will be more effective in treating crude oil emulsion from oils classified as light crude.

In a situation where there is too much water production (free water), a settling tank should be provided to drain out some settled water due to gravity, and chemicals (demulsifiers) should be injected before passing the crude into the settling tank to ease the quick breaking of the emulsion. Emulsion breakers should always be injected at a point where sufficient turbulence ensures quick and even distribution of the chemical through the production stream. The breaker should be injected upstream of the point of emulsification as practically feasible since emulsion stability will be reduced and emulsification will be prevented.

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BIOGRAPHIES

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APPENDIX (Treated emulsion samples)

Figure 31: Emulsion treatment with Servo demulsifier

Figure 32: Emulsion treatment with Separol demulsifier

Figure 33: Emulsion treatment using Lime demulsifier

Figure 34: Emulsion treatment using Grape demulsifier

Figure 35: Emulsion treatment using Orange demulsifier