

EVALUATION ON THE PERFORMANCE OF PALM OIL FUEL ASH  
(POFA) AS FLUID LOSS REDUCING AGENT

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To my beloved family

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## ABSTRACT

An attempt to solve the fluid loss problem, numerous additives was introduced in the industry as a fluid loss reducing agent. Thus, this study was conducted to evaluate the effectiveness of the new selected additives to minimize the filtrate loss. Malaysia is the second largest producer of palm oil industry in the world, the production of palm oil caused country to face problems in providing the land for disposal of this industries by-product which has been known as Palm Oil Feul Ash (POFA). Therefore, an alternative was made to eradicate the land disposal by the use of POFA as an additive in water base mud. Following to the American Petroleum Institute (API) the drilling mud was prepared with different concentration of an additives which are 0.5g, 1.0g and 1.5g respectively. The purpose was to study several parameter of rheological properties which are plastic viscosity, yield point, gel strength, filtrate loss and mud cake thickness. The rheological properties was done in both ambient and high pressure high temperature (HPHT). The laboratory experiment was conducted and shows silica oxide was dominant chemical composition of POFA. Subsequently, the rate of fluid loss attains from the mud sample was compared with the commercial fluid loss reducing agent, Hydro Pac-R with average of 13.3ml Basic Mud, 13.7ml POFA and 8.7ml POFA + Hydro Pac-R at ambient while at HPHT 31.6ml Basic Mud, 44.7ml POFA, 32ml POFA + Hydro Pac-R. As a result, POFA seems to improve the filtrate loss by the used of combination concentration formulation between POFA and Hydro Pac-R equally. However, it has been notified that after aging condition all the sample reduced its rheological performance

## ABSTRAK

Bagi mengatasinya masalah kehilangan bendalir, banyak bahan tambahan diperkenalkan dalam industri sebagai ejen mengurangkan kehilangan bendalir. Oleh itu, projek ini dijalankan untuk menilai keberkesanan bahan tambahan terpilih untuk meminimumkan kehilangan bendalir. Malaysia sebagai pengeluar minyak sawit terbesar kedua di dunia, pengeluaran minyak sawit menyebabkan negara menghadapi masalah dalam menyediakan tanah untuk pelupusan produk sampingan yang dikenali sebagai Palm Oil Feul Ash (POFA). Oleh itu, alternatif telah dibuat untuk membasmi pelupusan tanah dengan penggunaan POFA sebagai bahan tambahan dalam lumpur asas air. Dengan berpandukan Institut Petroleum Amerika (API), lumpur penggerudian telah disediakan dengan kepekatan yang berbeza iaitu 0.5g, 1.0g dan 1.5g. Tujuannya untuk mengkaji beberapa parameter sifat reologi iaitu kelikatan plastik, titik hasil, kekuatan gel, kehilangan bendalir dan ketebalan lumpur. Kajian rheologi dilakukan di kedua keadaan tekanan suhu rendah dan tinggi untuk memerhatikan aliran kehilangan bendalir. Disamping itu, kajian makmal dijalankan dan menunjukkan silika oksida adalah komposisi kimia POFA yang dominan. Selepas itu, kadar kehilangan cecair yang diperoleh daripada sampel lumpur dibandingkan dengan ejen mengurangkan kehilangan bendalir komersil, Hydro Pac-R dengan purata 13.3ml lumpur asas, 13.7ml POFA dan 8.7ml POFA + Hydro Pac-R pada suhu biasa manakala pada suhu tinggi 31.6ml lumpur asas, 44.7ml POFA, 32ml POFA + Hydro Pac-R. Hasilnya, POFA nampaknya meningkatkan kehilangan penapis dengan menggunakan formulasi kombinasi antara POFA dan Hydro Pac-R secara sama jumlahnya. Walau bagaimanapun, telah dimaklumkan bahawa selepas keadaan penuaan semua sampel mengurangkan prestasi rheologi.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Background**

Drilling is an operation to access the underground deposits of gases and liquids hydrocarbon. There are many factors to be consider before, during and after drilling operation such as target formation, pressure, temperature, well depth as well as mud design. Mud design of a drilling fluids is important to be noted with the many considerable condition of the well. This is because the fluid use may perform many functions. These include lubricating the drill and apply hydrostatic pressure in the well bore. Mainly, the purpose is to ensure the safety of the well and reduce the fluid loss across the permeable formations by forming filter cake sticking to wall.

Fluid loss into the formation can be a serious problem especially in the deep drilling operation. When the fluid loss has been identified the drilling engineer has to make a decision either the rate of fluid loss can be tolerated without changing the mud type or the mud has to be treated with large quantities of plunging materials. Therefore, the fluid loss controlling has become major aspect to prevent any unsafe well condition to the surrounding environment of the related area. This is essential in order to avoid the formation damage and loss of expensive brines solution in high permeability unconsolidated formation (Blauch et al, 1989).

This study has been conducted to evaluate the new additives as a fluid loss agent. Since Malaysia was the largest contributor to the palm oil industry, the productions continue to boost hence increase the wasting material. As a result, Palm Oil Fuel Ash (POFA) is a

byproduct obtained from the burning of palm oil fruits both from palm oil husk and shell. Due to the limited utilization of POFA, it has to be disposed as landfill materials, leading to potential future environmental problem (Chindaprasirt et al, 2007). The dominant composition of POFA is silica. The previous researchers found that POFA had pozzolanic properties and could be used as a replacement of cement in concrete that being confirmed by physical and chemical analysis conducted (Awal & Hussin, 1993). The pozzolan fines particle can react with calcium hydroxide to provide the cementing property. Based on Awal & Hussin (2011) the more fine the POFA particle will increase the concrete strength. In practice, when the POFA particle is blend with drilling mud it will strengthen the fluids as well as increase the viscosity resulted in less fluid loss into the formation and less formation damage.

In order to mitigate the problem arise, the POFA has been selected as a material in this study to determine the rate of fluid loss compared with the Polyanionic Cellulose (Hydro Pac-R). Hydro Pac-R is the industrial polymer used to control the fluid loss into the formation as well as provide no damage to the formation. Since this project is quite new in the drilling industry hence very limited research been done. Nevertheless, the performance of POFA as fluid loss agent is still remains undiscovered and yet to be studied.

## **1.2 Problem Statement**

Malaysian has been recognized as of one the largest Asia palm oil producer and exporter in world palm oil industry. As a result, the productions of palm oil keep increasing tremendously to fulfill the market demands. In consequent to the growth of palm oil production, the by-product of this industry which is POFA has been treated as wasting material or disposal wastes that are not being recycled and reused. According to Zamri (2012), every one million tones production of palm oil is equal to 0.8 million tonnes of disposal waste. In solving this matter, some of the studies have been conducted to counter the waste problems. Thus, this study was initiated to investigate the possibility of the wasting material as additives in drilling fluids to act as fluid loss agent. In addition, it is much cheaper compare to another type of fluid loss agent available in the market. One of the commercial fluid loss agent in the market that has been used in drilling operation is Hydro Pac-R due to its ability to increase the viscosity as well as provide minimum damaged to the formation. Therefore, the performance

of POFA and Hydro Pac-R will be determine and compare to identify the possibility of POFA as a fluid loss agent.

### **1.3 Objectives**

In this study, POFA and Hydro Pac-R has been selected as a material for fluid loss agents which will be verify by mix up as additives in WBM drilling fluids. Thus, the main objectives intended were:

1. To study the rheological properties of POFA and Hydro Pac-R in WBM at ambient and high pressure high pressure (HPHT) condition.
2. To evaluate the performance of POFA and Hydro Pac-R as fluid loss reducing agent in WBM.

### **1.4 Scopes of Study**

The scope of this study is focus on determining the optimum rate of fluid losses between POFA and Hydro Pac-R. The origin of POFA is from Segamat Palm Oil Factory while Hydro Pac-R is from Universiti Teknologi Malaysia (UTM) Drilling Laboratory.

There are several parameters which being concerned in this study such as:

- (a) Conducting analytical evaluation based on the laboratory analysis which includes X-Ray Diffraction Method (XRD), Scanning Electron Microscopy (SEM) and Energy Dispersive X-Ray (EDX)
- (b) Preparing the various concentration of POFA and Hydro Pac-R with 0.5g, 1.0g and 1.5g respectively.



- (c) Determining the rheological properties, mud cake thickness and fluid loss of drilling mud before aging with constant ambient pressure and temperature of 75 °F and 100psi.
- (d) Determining the rheological properties, mud cake thickness and fluid loss of drilling mud after aging with constant high pressure and temperature of 250 °F and 500psi.
- (e) Evaluating the effectiveness and performance of POFA and Hydro Pac-R in WBM as fluid loss control.

### **1.5 Significant of Study**

Fluid loss in the formation during drilling is one of the subjects that should be taking into consideration during planning for any completion operation. If this aspect is not well measure, it may contribute to the formation damage and cause the difficulties to the production stage. Hence, this study was conducted to investigate the performance and evaluate the possibility of POFA before and after aging to minimize the fluid loss in the formation. Applying POFA and Hydro Pac-R as a fluid loss reducing agent is feasible where it is require less cost and restriction. Positive results from this study can help to commercialize POFA as a new additive for fluid loss control. Thus, it well reduce the abundant amount of by-product created by palm oil as well as reduce the drilling cost. On the other hand, this study is realistic to carry out by considering the capability of master student and time constraint with the assistance of supervisor. The analytical evaluation can be done by the accessibility to journals, books and other sources.

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