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EXTRACTED AND POWDERED *RHIZOPHORA MUCRONATA* TANNIN AS DEFLOCCULANT IN DRILLING FLUID FORMULATION

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ABSTRACT

The application of tannin in drilling fluid after extraction and powderization from *Rhizophora mucronata* barks as deflocculant was investigated in this study. Tannin was extracted using Soxhlet extraction and boiling with variation of several parameters such as type of solvent used, time of extraction, and sample size. Powderization of the liquid extractant was conducted after extraction process using spray dryer and vacuum rotary evaporator. The percentage of extractives and the characterization of condensed and hydrolysable tannins were quantified before and after powderization. Rheological and filtration performances of water-based drilling fluid (WBDF) before and after hot-rolled with powdered tannin were conducted. Different weight of tannin (0, 2, 4, 6 and 8 g) was added into WBDF and the prepared samples were tested at 3 different temperatures namely 250, 300 and 350 °F. Results demonstrated that extracted tannin from *Rhizophora mucronata* bark with water for six hours was approximately 29 wt% and 13wt % for both Soxhlet extraction and boiling respectively. The Soxhlet extraction method was superior compared to boiling due to higher percentage of extractives. The optimum parameters for the Soxhlet extraction were using water at six hours extraction with 0.5 mm particles size of milled bark that able to extract 29 wt% of extractives. However, there is limitation on Soxhlet extraction as compared to boiling whereby the volume of solvent used in Soxhlet extraction (200 ml) is lower than boiling (1500 ml). The condensed tannin from Soxhlet extraction and boiling were 75.35 and 71.47 wt% respectively, while hydrolysable tannin were 0.00133 and 0.00117 wt% respectively. The extracted powdered tannin obtained by spray drying decomposed at higher temperature than those extracted using rotary evaporating i.e. at 270 °C. It is indicated that the powdered tannin extracted from spray drying was higher in thermal stability due to high crystallinity peak appeared from X-ray Powder Diffraction (XRD) analysis. Powdered tannins from spray drying and rotary evaporator contained 27.8% and 26.5% condensed tannins respectively and 0.001% hydrolysable tannins. The rheological properties after hot-rolled seems to be lower than before hot-rolled except for 8 g tannin. No flocculation occurred due to the anionic condition provided by hydroxyl ions in the tannin that neutralized the positively charged at the edge of clay particles. At higher temperature, tannin absorbed extra heat and prevented water molecules from forming hydrogen ions. This suggested tannin able to withstand high temperature condition. The filtration properties were also improved with low filtrate volume and thin filter cake due to bridging between negative-charge faces of the clay particles and the tannin molecules. The optimum weight was achieved at 6g of with the highest percentage reduction in rheological and filtration properties of 33.3 and 69.2 % recorded respectively.

Keyword: Extraction, powderization, *Rhizophora mucronata*, tannin, drilling fluid, rheological properties, filtration properties.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Crude oil is a naturally occurring, petroleum product and non-renewable source which comprised of hydrocarbon and other organic compounds. It has been an important source of our modern daily life as it can be refined to yield usable products such as fuel for transportation purpose, lubricants for mechanical machineries, paraffin wax used in food industries, asphalt for paving roads, etc. The refining of crude oil is called downstream sector which is the last phase in oil and gas industry. The first phase of the industry is upstream sector involves locating oil fields and producing crude oil. Followed by midstream sector which transporting the crude oil from field to refinery plant.

Upstream sectors consist of exploration and production services such as formation evaluation, drilling and cementing, production technology and feasibility study. Drilling refers to the activity of boring a hole through soil and rock to the targeted geologic reservoir parts where the oil and gas occurred. There are several types of oil wells with its very own functions: (1) exploration wells or wildcat wells are drilled in new areas, which the location is determined by geologists, for exploration objectives in new areas, (2) appraisal wells are those drilled to evaluate the properties of a confirmed petroleum reserve such as flow rate, (3) development or production wells are drilled once the fields is proven to be economical and recoverable oil or gas reserve for the production of oil or gas, (4) relief wells are drilled if a production wells has experienced a blowout which will stop the flow from the reservoir, and (5) abandonment well is drilled to collect data needed to close the well in order to avoid possible environmental disaster if no hydrocarbon were found (Hossain & Al-Majed, 2015). The drilling department supervises all drilling operations when exploration and development wells are committed. Drilling fluid is used to aid the drilling of boreholes and it is formulated using different type of additives based on the properties and condition of the targeted reservoirs. Drilling fluids are classified according to the type of base fluid used and usually divided into three major groups water-based drilling fluids (WBDF), oil-based drilling fluids (OBDF) and synthetic-based drilling fluids (SBDF) (Sampaio, 2007; Santos et al., 2018).Bioactive compounds or biopolymers plant-based additives are