The Effect of Regeneration Time of Biomass Activated Carbon using Low Temperature to Reduce Filtration Loss in Water-based Drilling Fluid

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Abstract: Activated Carbon (AC) is a material that has porous structure and high surface area. If Activated Carbon has long been opened to the air and interacts to the air, The surface of activated carbon can bind molecules from the liquid or gas phases by van der waals force. It can affect decreasing the ability of activated carbon to reduce filtration loss in water-based drilling fluid. The research has been carried out to increase the effectiveness of AC as an additive in drilling process by thermal regeneration of activated carbon using low temperature. This research using several samples that have various regeneration time by heated at 200°C. The regeneration times are for 0 minute (AC non- regeneration process), 30 minutes, 60 minutes, 90 minutes, and 120 minutes. Scanning Electron Microscope (SEM) shows the surface morphology and porous size of the sample. The results show that filtration loss decrease with addition time respectively 15 ml, 13.7 ml, 13.1 ml, 12.6 ml, and 12.1 ml. Regeneration process of activated carbon is one of the ways to reuse damaged activated carbon that can control filtration loss until 12.1 ml.

1 INTRODUCTION

The Drilling fluid also called drilling mud is one of important process in the petroleum industry. Some of the petroleum industry faces challenges while drilling processing. One of the challenges is how to control filtration loss in drilling operations. The way to reduce filtration loss during the drilling process at water-based mud can be added additive material into drier mud to produce appropriate mud cake and can control fluid loss (Paydar and Ahmadi, 2017). Some materials used as additives to control filtration loss are bentonite, calcium carbonate, boehmite, nano metal oxide, nano zinc oxide, nano silica, carbon nanostructure (El-Diasty and Ragab,).

Activated Carbon (AC) is an amorphous solid that has high surface area and porous structure (Sivakumar et al., 2012). It is widely used to adsorb the molecules from liquid and gas phase. AC is used in many application due to unique porous characteristic such as water filter (Siong et al., 2013), nuclear (Foo and Hameed, 2012), pharmaceutical (ALKHATIB, 2016), agriculture (Nolan et al., 2015), gas and oil industry (Mahto, 2013). The adsorptive properties of the AC is needed to adsorb the adsorbate of the water-based drilling fluid. The surface area of AC is excess 1000 m2/g that result have powerful adsorptive properties (Tadda et al., 2016). The smaller size of AC increased the surface area. The quality of AC dependent on the raw materials and the activation process. AC is produced by various sources of carbonaceous material such as coconut shell, sawdust, agricultural activities waste (McLean, 2003).

The adsorptive properties of the activated carbon can decrease when activated carbon has been long opened in the air and interacts with the air. The surface of activated carbon which is porous structure adsorb organic component and any impurities. It is because of London dispersion force between molecules. London dispersion force is a type of Van der waals force that can bind activated carbon with molecules from liquid or gas phases. The Van der waals force is a weak electrostatic force between uncharged molecules. The force have short range and sensitive in interaction between the carbon surface and the adsorbate molecules. The adsorption capacity of activated carbon is finite. If the porous surface of activated carbon adsorb any impurities from the air,

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it can affect activated carbon loses its adsorption efficiency.

Regeneration also called reactivation is a process to clean the pores of activated carbon from organic component or any impurities by reheated process. Regeneration process of activated carbon selectively can remove adsorbed organics from the pores of activated carbon (McLaughlin, 2005).

Some methods of regeneration of activated carbon are wet oxidation, supercritical fluid, classical solvent regeneration low-temperature regeneration using microwave (Çalışkan et al., 2012), but on an industrial scale only thermal regeneration is used (Sabio et al., 2004).

Thermal regeneration is a method to destroy the adsorbed component from surface of activated carbon using thermal process. It is desirable to restore the adsorptive capacity of the carbon and return the carbon to the formerly structure.

The objective of this research is to investigate the effect of thermal regeneration of biomass activated carbon using low temperature to control filtration loss in the water-based drilling fluid.

2 EXPERIMENTAL

2.1 Materials

The raw material of Activated carbon in this research is the oil palm shell from PT. Tunas Baru Lampung, Kecamatan Beringin, Kabupaten Pelalawan, Riau. Physical method used to produce activated carbon . There are Three general processes to produce activated carbon. That are dehydration of water, carbonization, and activation of the carbon.

2.1.1 Dehydration Process

Oil palm shell was prepared and has been cleaned. In this process, oil palm shell was dried in an oven at 100° C for 1 hour.

2.1.2 Carbonization Process

Carbonization is a process of combustion of organic material in the oil palm shell. This phase decomposes cellulose into carbon by heated in an oven at 300° C for 1 hour. The objection of carbonization is to disappear volatile compounds in the noncarbon elements, hydrogen, and oxygen form. After that, the carbon mashed to size $\leqslant$ 300 mesh.

2.1.3 Activation Process

Activation is a process of breaking the carbon chain from the compound organic by heated in a furnace at 1000° C for 1 hour.

2.2 Thermal Regeneration of Activated Carbon

The low temperature of the thermal regeneration with various time was carried out. The temperature used in regeneration is 200° C. Various time of regeneration are 0 minutes (non-regeneration process), 30 minutes, 60 minutes, 90 minutes, and 120 minutes. In the thermal regeneration process, the sample was heated by the oven for each time.

3 RESULT AND DISCUSSION

The focus study is to analyse the effect of regeneration time of activated carbon in controlling filtration loss. Volume filtrate test was carried out using a filter press set low-pressure low temperature (LPLT) for 30 minutes. The test result shows at table 1.

Table 1: Volume filtrate of the water-based drilling fluid with various time of the regeneration.

No	Sample	Regeneration Time of AC (Minute)	Volume Filtrate (ml)
1	Sample 1	0	15
2	Sample 2	30	13.7
3	Sample 3	60	13.1
4	Sample 4	90	12.6
5	Sample 5	120	12.1

Sample 1 is a non-regeneration of activated carbon. As can be seen the highest filtration loss is in non-regeneration activated carbon. The effect of regeneration process is reducing filtration loss in drilling-fluid. Generally, fluid loss decreases respectively with increasing regeneration time. Besed on table 1, the best time for regeneration process is 120 minutes that can control filtration loss until 12.1 ml. In this condition, adsorbed contaminants or impurities removed from porous of activated carbon.

The Grafik shows that cake thickness decrease respectively with addition regeneration time. The highest cake thickness is in non-regeneration activated carbon. This proves that regeneration of activated carbon can decrease cake thickness in drilling fluid.

The adsorption properties of activated carbon depend on its porous structure and pore size distribution

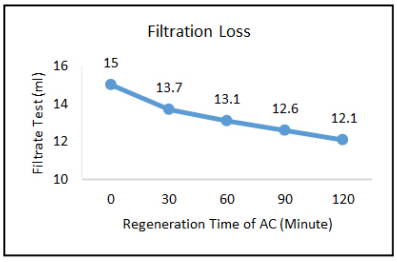

Figure 1: Grafik the effect of regeneration time to filtration loss

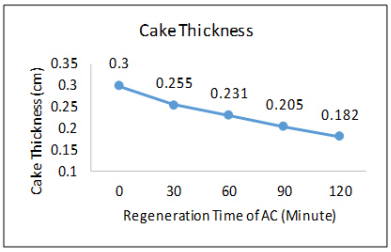

Figure 2: Grafik of the effect of regeneration time to cake thickness

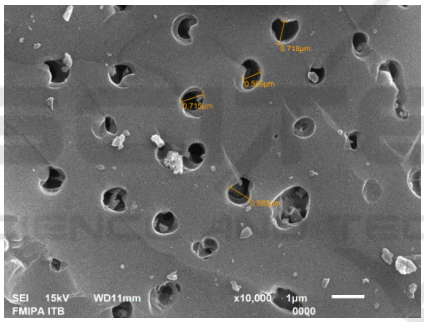

Figure 3: SEM image of AC with 0 minute regeneration time

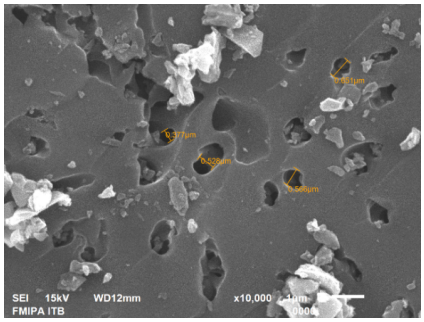

Figure 4: SEM image of AC with regeneration time 120 minute

(Guo and Du, 2012). Figure 3 and figure 4 shows the SEM image of activated carbon non-regeneration and activated carbon with regeneration for 120 minutes. The result showed that the average of pore size is 0.67 μm non regeneration activated carbon and 0.53 μm with regeneration process for 120 minutes. The activated carbon adsorption is better with more developed small pore size with large surface area than large pore size with small surface area.

4 CONCLUSION

Activated carbon is an additive material that can control filtration loss in drilling fluid. However, activated carbon should be regenerated when activated carbon is exhausted by impurities in the air. In this research, the exhaust activated carbon (activated carbon has been polluted by air) has been restored to the formerly adsorption capacity by thermal regeneration. The non-regeneration activated carbon has more filtration loss than activated carbon with regeneration process. Filtration loss and cake thickness reduce significantly with increasing regeneration time of activated carbon. Activated carbon with regeneration time 120 minutes is the best material to decrease filtration loss that can reduce filtration loss until 12.1 ml.

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