RHEOLOGICAL STUDY OF JATROPHA CURCAS OIL AS OIL BASED FLUID IN DRILLING OPERATION

By

ROZITA BANU ABDUL RAHMAN

Dissertation submitted in partial fulfillment of

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(Petroleum Engineering)

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UniversitiTeknologi PETRONAS

Bandar Seri Iskandar

31750 Tronoh

Perak DarulRidzuan

CERTIFICATION OF APPROVAL

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A project dissertation submitted to the

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Approved by,

Mazlin Idress

Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

JANUARY 2011

CERTIFICATION OF ORGANILITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

ROZITA BANU ABDUL RAHMAN

ABSTRACT

The drilling fluid plays several essential functions in drilling wells. If the mud properties (physical, chemical and rheology properties) are incorrect, safety and economics may be severely compromised. The drilling fluid is most essential system in drilling operation. Selection of drilling fluid lead to the success of drilling operation. Types of drilling fluid used in this project are oil based mud and synthetic based mud. The biodiesel oils (Jatropha Oil Fatty Acid Methyl Ester and Methyl Ester Palm Oil) is being use as oil phase in oil based mud and mineral oil (Sarapar) is being used as synthetic fluid in synthetic based mud. This project is mainly to identify whether Jatropha Fatty Acid Methyl Ester can be used as an alternative for biodiesel oil to replace diesel oil in oil based mud by examining the rheological properties of the muds.

ACKNOWLEDGEMENT

I would like to take this opportunity to thank all parties involved in the completion of my final year project.It a chance for me to learn to be independent of doing a project and to improve myself more for the betterment of my future.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

The use of oil based mud (OBM) has increased significantly in drilling operation. OBM is known to provide excellent shale inhibition, borehole stability, lubricity, thermal stability, corrosion inhibition, tolerance of contamination and ease of maintenance. Diesel oil had been widely used as the base oil since the introduction of OBM as drilling fluid. In early 1980's many researches on diesel oil as the base oil for drilling fluid. From these researches output showed that diesel oil not suitable to be used as base oil due to high toxicity and aromatic contents exposure to the people and environment.

Therefore, ester based drilling fluids and synthetic based mud were introduced as environmental friendly alternatives. Ester based drilling fluid is actually vegetable oil which already converted to biodiesel and is used as continuous oil phase in OBM. The vegetable oil that being used in this project are the Jatropha Oil Fatty Acid Methyl Ester and Methyl Ester Palm Oil.These oil have comparable physical and chemical properties with those of diesel oil that can be surely replaced the diesel oil in OBM. These vegetable oil is harmless to the environment since it has low aromatic content and less toxic.

The synthetic based mud (SBM) is also harmless to the environment and less toxic. It provides environmental superiority, technical acceptability and human health advantages. It is also less volatile where its vapor free of aromatic compounds which can reduce vapor inhalation on the drilling platform. SBM is same with OBM. The oil phase is replaced with synthetic fluid which is mineral oil (Sarapar). In this project rheological study will be done on Jatropha Oil Fatty Acid Methyl Ester, Methyl Ester Palm Oil (vegetable oil) and Sarapar (mineral oil). SBM will be comparison factor for OBM using vegetable oil.

1.2 Problem Statement

Diesel oil has been use commercially in drilling operation but it is harmful to the environment. The usage of vegetable oil and mineral oil can be an alternative based drilling fluid. Therefore, Jatropha Oil Fatty Acid Methyl Ester or Methyl Ester Palm Oil or Sarapar Oil might be a candidate solution as an alternative energy resource and it is comparable with diesel oil.

1.3 Objective

The objectives of this study are:

- To experimentally study and compare the rheology properties of the Jatropha Oil Fatty Acid Methyl Ester, Methyl Ester Palm Oil and Sarapar Oil.
- To identify whether Jatropha Oil Fatty Acid Methyl Ester can be an altenative base fluid for oil based mud

1.4 Scope of Study

- Converting the Jatropha Oil to ester form (FAME)
- Conducting research on the theory and definition of terms related to the study.
- Conducting experiments to see the effectiveness of Jatropha Oil Fatty Acid Methyl Ester, Methyl Ester Palm Oil and Sarapar Oil used as oil base fluidin drilling operation.

1.5 Relevancy of Study

This study will produce a quantitative correlation of the rheology study of Jatropha Oil Fatty Acid Methyl Ester, Methyl Ester Palm Oil and Sarapar Oil. This correlation will give an idea in choosing the suitable drilling fluid to be use in drilling operation.

1.6 Feasibility of Study within the Scope and Time Frame

The study was not feasible enough due to problems faced during the commencement of experiments for the project that coerce the author to eliminate formation damage experiment due to time constraint and the duration of the experiment. Therefore, author focused more into the rheology study of Jatropha Oil Fatty Acid Methyl Ester, Methyl Ester Palm Oil and Sarapar Oil as a base fluid in drilling operation and some view from economy sector.

CHAPTER 2

LITERATURE REVIEW

2.1 Jatropha Oil

Jatropha oil is vegetable oil produced from the seeds of the Jatrophacurcas, a plant that can grow in marginal lands and common lands. The plant that is generally cultivated for the purpose of extracting jatropha oil is Jatrophacurcas. The seeds are the primary source from which the oil is extracted. Owing to the toxicity of jatropha seeds they are not ingested by humans. The major goal of jatropha cultivation, therefore, is performed for the sake of extracting jatropha oil

2.2 Methyl Ester Palm Oil

Methyl ester palm oil is a clear yellow of vegetable oil origin obtained by pressing or boiling the flesh of the fruit of the oil palm (Elaeisguineensis). Palm oil differs from palm kernel oil, the latter being obtained from the kernels of the oil palm. Crude palm oil has complex process to change to methyl ester palm oil. Methyl ester palm oil used in this project is obtained from ***Emery Oleochemical (M) SdnBhd*.**

2.3 Sarapar Oil

Sarapar is a mineral oil used as synthetic fluid in synthetic based mud. This type of drilling fluid is widely use in drilling operation nowadays.

2.4 Base Fluid Properties

There are certain requirements to identify whether the oil can be use as base fluid in drilling fluid. The requirements are as follows;

2.4.1 Kinematic Viscosity

It should be as low as possible. This allows the oil based mud to be formulated at lower oil/water ratio and gives better rheology (lower plastic viscosity) especially at lower mud temperature.

2.4.2 Flash Point

It should be greater than 100°F. Higher flash point will minimize fire hazards as less hydrocarbonvapours is expected to generate above the mud.

2.4.3 Pour Point

It should be lower than the ambient temperature to allow pumpability of mud from storage tanks.

2.4.4 Non-toxic and low aromatic content

Base oil should have total aromatic hydrocarbon content of less than 5%. It should be non-acutely toxic in a standard 96 hr LC 50 toxicity test, performed using 100% water soluble fraction of the base.

To choose a better base fluid for drilling operation, a base fluid should have all the requirements as listed above. Table 2.1 below shows the base fluid properties of JatrophaOil Fatty Acid Methyl Ester, Methyl Ester Palm Oil and Sarapar Oil.

Base Oil / Base Oil Properties	Base Oil Required Properties	Jatropha Oil Fatty Acid Methyl Ester	Methyl Ester Palm Oil	Sarapar Oil	Test Method
Specific Gravity		0.87	0.87	0.77	ASTM D1250
Kinematic Viscosity@40°C mm^2/sec	2.3 – 3.5	5.5	4.3	2.5	ASTM D445
Flash Point °C	> 66°C	>85	168	135	ASTM D93
Pour Point °C	<Ambient temp.	3	2	2	ASTM D97
Aromatic Content %	4 - 8	-	-	0.9	ASTM D1319

Table 2.1: Base Oil Physical Properties

2.5 Rheological Study

Rheology of fluids in the well is the relationship between the flow rate and the pressure required to maintain the flow rate (either in pipe or annulus). The relationships between these properties will affect circulating pressures, surge and swab pressures and hole cleaning ability. In this project, the rheological study comprises of plastic viscosity, yield point, electric stability and gel strength. Each study is so significant to choose a better base fluid.

2.5.1 Plastic Viscosity

Plastic viscosity relates to the resistance to flow due to interparticle friction. The friction is affected by the amount of solids in the mud, the size and shape of those solids and the viscosity of the continuous liquid phase.

$$\boxed{\boldsymbol{PlasticViscosity, PV = [600rpmReading] - [300rpmReading]}}$$

Unit: **centipoise,cp**
Specification value: **25 - 45 cp**

2.5.2 Yield Point

Yield point estimates the portion of the total viscosity that comes from attractive forces between particles suspended in the mud.

$$\boxed{\boldsymbol{YieldPoint, YP = [300rpm\ Reading] - [Plastic\ Viscosity, PV]}}$$

Unit: **lb/100 ft²**
Specification value: **10 – 20 lb/100ft^2**

2.5.3 Electric Stability

The electric stability (ES) of an oil-based drilling fluid mud is a property related to its emulsion stability and oil-wetting capability. ES is determined by applying a voltage ramped sinusoidal electrical signal across a pair of parallel flat-plate electrodes immersed in the mud. The resulting current remains low until a threshold voltage is reached, whereupon the current rises very rapidly. This threshold voltage is referred to as the ES of the mud and is defined as the voltage. Chemical composition and shear history of a mud control the absolute magnitude of ES in a complex fashion.

Specification value: > 600volts

2.5.4 Gel Strength

Gel strength are determined in two-speed direct-indicating viscometer by slowly turning the driving wheel on top of the instrument by hand and observing the maximum deflection before the gel breaks. Gel strength may be measured after allowing the mud to stand quiescent for any time interval of interest, but they routinely measured after 10 seconds (initial gel strength) and 10 minutes.

Specification value;

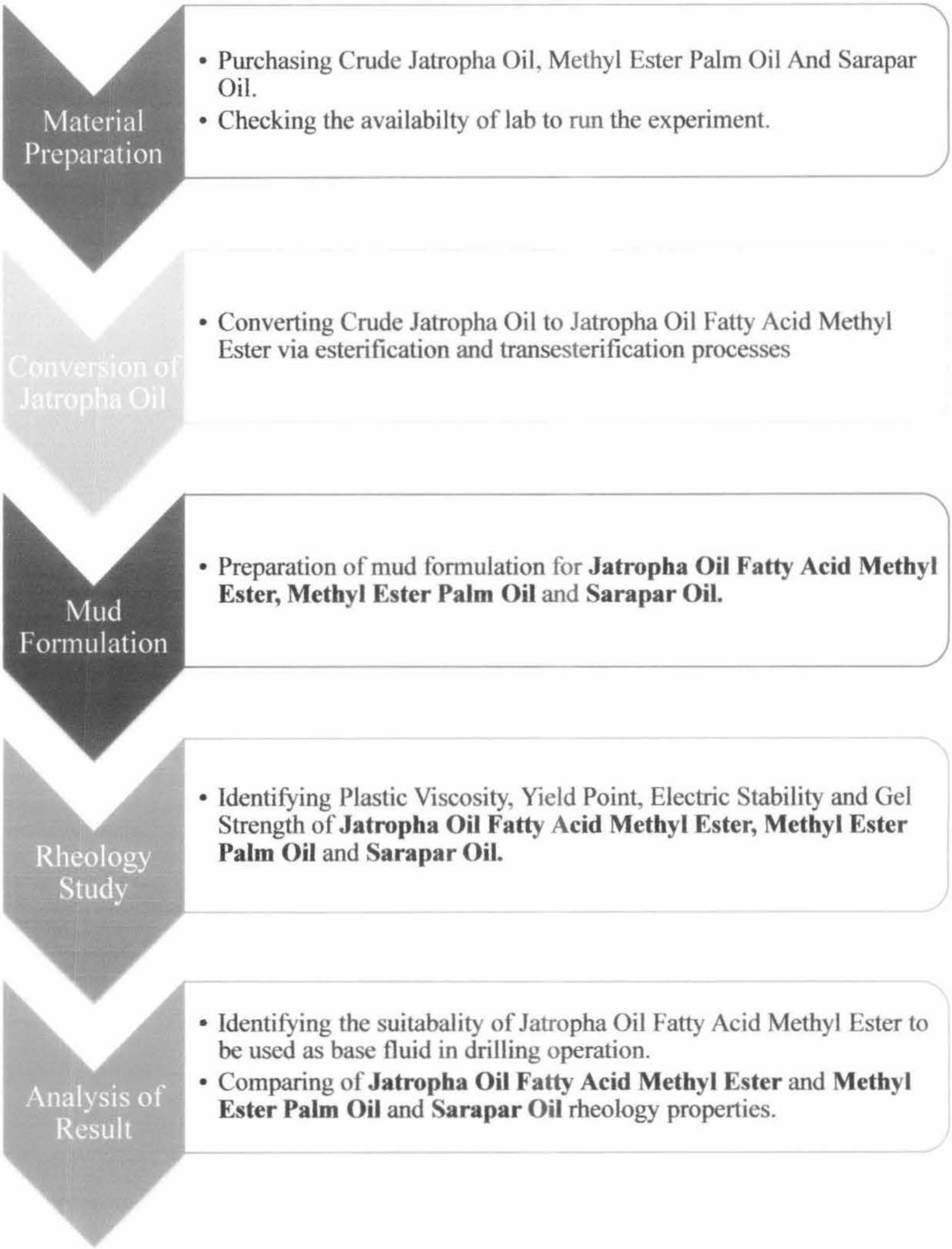
Gel 10sec: **10 – 20 lb/100ft^2**

Gel 10min: **20 – 40 lb/100ft^2**

CHAPTER 3

METHODOLOGY

3.1 Methodology Flowchart



3.2 Conversion of Jatropha Oil to Jatropha Oil Fatty Acid Methyl Ester

To convert crude jatropha oil to jatropha oil FAME, esterification and transesterification process must be conducted onto crude jatropha oil. Below are steps of the processes.

3.2.1 Esterification process

Jatropha oil	: 149.749 g (Figure 1)
Methanol	: 50 ml
H_2SO_4	: 1.620 g
Temperature	: 65°C (internal)
Time	: 90 mins

a. All materials above are prepared
b. Methanol and sulphuric acid, H_2SO_4 are mixed in a small beaker.
c. Jatropha oil and mixture of methanol and sulphuric acid, H_2SO_4 are filled into the 3 neck flask as shown in figure 3.2 below.

Figure 3.1 :Jatropha Oil

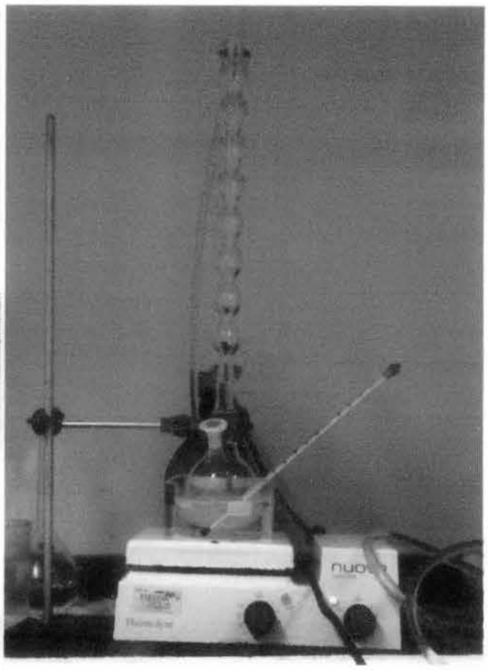


Figure 3.2: Esterification Process

d. The mixture must be heated up in a water bath with 65°C (internal temperature) for 90 minutes

e. After 90 minutes of reaction, the sample are poured into clean separatory funnel and let it stand for 3 hours. (refer Figure 3.3)

f. After 3 hours, the upper brown layer of methanol is removed.(refer Figure 3.4)

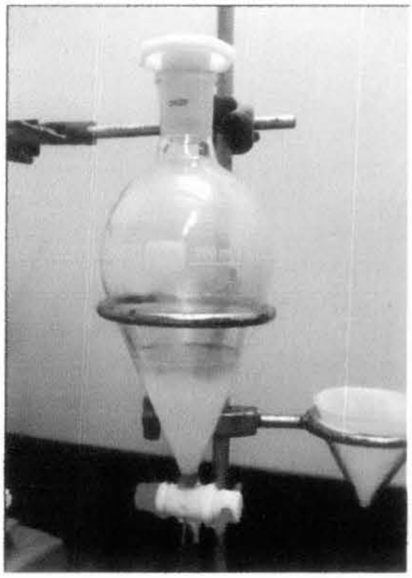


Figure 3.3: Before 3 hours

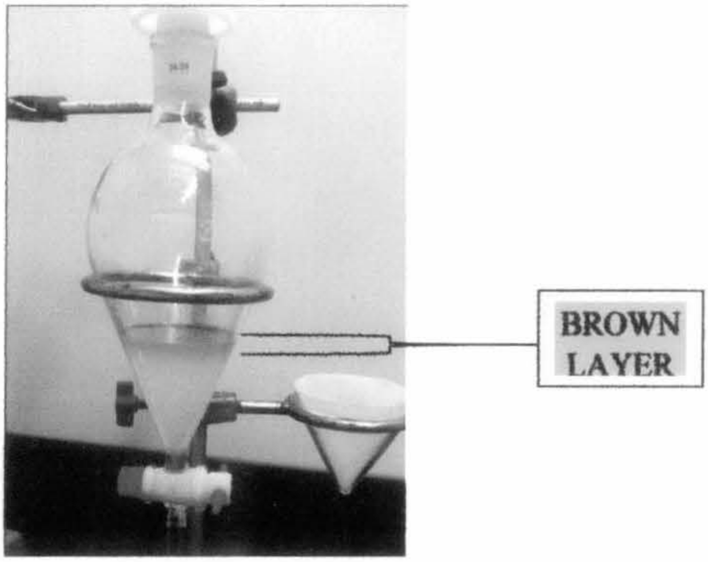


Figure 3.4: After 3 hours

g. The lower layer (yellow oil + FAME layer) is washed with 1000 ml (200 x 5) of warm (50—60°C) water until the pH is neutral (7.0).

h. Water is separated and oil is let rest at room temperature in separatory funnel as in Figure 3.5.

i. After the water is drained, the oil is heated on a magnetic stirrer hot plate at 105°C with medium stirring for 15—20 mins. The color of oil turn to darker colour, which indicate that oil must NOT be heated beyond 105°C. (refer Figure 3.6)

j. After the heating process, the oil remain in the beaker is thejatropha oil fatty acid methyl ester where it still contain free fatty acid that must be remove in order to get the pure jatropha oil fatty acid methyl ester.(refer Figure 3.7)

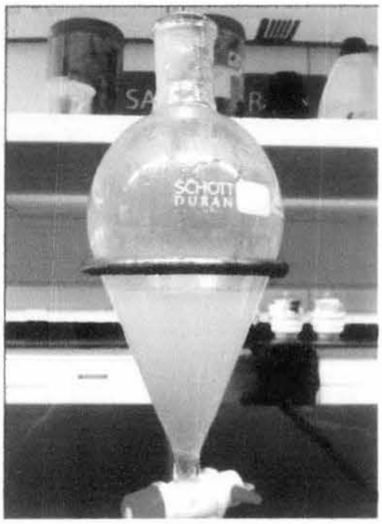


Figure 3.5: Water separation

Figure 3.6: Heating the oil

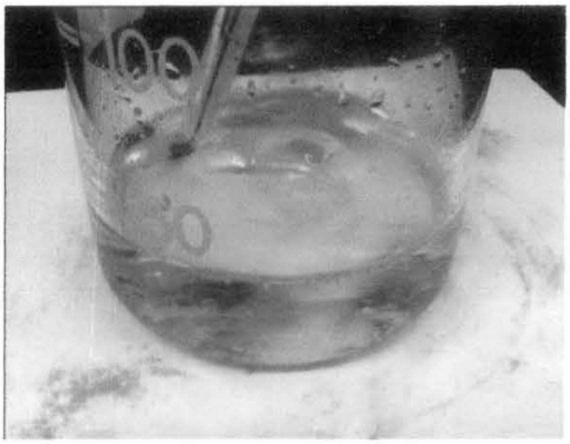


Figure 3.7: Free Fatty Acid Jatropha Oil

3.2.2 Transesterification process

Jatropha oil	: 135.0 g
Methanol	: 40 ml
NaOH	: 2.5 g
Temperature	: 55—60°C (internal)
Time	: 1 hour

Last 15 minstemperature : 70°C (internal)

a. All materials are prepared
b. Methanol and NaOH are mixed in a small beaker.
c. Jatropha oil and mixture of methanol and NaOH are filled into the 3 neck flask as shown in Figure 3.8.

d. The mixture must be heated up in a water bath with 55—60°C (internal temperature) for 1 hour.
e. After 1 hour, the mixture is then poured into clean separatory funnel and let it stand for 4 hours.
f. After 4 hours the bottom brown layer of glycerin is removed.
g. The oil is then washed with 1L of warm water (50-55°C) in separatory funnel until the pH is neutral.
h. After the water is drained, the oil is heated on a magnetic stirrer hot plate at 105°C with medium stirring for 15—20 mins.
i. After the heating process the colour of Jatropha Oil Fatty Acid Methyl Ester will turn to lighter colour compared to crude Jatropha oil. (refer Figure 3.9)

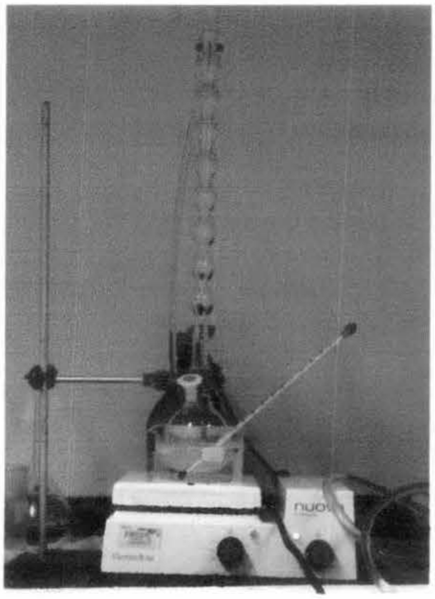


Figure 3.8: Transesterification Process

Figure 3.9: Jatropha Oil Fatty Acid Methyl Ester

From the experiment, Jatropha Oil Fatty Acid Methyl Ester is obtained and next step of the project can be preceded.

3.3 Mud Formulation of Base Fluid

Before rheology test commence, mud formulation should be done for each base fluid that going to be tested. Table 3.1 shows the mud formulation of Jatropha Oil Fatty Acid Methyl Ester, Methyl Ester Palm Oil and Sarapar Oil.

Composition	Test 1	Test 2	Test 3
Jatropha Oil FAME	191.7ml	-	-
Methyl Ester Palm Oil	-	191.7ml	-
Sarapar	-	-	163.1ml
HT Emulsifier,lb	10.0	10.0	10.0
Liquid Fluid Loss Additive,lb	2.5	2.5	2.5
CONFI-GEL HT	1.0	1.0	1.0
CONFI-TROL 450	4.0	4.0	4.0
CONFI-TROL-HT	4.0	4.0	4.0
LIME	5.0	5.0	5.0
Drillwater,ml	55.1	53.7	55.1
Calcium Chloride	32.1	31.4	32.1
DRILL-BARITE,lb	156.7	187.2	156.7

Table 3.1: Mud Formulation

3.4 Required Tools

Equipments:

1) Multi Mixer, 2) FANN Model 34 A with heater, 3) Shearmeter, 4) Electric Stability Meter, 5) Roller Oven 6) Basic equipments in lab such as beaker,heater,3 neck flask, separator funnel, condenser, and termometer

Consumables:

1) Crude Jatropha Oil, Jatropha Oil Fatty Acid Methyl Ester, Methyl Ester Palm Oil, Sarapar Oil, Methanol, Sulphuric Acid and Natrium Hydroxide.

3.5 Gantt Chart of Final Year Project 2

No	Task / Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Converting Jatropha Oil														
2	Rheology study														
3	Submission of progress report														
4	Analysis of result														
5	Pre-EDX and poster submission														
6	Submission of final report														
7	EDX														
8	Final Oral presentation														
9	Submission of hardbound														

Table 3.2: Gantt Chart and Milestone of Project

CHAPTER 4

RESULT AND DISCUSSION

4.1 Rheology Test Result

Table 4.1 shows the mud properties results after rheology test were applied to of Jatropha Oil Fatty Acid Methyl Ester, Methyl Ester Palm Oil and Sarapar.

Test 1 = Jatropha Oil FAME

Test 2 = Methyl Ester Palm Oil

Test 3 = Sarapar Oil

	Test 1		Test 2		Test 3	
	BHR	AHR	BHR	AHR	BHR	AHR
PV, cp	43	66	37	47	15	13
YP, lb/100 ft^2	19	22	3	30	2	3
Gel 10 sec, lb/100 ft^2	11	10	7	15	3	3
Gel 10 min, lb/100 ft^2	13	17	9	18	4	10
ES, volts	1999	1785	1999	1380	1468	897
HTHP Filter Loss (500psi, 350 °F)	not tested	4.0	not tested	1.0	not tested	2.0

Table 4.1: Mud Properties Results

BHR = Before Hot Rolling (at room temperature)

AHR = After Hot Rolling (at wellbore condition)

From the rheology test result, it shows that Jatropha Oil FAME has high PV and YP but has preferable value of ES and Gel Strength. This shows that Jatropha Oil FAME did not acquire the characteristic of a base fluid. When, Jatropha Oil FAME is compared with Methyl Ester Palm Oil, Methyl Ester Palm Oil shows a better base fluid characteristic because it has lower PV but high YP and preferable value of ES and Gel Strength. Therefore, it also shows that between the vegetable oil, Palm Oil is a better candidate to be use as base fluid.

When, Jatropha Oil FAME and Methyl Ester Palm Oil is compared with Sarapar Oil, Sarapar Oil has lower PV and YP and also preferable ES and Gel Strength value that shows that it has a better and more preferable characteristics to be use as base fluid. This is because Sarapar Oil is commercially used base fluid in oil and gas industry these days. Therefore, Sarapar Oil being a comparison factor in this project where it shows more preferable rheology properties of a base fluid. Below shows the rheology study parameters of the base fluid using tables and graphs.

4.1.1 Plastic Viscosity

A. Before Hot Rolling

Base Fluid	**Jatropha Oil FAME**	**Methyl Ester Palm Oil**	**Sarapar Oil**
Plastic Viscosity, cp	43	37	15

Table 4.2: Before Hot Rolling Plastic Viscosity

B. After Hot Rolling

Base Fluid	**Jatropha Oil FAME**	**Methyl Ester Palm Oil**	**Sarapar Oil**
Plastic Viscosity,cp	66	47	13

Table 4.3: After Hot Rolling Plastic Viscosity

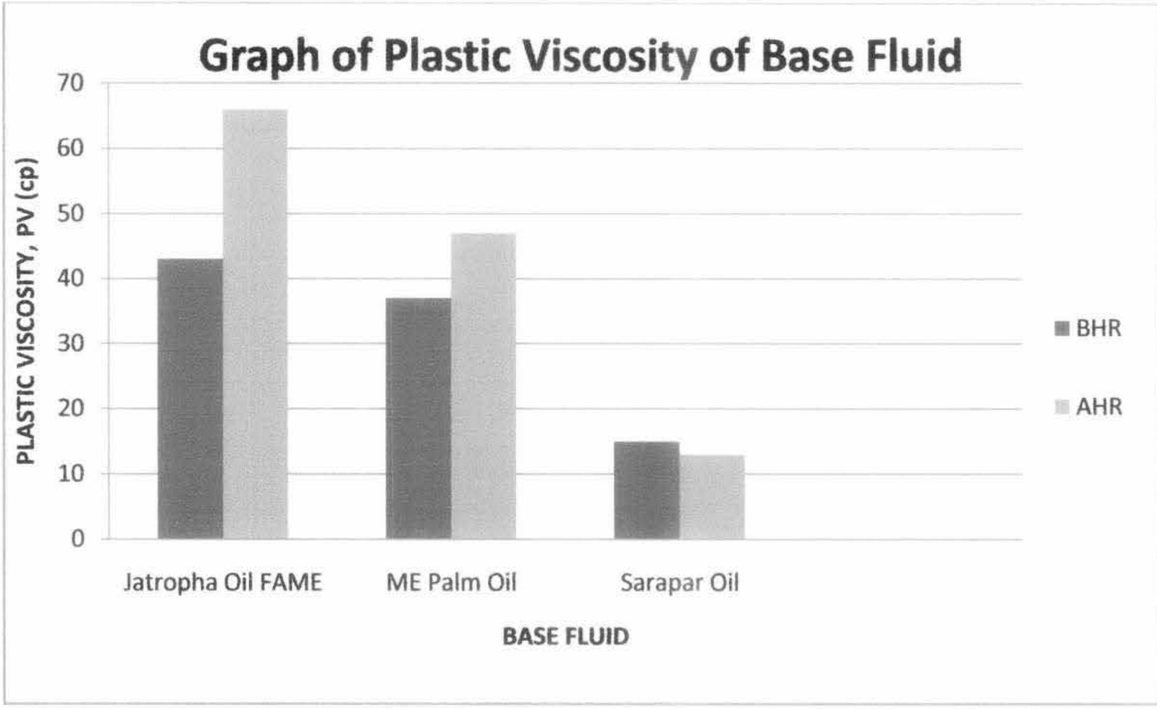


Figure 4.1: Graph of Plastic Viscosity of Base Fluid

Discussion:

Jatropha Oil FAME and Methyl Ester Palm Oil show a rise and Sarapar Oil shows a decline in PV value from before hot rolling (BHR) to after hot rolling (AHR).

Jatropha Oil FAME : 43cp (BHR) → 66cp (AHR)

Methyl Ester Palm Oil: 37cp (BHR) → 47cp (AHR)

Sarapar Oil : 15cp (BHR) → 13cp (AHR)

Plastic viscosity of Jatropha Oil FAME is higher than Methyl Ester Palm Oil and Sarapar Oil. This shows that Jatropha Oil FAME has higher resistance to flow due to higher inter particle friction. Comparing between vegetable oil, palm oil has lower PV. Lower PV is preferable to be use as base fluid and the maximum PV required is 45cp.

4.1.2 Yield Point

A. Before Hot Rolling

Base Fluid	Jatropha Oil FAME	Methyl Ester Palm Oil	Sarapar Oil
Yield Point, lb/100ft^2	19	3	2

Table 4.4: Before Hot Rolling Yield Point

B. After Hot Rolling

Base Fluid	Jatropha Oil FAME	Methyl Ester Palm Oil	Sarapar Oil
Yield Point, lb/100ft^2	22	30	32

Table 4.5: After Hot Rolling Yield Point

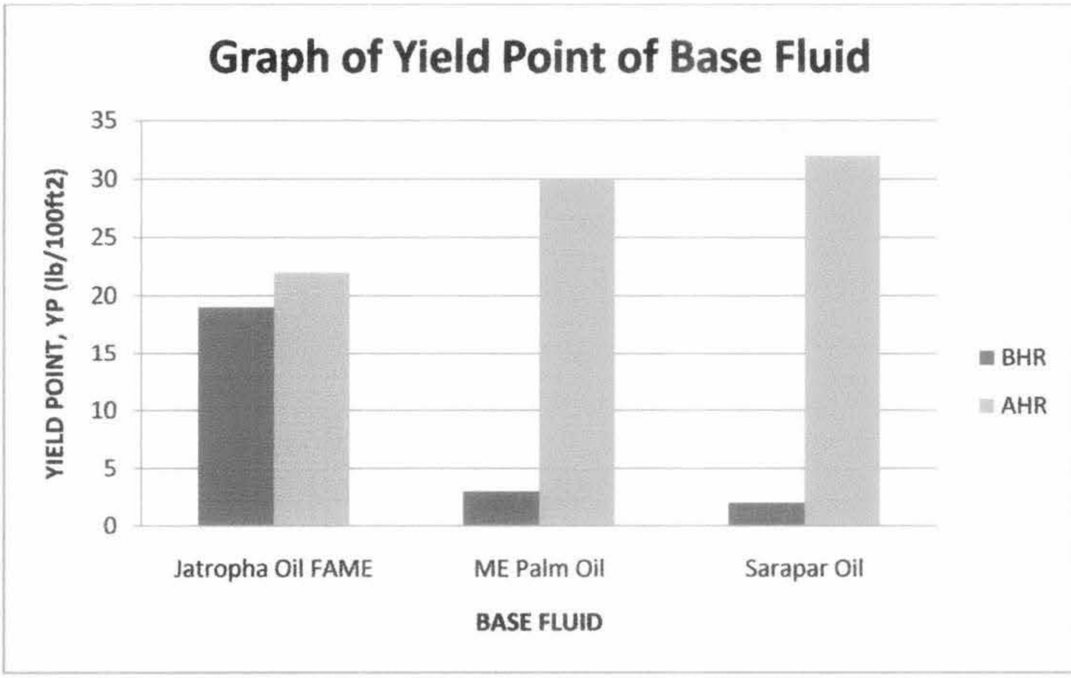


Figure 4.2: Graph of Yield Point of Base Fluid

Discussion:

Jatropha Oil FAME, Methyl Ester Palm Oil and Sarapar Oil shows a rise in YP value from before hot rolling (BHR) to after hot rolling (AHR).

Jatropha Oil FAME : 19 $lb/100ft^2$ (BHR) → 22$lb/100ft^2$ (AHR)
Methyl Ester Palm Oil: -1$lb/100ft^2$ (BHR) → 30 $lb/100ft^2$ (AHR)
Sarapar Oil : 2$lb/100ft^2$ (BHR) → 3$lb/100ft^2$ (AHR)

Jatropha Oil FAME and Sarapar Oil shows a consistent rise in YP but Methyl Ester Palm Oil shows a drastic decline in YP value which the author doubt there should be some error during the experiment. Maximum specification value of YP is 20 $lb/100ft^2$. Therefore, Sarapar Oil shows a better YP value and Jatropha Oil shows slightly better value of YP.

4.1.3 Electric Stability (ES)

A. Before Hot Rolling

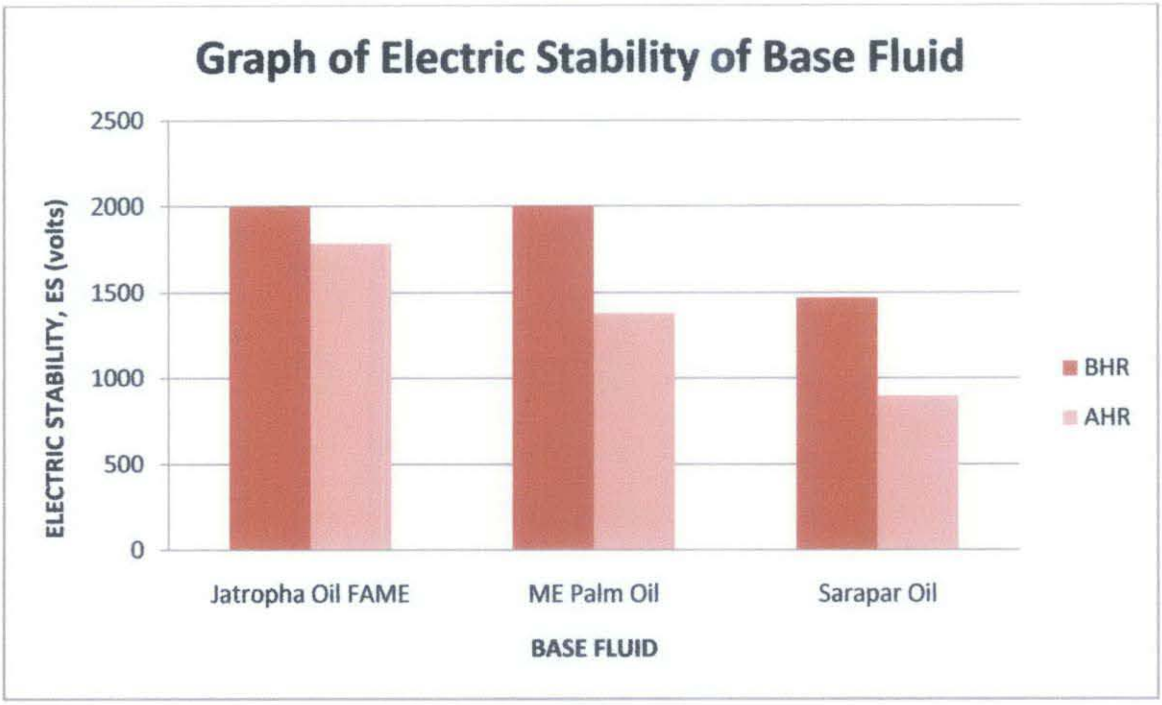
Base Fluid	Jatropha Oil FAME	Methyl Ester Palm Oil	Sarapar Oil
ES, volts	1999	1999	1468

Table 4.6: Before Hot Rolling of Electric Stability (ES)

B. After Hot Rolling

Base Fluid	Jatropha Oil FAME	Methyl Ester Palm Oil	Sarapar Oil
ES, volts	1785	1380	897

Table 4.7: After Hot Rolling of Electric Stability (ES)



BASE FLUID

Figure 4.3: Graph of Electric Stability of Base Fluid

Discussion:

Jatropha Oil FAME, Methyl Ester Palm Oil shows decline of ES value from before hot rolling to after hot rolling.

> Jatropha Oil FAME : 1999 volts (BHR)→ 1785 volts (AHR)
> Methyl Ester Palm Oil: 1999 volts (BHR)→ 1380 volts (AHR)
> Sarapar Oil : 1468 volts (BHR)→ 897 volts (AHR)

Specification value for ES shows, ES >600 volts. Therefore, all the base fluid shows better ES value. This concluded that Jatropha Oil FAME, Methyl Ester Palm Oil and Sarapar Oil have better emulsion stability and oil wetting capability.

4.1.4 Gel Strength

A. Before Hot Rolling

Base Fluid	Jatropha Oil FAME	Methyl Ester Palm Oil	Sarapar Oil
Gel 10 sec, $lb/100ft^2$	11	7	3

Table 4.8: Before Hot Rolling of Gel 10 sec

B. After Hot Rolling

Base Fluid	Jatropha Oil FAME	Methyl Ester Palm Oil	Sarapar Oil
Gel 10 sec, $lb/100ft^2$	10	15	3

Table 4.9: After Hot Rolling of Gel 10 sec

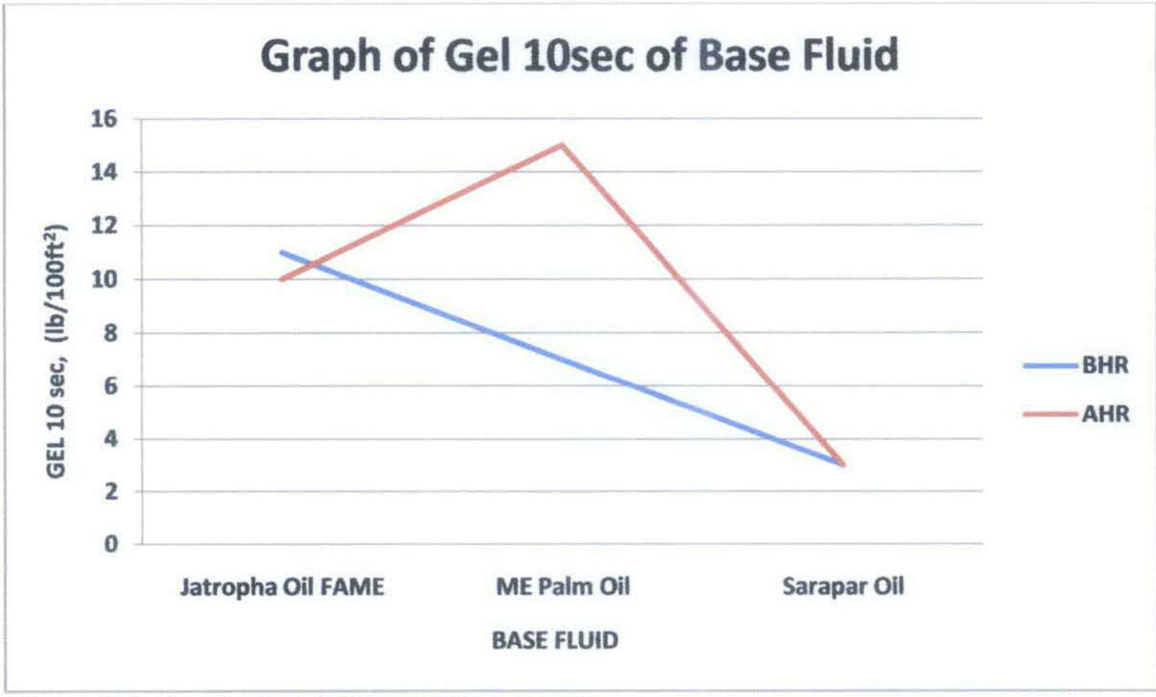


Figure 4.4: Graph of Gel 10sec of Base Fluid

Discussion:

Jatropha Oil FAME shows a declination, Methyl Ester Palm Oil shows a rise and Sarapar Oil shows no change in gel strength 10 sec value

Jatropha Oil FAME : 11 lb/100ft^2 (BHR)$\rightarrow$ 10 lb/100ft^2 (AHR)
Methyl Ester Palm Oil: 10 lb/100ft^2 (BHR)$\rightarrow$ 15 lb/100ft^2 (AHR)
Sarapar Oil : 3 lb/100ft^2 (BHR)$\rightarrow$ 3 lb/100ft^2 (AHR)

Maximum specification value for gel10sec is 20 lb/100ft^2. Jatropha Oil FAME, Methyl Ester Palm Oil and Sarapar Oil is in the range of specification range for Gel10sec. Therefore, it has better gel strength at 10 sec before and after hot rolling.

A. Before Hot Rolling

Base Fluid	**Jatropha Oil FAME**	**Methyl Ester Palm Oil**	**Sarapar Oil**
Gel 10 min, lb/100ft^2	13	9	4

Table 4.10: Before Hot Rolling of Gel 10 min

B. After Hot Rolling

Base Fluid	***Jatropha Oil* FAME**	***Methyl Ester* Palm Oil**	***Sarapar Oil***
Gel 10 min, lb/100ft^2	17	18	10

Table 4.11: After Hot Rolling of Gel 10 min

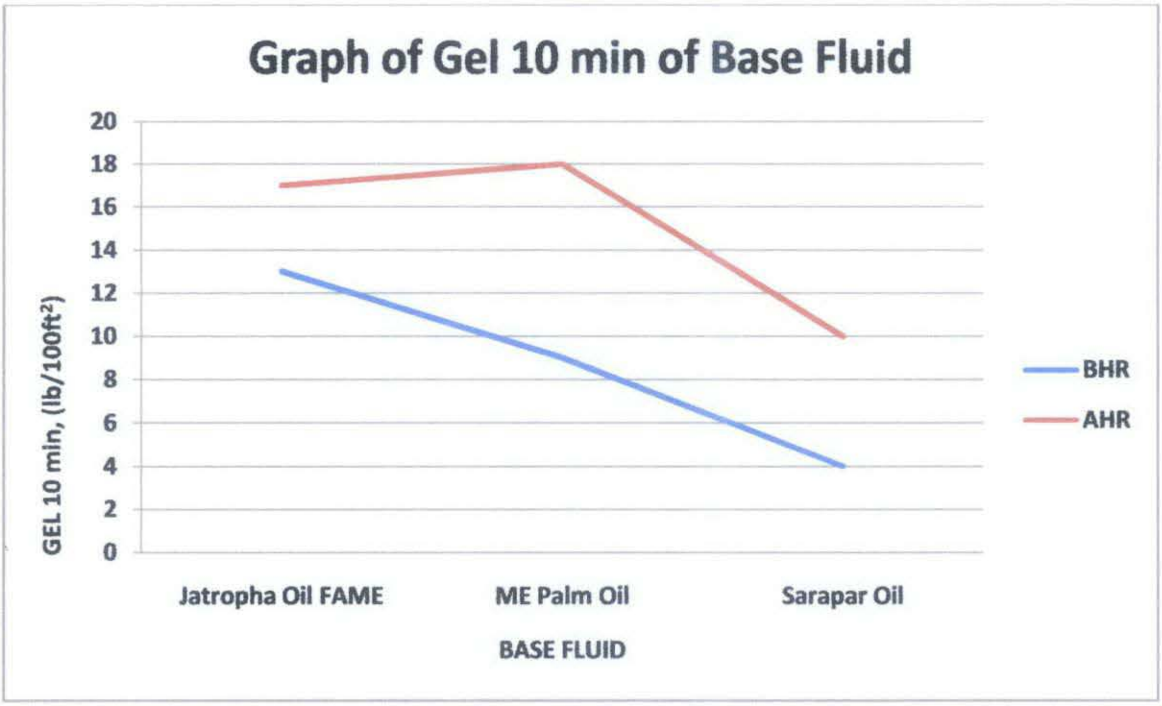


Figure 4.5: Graph of Gel 10 min of Base Fluid

<u>Discussion:</u>

Jatropha Oil FAME, Methyl Ester Palm Oil and Sarapar Oil shows a rise in gel strength at 10 min before and after hot rolling.

Jatropha Oil FAME : 11 lb/100ft^2 (BHR)⟶ 10 lb/100ft^2 (AHR)
Methyl Ester Palm Oil: 10 lb/100ft^2 (BHR)⟶ 15 lb/100ft^2 (AHR)
Sarapar Oil : 3 lb/100ft^2 (BHR)⟶ 3 lb/100ft^2 (AHR)

Maximum specification value for gel 10 min is 40 lb/100ft^2. Jatropha Oil FAME, Methyl Ester Palm Oil and Sarapar Oil is in the range of specification value. Therefore, it has the better gel strength value at 10min.

4.2 Economic Analysis

The successful completion of an oil well and its cost is depend to a considerable extent on the properties of the drilling fluid. The cost of the drilling fluid itself is relatively small, but the choice of the right fluid and maintenance of the right properties while drilling greatly influence the total well costs. Drilling means money, therefore each and every decision taken in oil and gas industry must be very careful and effectively to the industry. This project is mainly about choosing the right drilling fluid in drilling operation in order to have a successful completion of a well.

CHAPTER 5

CONCLUSION

Based on the objectives stated author can conclude that, from rheology test result, Jatropha Oil Fatty Acid Methyl Ester, does not acquire much of an ideal base fluid to be use in drilling operation. But it can be treated to some extent by changing the composition of materials in the mud formulation. By referring to Table 2.1, Jatropha Oil FAME has the criteria of a base fluid. Therefore, it can be treated further to be use commercially as a base fluid in drilling operation. When, Jatropha Oil FAME and Methyl Ester Palm Oil are compared, Methyl Ester Palm Oil attains the characteristics of a base fluid.

When Jatropha Oil FAME and Methyl Ester Palm Oil are compared with Sarapar Oil which also can be mentioned as comparing between vegetable oil and mineral oil, mineral oil shows a better base fluid to be use in drilling operation. Mineral oil also has the criteria of a base fluid as shown in Table 2.1. The reason why mineral oil is far more better compare to vegetable oil is because mineral oil is an environmentally friendly which are preferable to use in drilling fluid. Therefore, it definitely will show a most convincing result than the other two of the vegetable oil.

CHAPTER 6
RECOMMENDATION

From the results of this project, author found out that, Jatropha Oil Fatty Acid Methyl Ester was not a convincing base fluid to be use in drilling operation and author also found that Methyl Ester Palm Oil and Sarapar Oil can be the best candidate to replace diesel oil in oil based mud.

From discussion with lecturer and review from a journal paper [7], author found that Jatropha Oil FAME is a good candidate to be use as base fluid in drilling operation. Methyl Ester Palm Oil is also a good candidate of base fluid compare to Jatropha Oil FAME. That is why it has better rheology properties. Methyl Ester Palm Oil also is widely used in food industry and it may cause problem in food industry if it being use widely in oil and gas industry. Therefore, Methyl Ester Palm Oil can't be a suitable candidate for drilling operation.

The author doubts that there might be error during the experiment for Jatropha Oil FAME. There might be error during the conversion process of Crude Jatropha Oil to Jatropha Oil FAME. The storage of Crude Jatropha Oil might not be proper and incomplete processes been done during the conversion experiment.

In conclusion, the recommendation for this project by the author is to have a clean and proper procedure of conversion of Jatropha Oil into Jatropha Oil FAME to have a better rheology test result to ensure that Jatropha Oil FAME can be a better candidate to replace diesel oil in drilling operation.

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APPENDIX

Emery Oleochemicals (M) Sdn Bhd (63812-D)
Formerly known as Cognis Oleochemicals (M) Sdn Bhd

Emery Oleochemicals

Mailing address:
P O Box 122
42007 Telok Panglima Garang
Selangor, Malaysia
Telephone (60) 3-31260606
Telefax (60) 3-31226092
www.emeryoleo.com

CERTIFICATE OF ANALYSIS

Page 1 of 1

PRODUCT	:	Methyl Ester Palm Oil
DATE	:	Feb 01 2011
BATCH NUMBER	:	M1030706w
SAMPLE DETAILS	:	Representative sample of 5kg

TEST	RESULT	SPEC	REF.METHOD
Acid value (mgKOH/g)	0.38	<= 1.00	ISO 660 (Part 5): 1996
Iodine value % I2	53.70	46.00 - 59.00	AOCS Tg 1a-64 : 1997
Colour (Lov. 5 1/4) red	0.5	<= 1.0	AOCS Cc 13e-92 : 1997
Colour (Lov. 5 1/4) yellow	6	<= 10.0	AOCS Cc 13e-92 : 1997
Water (Karl Fischer) %	0.06	<= 0.20	ISO 760 (Part 7) : 1978
Saponification value (mgKOH/g)	197	193 - 203	AOCS Tl 1a-64 : 1997
C 12	0.1	<= 1.0	ISO 5508:1990
C 14	2.9	<= 3.0	ISO 5508:1990
C 16	42.3	40.0 - 48.0	ISO 5508:1990
C 16-1	0.1	<= 1.0	ISO 5508:1990
C 18	4.4	2.0 - 7.0	ISO 5508:1990
C 18-1	41.6	35.0 - 44.0	ISO 5508:1990
C 18-2	10	7.0 - 15.0	ISO 5508:1990
C 18-3	0.1	<= 1.0	ISO 5508:1990
C 20	0.3	<= 1.0	ISO 5508:1990
DATE OF MANUFACTURE	Nov 05 2010		
EXPIRY DATE	Nov 05 2012		

We hereby certify the analysis of the sample as shown above.

BATCH QTY: 5kg

[illegible signature]

CHANG CHEE SIEW
QC MANAGER [illegible]

[illegible]

[illegible]