

Analysis of Corn Starch Additives against Filtration Loss and Drilling Mud Rheology

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Abstract—One of the problems that is very avoided when oil and gas drilling operations is the filtration loss. The usual and often used additive to overcome this problem is the Carboxymethyl Cellulose (CMC) where the CMC is relatively expensive, so research needs to be done using alternative materials or natural ingredients to make it more economical. The alternative material used in this study was corn starch because of its polymer composition and its function fluid loss control and viscosifier. This study was conducted to determine the effect of starch on filtration loss and rheological drilling mud by determining the filtrate volume, mud cake thickness, viscosity, plastic viscosity, gel strength. Corn starch is made by smoothing and filtering corn with gauze, after that it is dried in the sun to dry and do sieve analysis with a size of 200 mesh. Then corn starch with a composition of 2, 4, 6, 8 and 10 grams mixed with standard mud. Filtration loss testing is done using an Low Pressure Low Temperature (LPLT). Rheological tests such as viscosity use marsh funnel devices while plastic viscosity and gel strength use the Fann VG Meter tool. The results showed that the filtration loss obtained was 14,7 – 12,7 ml, mud cake thickness of 1,5 – 1,1 mm, viscosity of 42,38 – 60,02 cp, plastic viscosity of 4 - 11 cp, gel strength of 0,2 – 0,54 (lb / 100 ft²). Mass addition which will reduce filtration loss and mud cake and vice versa with the addition of mass causes increased values of viscosity, plastic viscosity and gel strength.

Keywords—*Corn starch, Drilling Mud, Filtration Loss, Mud cake, Rheology*

I. INTRODUCTION

Partial loss of the liquid phase (filtrate) drilling mud into formation (filtration loss) is an undesirable and detrimental thing in carrying out drilling operations. The additive used to overcome the problem of filtration loss is the Carboxymethyl Cellulose (CMC) industry. This additive is a type of chemical that is quite expensive so it needs to be innovated to find a more economical alternative. One alternative substitute is corn starch because starch can be

functioned as a polymer and muddy drilling starch functions for fluid loss control and viscosifier. Research on starch carried out in the petroleum world includes research by Amanullah and Yu, where corn starch is considered to have high potential as an additive for drilling wells that have a low temperature due to high biodegradability. In addition, there are also studies that use corn starch as an additive to control fluid loss in drilling mud using different temperatures ranging from 170 to 200 ° F.

In recent years Indonesia's corn production has increased by 5,21% per year, in 2016 corn production increased by 23,58 million tons and in 2017 25,85 million tons of corn production increased to 26,69 million tons. In this experimental study, the high production of Indonesian corn made the reason for choosing corn starch as a natural ingredient and alternative media in reducing loss of filtration. This study covers the physical properties of drilling mud such as viscosity, gel strength, plastic viscosity, and filtration loss, mud cake. The effect of adding corn starch additives to drilling mud will be a preliminary study to determine the ability of corn starch in replacing CMC industries in overcoming filtration loss. In addition, regression analysis and correlation of the results of the research using the Minitab software were also conducted to determine the correlation between the parameters assessed for the results of the study.

II. RESEARCH METHODOLOGY

The initial step of this research is to prepare equipment and materials. The material used in this study is corn starch. Making corn starch was done by smoothing corn kernels using a blender with a ratio of 1 kg of corn and 500 ml of water. The mashed corn seeds were filtered using gauze until the pulp and filtrate are obtained. The pulp obtained was extracted again with the addition of water (750 gram pulp, 300 ml of water). The starch filtrate from corn seeds obtained from two filters was deposited for 24 hours to precipitate starch, after 24 hours two layers were obtained, namely starch deposition and sedimentation water. The

water from the sediments was discharged to obtain wet starch deposits. Then the starch deposition was washed with water so that the wash water was clear and deposited again so that the starch was clean. Then the starch was dried under the sunlight for two days until the starch was completely dry and then mashed by using mortar until the starch looks very smooth.

The next step was making drilling mud samples by mixing bentonite, water additives and corn starch using a mixer according to API Specification 13A, 2015. The drilling mud samples used in this study consisted of 6 drilling samples. The composition of each sample is in table 1 below.

Table 1. Drilling mud sample

Sample Name	Mud composition
Sample 1	Standard Mud (LS)
Sample 2	SM + 2 Gram of Corn Starch
Sample 3	SM + 4 Gram of Corn Starch
Sample 4	SM + 6 Gram of Corn Starch
Sample 5	SM + 8 Gram of Corn Starch
Sample 6	SM+ 10 Gram of Corn Starch

Filtration loss and mud cake were tested using a low pressure low temperature device, while drilling mud rheology such as plastic viscosity, yield point and was determined by Fann VG meter while viscosity was determined by marsh funnel. The results obtained from the experimental test will be analyzed regression and the correlation using Minitab software.

III. RESULTS AND DISCUSSION

The results of research obtained after testing are as follows:

1.1. Filtration Loss and Mud Cake

The results of research on filtration loss and mud cake additive of corn starch can be seen in the figures below:

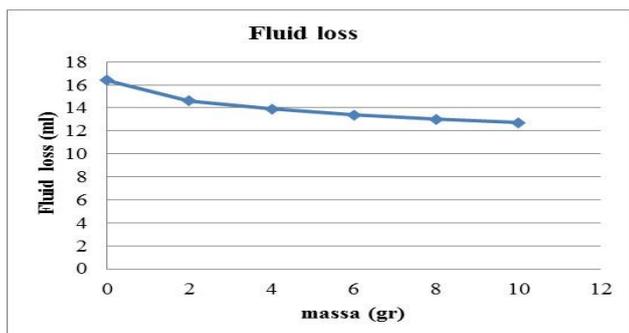


Figure 1. Effect of corn starch on drilling mud filtration loss

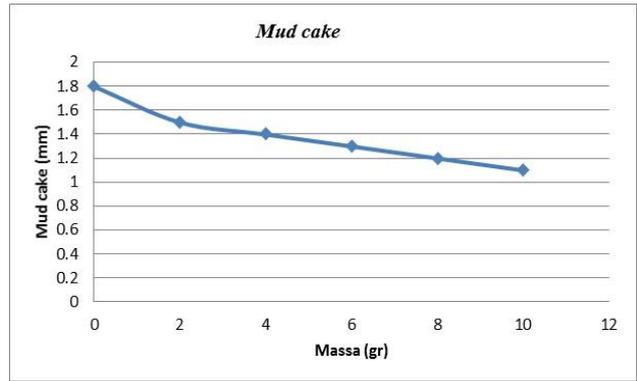


Figure 2. Effect of Corn Starch on the Value of Mud Cake Drilling Mud

Based on Figure 1, the higher the addition of mass, the lower the value of the filtrate volume. Filtration volume reduction caused by corn starch is absorbing water in drilling mud. The higher the corn starch content, the higher the absorption capacity of the liquid, so that the filtrate volume gets lower.

Based on specifications (API Specification 13A, 2015) for a maximum standard filtrate volume of 15 ml. And it can be seen that corn starch added to the drilling mud gets the result of filtrate volume below 15 ml so it is categorized as meeting API standards.

Based on Figure 2, it can be seen that the more mass of corn starch increases, the smaller the value of mud cake obtained. The mud cake thickness according to the standard is a thin mud cake so as not to be squashed by the drilling pipe and as a guard for the stability of the formation. According to the maximum thickness of mud cake is 3/8 inch or 9,525 mm, this is still in the good mud cake category.

1.2. Drilling Mud Rheology

The results of the viscosity, plastic viscosity and gel tests of standard drilling mud with additional corn starch additives are as follows:

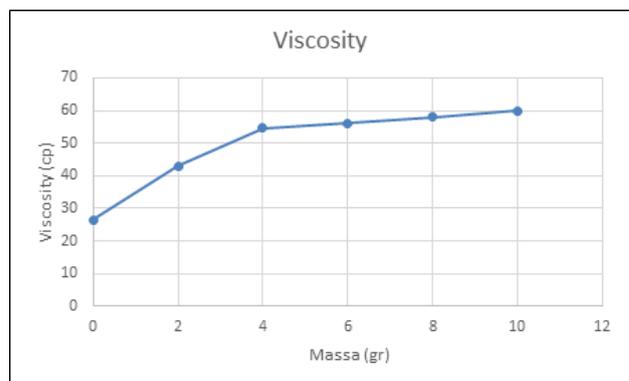


Figure 3. Effect of Corn Starch on the Viscosity of Drilling Mud

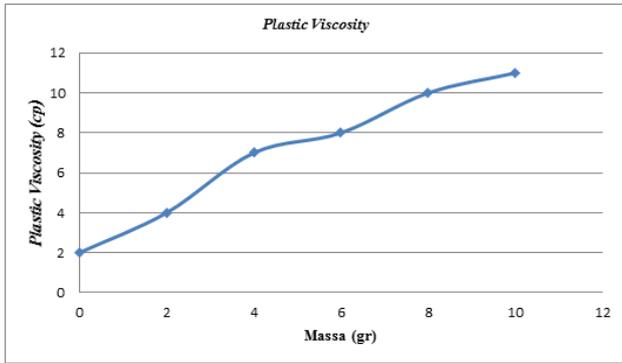


Figure 4. Effect of Corn Starch on Plastic Viscosity Drilling Mud

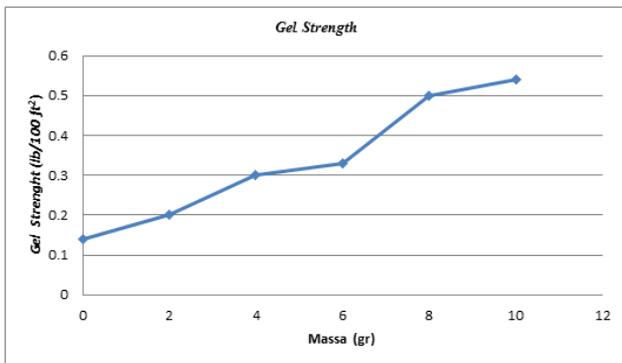


Figure 5. Effect of Corn Starch Additives on Drilling Mud Gel Strength

The results of the study for viscosity are shown in Figure 3 where mud with the addition of corn starch showed an increase in viscosity at each mass addition. The higher the mass used, the higher the viscosity obtained. This is because starch has a viscosifier.

The results of the study in Figure 4 show that the increasing mass of corn starch will increase the mud viscosity. However, the reduced viscosity needs to be considered because if the viscosity of the mud becomes too small, the removal of the drill cuttings will be less than perfect and can result in the drill cuttings left behind in the drill hole so that the drilling pipe circuit will be sandwiched.

The results of gel strength research are shown in Figure 5 where each mass addition, the value of the obtained gel strength increases because starch is a viscosifier.

1.3. Regression and Correlation between Filtration loss, Mud cake and rheology of drilling mud with the addition of corn starch additives to the masses

Regression results and correlation of filtration loss, mud cake and rheology drilling mud are as follows:

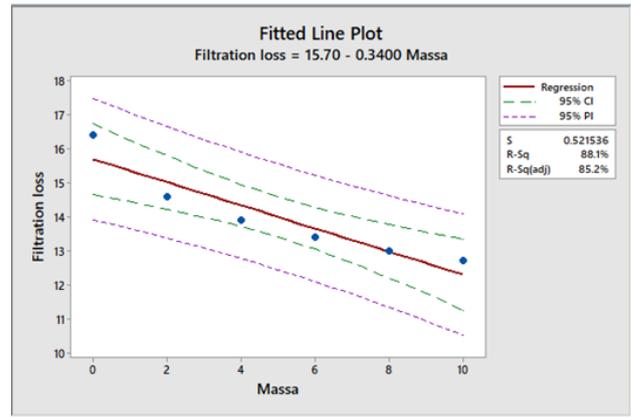


Figure 6. Fitted Line Plot Mass VS Filtration Loss

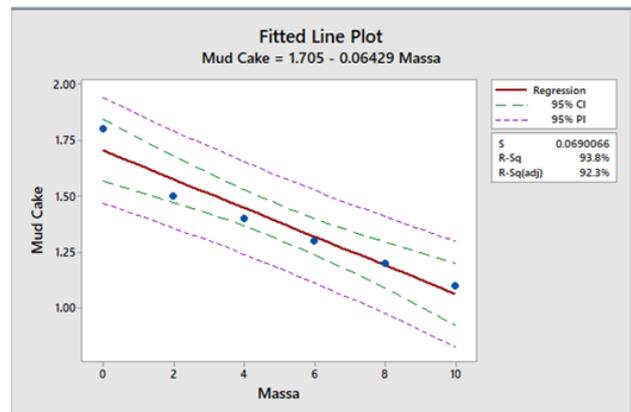


Figure 7. Fitted Mass Plot Line VS Mud Cake

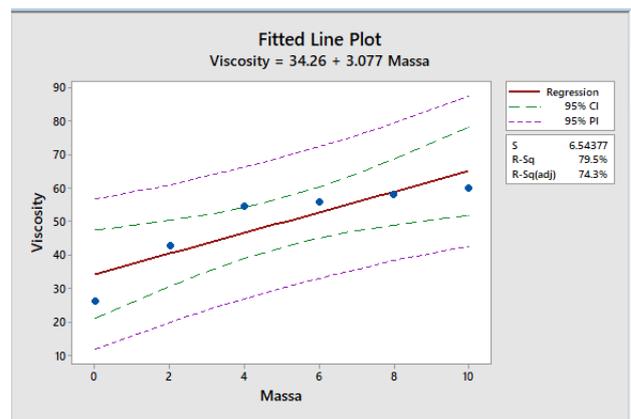


Figure 8. Fitted Mass Plot Line VS Viscosity

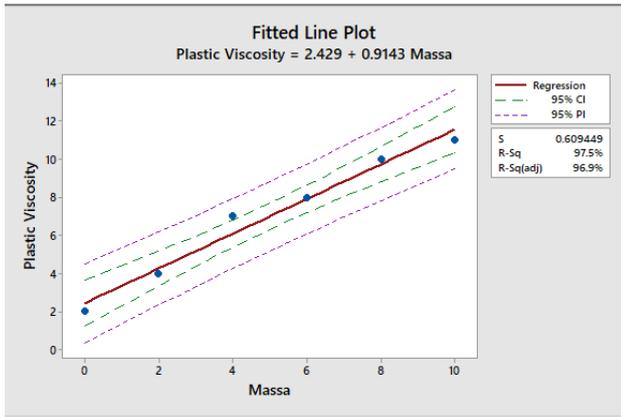


Figure 9 Fitted Mass Plot VS Plastic Viscosity

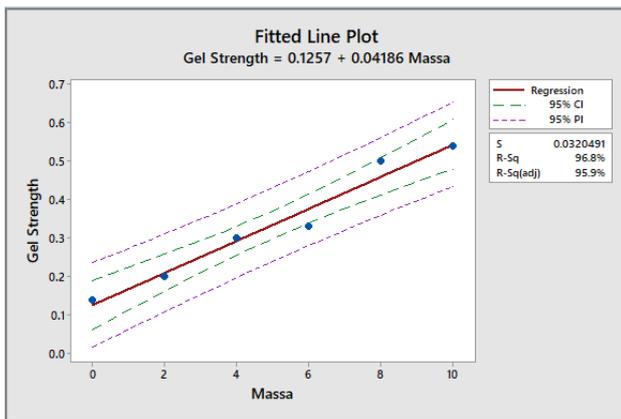


Figure 10. Fitted Line Mass Plots VS Gel Strength

Based on the analysis of variant output, the results obtained show that all the parameters tested, namely filtration loss, mud cake, viscosity, plastic viscosity and gel strength values obtained were smaller than the significant criterion values used by confidence levels so that the linear regression model met the linearity criteria.

For filtration loss The equation obtained is filtration loss = $15,70 - 0,3400 \text{ Mass}$ which means that if one mass increases it will affect the decrease in filtration loss by 0,3400. The correlation of mud cake is Mud Cake = $1,705 - 0,06429 \text{ Mass}$ The mass which means that if one mass increases one will affect the decrease in mud cake by 0,06429. While viscosity = $34,26 + 3,077 \text{ Mass}$ means an increase of 1 mass has a positive effect on viscosity of 3,077. Plastic viscosity = $2,429 + 0,9143 \text{ Mass}$ means an increase of 1 mass has a positive effect on viscosity of 0,9143 and gel strength = $0,1257 + 0,04186 \text{ Mass}$ means an increase of 1 mass has a positive effect on gel strength by 0,04186.

IV. CONCLUSION

Based on the results of the study it can be concluded that the increase in the addition of mass of corn starch affects the filtration loss and mud cake where the more mass addition of corn starch will cause the value of filtration loss and mud cake will be smaller. With the addition of 2-10 grams of corn starch obtained by filtration loss of 14,6-12,7 ml while

the mud cake is 1,5-1,1 mm. Furthermore, the addition of corn starch additives has an effect on the rheology of drilling runoff where the more addition of corn starch the greater the rheology value of the drilling mud. With the addition of 2-10 grams of corn starch, the viscosity value is 42,38-60,02 cp, the plastic viscosity is 4-11 cp and the gel strength is 0,2-0,54 (lb / 100 ft²). Finally, the correlation obtained for each parameter is filtration loss = $15,70 - 0,3400 \text{ Mass}$, Mud Cake = $1,705 - 0,06429 \text{ Mass}$, viscosity = $34,26 + 3,077 \text{ Mass}$, plastic viscosity = $2,429 + 0,9143 \text{ Mass}$ and gel strength = $0,1257 + 0,04186 \text{ Mass}$

ACKNOWLEDGMENT

Thanks to the Laboratory of Petroleum Drilling, Petroleum Engineering Department, Universitas Islam Riau which has given the opportunity and permission to conduct the experiments.

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