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Analysis of Rheological Properties of Drilling Fluid Formulated with Wheat Husk and Groundnut Husk

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Abstract **- Drilling fluid is an intricate system of fluid that involves a variety of additives. These additives are used to improve or manage the drilling mud's rheological properties. Because of the significant environmental and safety concerns, several modifications have been made to drilling fluids and its additives. Curbing the quantity of harmful compounds in drilling fluid can contribute to mitigate the environmental effect. In order to develop an efficient mud, it is critical to have a thorough understanding of all the characteristics of drilling fluids. (Dagde et al., 2014)**

Drilling muds are made with a variety of additives; however, the focus of this study is on the changes in rheological properties of Bentonite Mud with addition of Wheat husk and Ground nut husk at different concentrations. The objective is to understand how these additives affect drilling fluid parameters such filtration rate, filter cake thickness, pH, and viscosity in order to improve drilling performance.

Wheat and groundnut husk are typically found as a by-product of flour mills and oil plants, and they are generated in large amounts and burned as agricultural trash. The introduction of wheat and groundnut husk powder to the drilling fluid improves rheological properties, reduces filtration loss while also being environmentally benign, cost-effective, and thermally stable. Wheat and groundnut husk have shown to be a sustainable method for keeping the environment healthy since they are biodegradable, easily disposable, and have minimal impact on the ecosystem. (Yaseer et al., 2020)

Key Words: ***Barmer Bentonite, Wheat husk, Groundnut husk, Rheological properties***

1.INTRODUCTION

Drilling is an important part of the process of extracting hydrocarbons, and to keep the drilling process smooth and minimize reservoir formation damage; various types of drilling fluid additives are added to the facilitate the process of drilling. Bentonite is generally used in formulating drilling mud and Barmer is the largest manufacturer of Bentonite powder in Rajasthan. In this study we have used Barmer Bentonite due to its (low hydraulic conductivity, expansive behaviour in the presence of water, high specific surface area and contaminant retention properties) and the aim is to analyse how different concentrations of Wheat husk and Ground nut husk affect the rheological properties such as Viscosity, Yield Point, and Gel Strength etc (Muhsan, januray2017) . The cellulose present in Wheat Husk and Groundnut Husk affects the rheological characteristics and influences the overall performance of the drilling mud. The rheological properties taken into account are apparent viscosity, plastic viscosity, yield point, Gel strength (10 sec gel, 10 min gel) of the formulated mud. Rheology is the study of the manner in which materials respond to applied stress or strain (Dagde et al., 2014). Rheological models are mathematical equations used to predict fluid behaviour. Based on rheology, there are Newtonian and Non-Newtonian fluids. Newtonian Fluid is the fluid whose viscosity remains constant regardless of the amount of shear applied at a constant temperature. The viscosity and shear stress of these fluids are proportional. Non-Newtonian Fluid is a fluid whose viscosity reduces or increases when shear is applied, depending on the fluid. Apparent Viscosity is defined as the viscosity of a fluid measured at the shear rate specified by API (Herzhaft et al., 2001) In the Bingham plastic rheology model, apparent viscosity (AV) is one-half of the dial reading at 600 rpm using a direct-indicating, rotational viscometer. Plastic viscosity is defining as the resistance offered by a fluid to flow freely. This resistance is a result of friction between the liquid undergoing deformation under shear stress and the solids and liquids present in the drilling mud (Dagde et al., 2014). Plastic viscosity is usually described as that part of resistance to flow caused by mechanical friction. Primarily, it is affected by Solids concentration, Size and shape of solids, Viscosity of the fluid phase. Yield point, the second component of resistance to flow in a drilling fluid, is a measurement of the electro-chemical or attractive forces in a fluid. These forces are a result of negative and positive charges located on or near the particle surfaces. Yield point is a measure of these forces under flow conditions and is dependent uponthe surface properties of the fluid solids, Volume concentration of the solids, and the electrical environment of these solids (concentration and types of ions in the fluid phase of the fluid). Gel strength can be defined as a measure of the ability of a colloidal dispersion to develop and retain a gel form based on its resistance to shear (Rabia, n.d.)Gel strengths can be measured after allowing the mud to stand quiescent for any time interval of interest, but they are routinely measured after 10 seconds (initial gel strength) and 10 minutes. The dial reading gives the gel strength directly in pounds per hundred square feet.

1.1. RHEOLOGY CONTROL MATERIALS

Basic Rheological control is achieved by controlling the concentration of the primary viscosifiers used in the drilling fluid system. However, when control of viscosity and gels cannot be efficiently achieved by this method, materials variously called "thinners," "dispersants," and/or "deflocculants" are used (Okon et al., 2014)These materials

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reduce the viscous and structure-forming properties of the drilling fluid by changing the physical and chemical interactions between solids and/or dissolved salts. In this research we have used cellulose as a rheology control material (Herzhaft et al., 2001). Cellulose is extracted from two source viz. Groundnut Husk and Wheat Husk. Wheat and Groundnut husk are typically found as a by-product of flour mills and oil plants, and they are generated in large amounts and burned as agricultural trash. The introduction of wheat and groundnut husk powder to the drilling fluid improves rheological properties, reduces filtration loss while also being environmentally benign, cost-effective, and thermally stable.

GROUNDNUT HUSK: The physical characteristics of the plant waste under study are provided in detail (Table A). As a result, the characteristics include: colour, appearance, smell of the waste material for analysis; size (of the sample after grinding for pre-treatment); and finally, sample weight**.**

Property	Groundnut Husk
Colour	Dirty Dusty Brown
Smell	Oil Rich smell

Table 1: Physical characteristics of the groundnut shell used in this study.

WHEAT HUSK: Wheat husk is a cellulosic product that contains around 15–20 percent wheat and is used as cattle feed and fuel in some areas. As a result, the characteristics include: colour, Appearance, smell of the waste material and size (of sample after grinding for pre-treatment).

Property	Wheat husk
Colour	Red yellow with grey shadow
Smell	Pleasant or Musty smell

Table 2: Physical characteristics of the Wheat Husk shell used in this study.

2. METHODOLOGY

2.1 Preparation and Extraction of Groundnut Husk powder.

The current research demonstrates the development and analysis of a sustainable drilling fluid system in which biodegradable groundnut husk is employed as a rheological modifier. The cellulose derived from groundnut husk is being used as an alternative to the current practice of using polyanionic cellulose (PAC) in the formulation of drilling fluids (Baokui et al., 2012). An analysis is performed with a standard drilling fluid at various concentrations to validate the results based on different rheological parameters.

Materials: Groundnut husk was obtained from a local mill Barmer used as the raw material. The chemicals used were Sulphuric acid and water. Equipment's used were Ice bath, Magnetic Stirrer. All chemicals used for the isolation are of reagent grade.

1. Around 5g of cellulose was combined with sulphuric acid (64 wt. per cent, 45 ml) in an ice bath and agitated for 120 minutes at 45^0C using a magnetic stirrer. To stop the hydrolysis, 500 ml of water was added to the reaction mixture. The solution was then rinsed until it became neutral.
2. The sample collected was then sun dried for 72 hours and then crushed to form very fine groundnut husk powder.

2.2. Preparation and Extraction of Wheat Husk powder

Wheat is a basic ingredient that is used to generate flour for leavened, flat, and steamed breads; cookies, cakes, pasta, noodles. Wheat is cultivated as a forage crop for cattle to a limited degree, and the straw can be utilized as fodder or as a building material for roofing thatch. Wheat husk is a lignocellulosic waste product that contains around 15–20 percent wheat and is used as cattle feed and fuel in some areas. Wheat husk is a by-product of milling and is used in the preparation of some food products. Recent studies have shown that India alone generates 21 million tons of wheat waste ever year.

Materials: Wheat Powder was locally obtained. The equipment used were Heat Oven, Grinding machine, Measuring Cylinder.

1. To remove all moisture content, the sample was held in a high vacuum oven at 100°C.
   After that, it was ground into fine particles with a grinding machine for 20 minutes.
2. The crushed material was sieved to 125 microns.

2.3. Experimental Procedure

The drilling mud preparation involves the following steps:

1. To prepare a 2% bentonite mud, 5gm of bentonite clay was mixed with 250ml of distilled water and mixed with Hamilton beach. The density of the prepared solution was then measured using a mud balance.
2. The rheological properties of this mud were then estimated using a Rotational Viscometer. The rheological properties examined were Apparent Viscosity, plastic viscosity, Yield Point, Gel strength (10 sec gel, 10 min gel)
3. Now, a new mud is prepared using 1%, 2%, 3%, 4%, & 5% of powdered groundnut husk and mixed with Hamilton Beach mud mixer.
4. The aforementioned rheological properties were measured then.
5. Again, a new mud is formulated with 1%, 2%, 3%, 4%, & 5% of powdered wheat husk and mixed with Hamilton Beach mud mixer and the rheological properties were measured.

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Then change in the rheological properties of each of the sample was then studied and analysed.

3. RESULTS

Based on the experimental procedure, the following results were obtained. Results from Wheat Husk Powder Drilling mud:

Physical Properties	**Results**
Colour	Reddish Yellow
Odour	Musty
State	Fine Powdered

Table 3: Physical properties of Wheat Husk Powder

Rheological properties	**1%**	**2%**	**3%**	**4%**	**5%**
Apparent Viscosity	14	24	28	34	36
Plastic Viscosity	8	13	17	20	26
Yield Point	15	17	25	28	35
10 sec Gel	6	9	12	15	18
10 min Gel	8	10	14	16	19
pH	8.9	8.9	9.1	9.1	9.1

Table 4: Rheological Properties of Drilling Mud formulated with 1%, 2%, 3%, 4% & 5% Wheat Husk Powder.

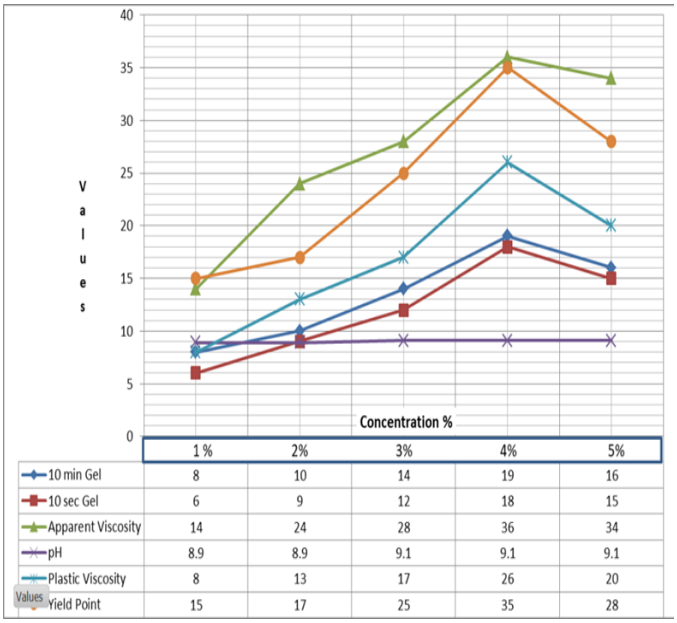

Figure 1: Rheological Properties of Wheat Husk Powdered drilling mud

Results from Ground Nut Powder Drilling Mud:

Table 5: Physical properties of Groundnut Husk Powder

Physical properties	**Results**
Colour	Dusty Brown
Odour	Oil Rich smell
State	Fine Powder

Table 6: Rheological Properties of Drilling Mud formulated with 1%, 2%, 3%, 4% & 5% Groundnut Husk Powder.

Rheological properties	1%	2%	3%	4%	5%
Apparent Viscosity	19	22	21.5	26	27.5
Plastic Viscosity	10	16	15	17	18
Yield Point	20	19	18	21	22
10 sec gel	10	16	15	16	17
10 min gel	14	20	22	24	25
pH	7.2	7.3	7.34	7.5	7.6

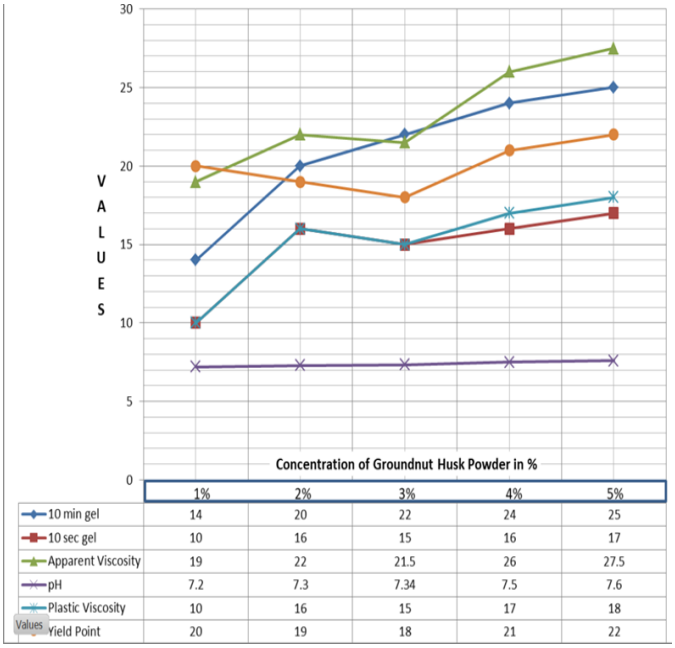

Fig.2: Rheological Properties of Groundnut Powder drilling mud

CONCLUSION AND DISCUSSION:

The rheological properties of the drilling mud formulated with Groundnut husk and Wheat husk shows similar characteristics. Groundnut husk mud has higher yield point than Wheat husk mud and shows higher gel strength. Thus indicating greater hydraulic losses during circulation. However further investigation of filtrate loss and control is required to properly estimate the impact of both the resources. Also Groundnut mud has lower pH value as compared to Wheat husk mud and thereby indicating effect on formation damage and formation of a skin zone. However one thing can be asserted based on early researches that both groundnut and wheat husk can act as better alternative to chemically formed additives like PAC, CMC and thereby act as an ecofriendly alternative too(Herzhaft et al., 2001)

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