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Evaluation of N-Acylglycerols for use in Drilling Fluids

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Abstract**-**Drilling fluids are used in oil and gas industry, which implies formulations with nonrenewable compounds like diesel. It has high environmental and health impacts but until now there is no much proposes to mitigate this effect with similar ecological products. The evaluation of different batches of n-acylglycerols was performed for use as raw material in the production of drilling fluids to which they were assessed its rheological behavior with respect to temperature increase, and API standard RP 13B. Being the sample M2 with 2% initial solids and 37 cP of viscosity, showing the fluid-like behavior to be approved.

Keywords*- Fluid, viscosity, behavior*

I. INTRODUCTION

In this century, mankind faces a serious problem because of increase in global energy demand, depletion of fossil fuels, increase in services to obtain oil but decrease in oil prices and the environmental problems caused by greenhouse gases and local air pollution. This situation urgently demands alternative energy sources. A promising alternative in recent years has been biodiesel. [1]

Biodiesel is mono-alkyl esters of short chain alcohols, ethanol and methanol usually with long chain fatty acids obtained from renewable biomass. [1]. This bioenergetic is originated from a transesterification reaction that produces a mixture of n-acylglycerols. N-acylglycerols in pure form are viscous liquids, colorless and sweet. Their solvent properties are similar to water: insoluble in hydrocarbons, long-chain alcohols and halogenated solvents. [2]

The most frequent uses of the compounds in pure form glycerides are in the pharmaceutical or food industry (as an emulsifier or conservative). In the chemical industry is used for the production of polyols, additives for improving the compressive strength of the cement, plasticizer, humectant, coatings, paints, plasticizers, even as precursor in the preparation of trinitroglycerine. [3] [4] [5]

As a result of the growing market for biodiesel, it produced an inevitable increase in the supply of n-acylglycerols. However, the demand for traditional applications does not increase in the same way. Thus there has been a glut of glycerol causing the decline in value. [2] It is therefore necessary to find new ways to transform glycerol into products with high added value so that there can be a profitable exit of excess glycerol generated. [6]

A drilling fluid is a liquid or gas flowing through the drill string to the drill bit and returns to the surface through the annular space is used during construction operations of oil wells, its rheological properties should be assessed and controlled.

Different applications for n-acylglycerols, which are marketed according to their degrees of quality, are now known, but there are still no definite proposals for the use of n-acylglycerols obtained as a byproduct of biodiesel, because to achieve high purity should undergo a process of distillation and bleaching; this increasing cost. [2]

In this work we study one of the new applications in drilling fluids which consist in biodiesel mixed in different proportions with fresh or salt water, viscosifying agents, densifying products, foaming among other additives.

These fluids show an improved lubrication compared with water based fluids and less environmental impact than these base oil, this because glycerin is completely biodegradable. [7] The drilling fluids based glycols stabilize highly active shales, and have the property nonstick drill cuttings and lower water absorption. [8] [9]

The objective of this project is to evaluate different lots of product of the transesterification reaction, for use as main base in the formulation of a drilling fluid previously developed with glycols and called Biogel G; which exhibits stable rheological properties to 60 ° C and then begin to decrease slightly. [10] This as an alternative to the use of this resource. This comparison will be made based on the rheological properties of drilling fluid.

II. METHOD

Separate samples of n-acylglycerols obtained from different transesterification processes are identified as M1, M2, M3, M4, M5 and M6; are subjected to a process of evaporation at 80-83

°C to remove alcohol. Initial and final volumes are measured to determine the volume evaporated.

They were also carried out density determinations according to API standard RP 13B, Brookfield viscosity with DU-II + PRO and solids and liquids; such tests at 25 ° C.

Original formulation of Biogel G was changed: the polyols are replaced by samples 1-6 n-acylgliecerols, thus obtaining six different fluids and they are left to stand for 8 hours.

Determinations are made relating to drilling fluids: content of solids and liquids; density and filtration at 25 ° C; viscosity and gel strength with direct indication viscometer at 25 °C, 50 °C and 65.5 °C. [11] [12]

TABLE I. FORMULATION BIOGEL G

Reagent	**Quantity**
Seawater	324 ml
Treated wáter	139 ml
Polyols	464 ml
Bentonite	15.9 g
PolyGeo	15.25 g
Calcium carbonate	16.2 g

Table 1 shows the original composition of Biogel G, where can see the amounts of each component.

III. RESULTS AND DISCUSSION

In table 2 results of the samples testing are showed, it was observed that sample M3 has the highest density and the sample M2, M4 and M6 are less dense. The evaporated volume of alcohol is of 17 to 20%; it is the samples M1, M3, M5, M6 the higher alcohol content and the minor M4. The most notable difference between the samples is the solids content ranging from 1 to 10%, without knowing the nature of them.

TABLE II. RESULTS PERFORMED ON SAMPLES OF N-ACYLGLYCEROLS

Samples of n-acylglycerols	Liquids	Solids	Density	Viscosity cP	Volume evaporated
M1	98%	2%	1.08	35	20
M2	98%	2%	1.07	37	19
M3	99%	1%	1.09	59	20
M4	90%	10%	1.07	67	17
M5	92%	8%	1.08	75	20
M6	90%	10%	1.07	79	20

Table 3 shows the results of some tests performed to the fluids developed in this work. It was observed that densities are equal, the fluid M5 differs only in 0.01 g / cm^3.The fluid M4 showed the higher solids and the fluid M5 the lower.

TABLE III. RESULTS FOR THE DIFFERENT FLUIDS GENERATED.

n-acylglycerols base fluids	Liquids	Solid	Density
M1	96%	4%	1.07
M2	97%	3%	1.07
M3	90%	10%	1.07
M4	89%	11%	1.07
M5	98%	2%	1.08
M6	96%	4%	1.07

Shows and explain the rheological behavior of different fluids made with the six samples. The apparent and plastic viscosity, yield point and gels 10s and 10 min were analyzed; at different temperatures.

It is important to consider these parameters as they depend on the solids containing fluid. Low plastic viscosity indicates a high fluidity allowing quickly drill therefore low plastic viscosity with a high yield point enables higher cleaning hole with a high rate of penetration.

Graph 1 shows the behavior of the apparent viscosity of the different fluids generated. It is noted that the samples values decrease slightly with increasing temperature in the test, except sample 6 having a decrease and then an increase in value.

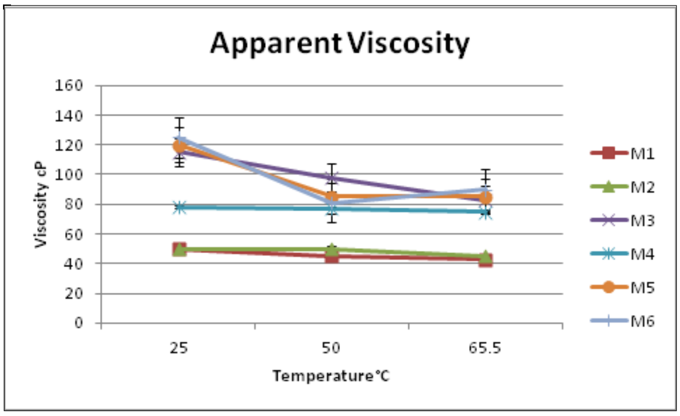

Figure 1. Behavior of the apparent viscosity of the different fluids generated.

Graph 2 shows the behavior of the plastic viscosity of the different fluids generated. It is noted that the samples values decrease as the temperature increases in the test, except sample M5 that first presents a decrease and then an increase in value.

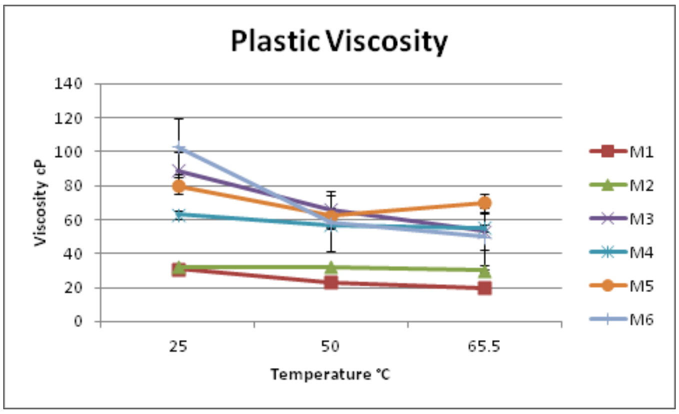

Figure 2. Behavior of the plastic viscosity of the different fluids generated.

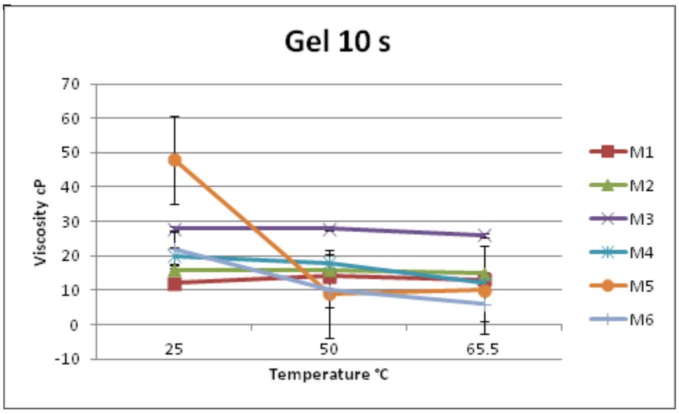

Figure 4. Behavior of the gels to 10 seconds

Graph 3 shows the behavior of the yield point of different fluids generated. It is noted that the sample M2 remains constant in its values, in the samples M1, M4 and M6 their values increase with increasing temperature in the test, in the sample 5 their values decrease with increasing temperature, the sample M3 shows a slight increase in its value and then decreases.

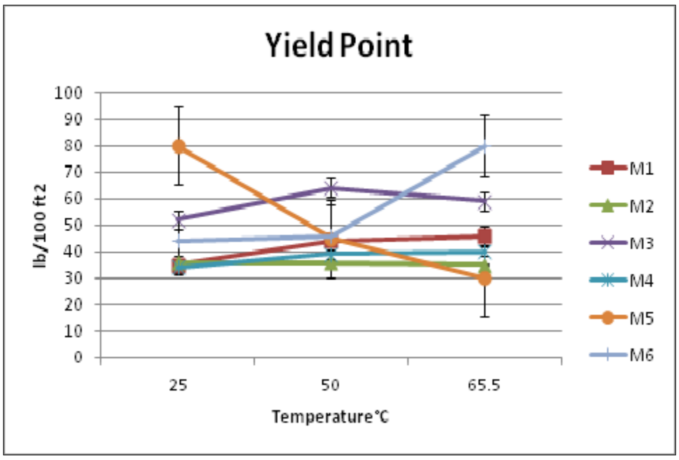

Figure 3. Behavior of the yield point of the different fluids generated.

Graph 4 shows the behavior of the gels to the 10s of the generated fluids. It shows that samples M1, M2 and M3 are kept almost constant values, the samples M4, M5 and M6 their values decrease with increasing temperature.

Graph 5 shows the behavior of the gels to the 10 min of the generated fluids. It shows that samples M1, M2 and M3 are kept constant at 50 ° C and begin to decrease by increasing the temperature. The samples M4, M5 and M6 their values decrease with increasing temperature.

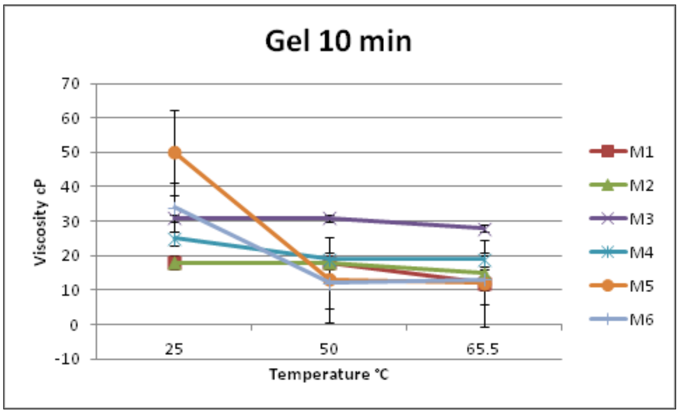

Figure 5. Behavior of the gels to 10 minutes

Having analyzed and compared each rheological behavior at different temperatures of the six fluids; it was observed that the most stable behavior the present samples M2 and M5, however the only one that is stable up to 60 ° as the fluid is to be performed is sample M2, which starts showing a slight decrease up the 65.5 ° C. The sample M2 initially had a density of 1.07 and 37 cP viscosity.

IV. CONCLUSIONS

Sample M2 corresponding to n-acylglycerol obtained from a transesterification process is the one with better behavior rheological and very similar to the Biogel G that is intended to match.

This sample of n-acylglycerol presents only a 2% initial solids and viscosity 37 cP. The fluid prepared with M2 is 97%

water, 5% solids and density of 1.07 g / cm^3. Apparent viscosity 50 cP, 32 cP plastic viscosity, yield point 36 lb / 100 ft^2 and gels 16/18 lb / 100 ft^2 analyzed at 25 ° C.

The fluid has good values of plastic viscosity and yield point. The viscosity and gel remain low compared to M3- M6 samples having higher values making it difficult to drill.

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