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Biodegradation of Drilling Fluid used in Upstream Sector of the Nigeria Petroleum Industry in Marine Water Environment

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Abstract

Biodegradation of drilling mud (water based and oil based drilling fuild) utilized in the upstream sector of the Nigeria petroleum industry was investigated in marine water environment. Drilling fluid were obtainedfrom Izombe well drilling site Owerri and marine water sample from Bonny River, Nigeria. The methodology of ultimate biodegradability estimated from the ratio of Biochemical Oxygen Demand to Chemical Oxygen Demand was wont to determine biodegradability. Evaluation of percentage (%) ultimate biodegradation at day 20; showed that water based drilling fluid had 59.5% to be more biodegradable than Oil based drilling fluid with 54.2%. Drilling fluid utilizing bacteria genera isolated were: Pseudomonas, Bacillus, Micrococcus and Enterobacter, with Pseudomonas having the very best frequency of 35.7%, followed by Bacillus with the frequency of 30.7%, Micrococcus had 15.4% and Enterobacter 15.4%.Fungi genera isolated include Aspergillus, Penicillium, Rhizopus Mucor. Conclusively, the study showed that water based drilling mud is more biodegradable in marine water environment than oil based drilling mud . Therefore it's recommended that since most oiler drilling activities in Nigeria are administered in marine environments, water based drilling mud should be the simplest option due to its high degradability rate.

Biodegradation is that the breakdown of an organic substance, like oil by the action of microorganisms, especially bacteria . Some substances biodegrade more rapidly and more completely than others. Biodegradation may occur under both aerobic (with oxygen) and anaerobic (without oxygen) conditions, if the contamination is well dispersed in water there is usually more oxygen available for aerobic biodegradation. Water based muds is more readily dispersed than oilbased muds because it's water soluble. Drilling fluids are mixture of natural and artificial chemical compounds wont to cool and lubricate the drill bit; clean the opening bottom; carry cuttings to the surface, control formation pressure and improve the function of the drill string and tools in the hole . Microorganisms are known to be ubiquitous and also adapt to the environment for effective competition for available nutrient. However the introduction of drilling mud alters the environment causing a variety of these microorganisms capable of degrading petroleum . Water Base Fluid (WBF) is the drilling fluid, in which fresh salt, or sea water is the continuous phase and it is the most used fluid (90-95%). The WBM are mainly composed of aqueous solutions of polymers and clays in water or brines, with different types of additives incorporated to the aqueous solution. Oil Base Fluid (OBF); Oil base fluid is a smaller amount used (5-10%). These drilling fluids have been developed for situations where WBF were found inadequate. The OBM are oil (usually gas oil) based muds. Generally, they're invert emulsions of brine into an oil major, continuous phase stabilized by surfactants. Also other additives are often added to the organic phase like organophilic modifiers of the clay surface. However OBM often give better performances, they have major drawbacks such as to be generally more expensive and less ecologically friendly than WBM. Consequently, although OBM give greater shale stability than WBM . These later systems have also been developed by researchers so as to reply to environmental regulations .The biodegradability of petroleum products depends on the chemical structure of their various components. Compound resistance to biodegradation increases with increasing relative molecular mass . The oils used in OBM can be classified according to their aromatic hydrocarbon concentration, which contributed to fluid toxicity. However, the relations between hydrocarbon physio chemical properties and biodegradability have been little studied. Several works dealing with laboratory techniques of biodegradability determination and the influence of experimental conditions, showed the variation of the results according to the used method and considered conditions. In general, the soluble, lighter petroleum hydrocarbons are more biodegradable than the less soluble, heavier members of the group. Viscosity is additionally known to possess a crucial impact on biodegradability. Highly viscous hydrocarbons are less biodegraded due to the inherent physical difficulty in establishing contact among contamination and microorganisms, nutrients and electron acceptors components . In the biodegradation process, it's pertinent that the sole carbon source should be petroleum products. This otherwise would not slow down the biodegradation rates as the microorganism will turn to alternative carbon sources as a source of energy thus leaving behind the hydrocarbon. More so, hydrocarbon degrading microorganisms require nitrate and phosphate for growth, limitation of those substrates affects the speed and extent of degradation of petroleum in soil environment . The

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aim of this research work was to evaluate the biodegradation rate of the two major types of drilling fluid (Water based drilling fluid and oil based drilling fluid) often employed in the upstream sector of the Nigeria Petroleum Industry in marine water environment.

The study showed that Water based drilling mud is more biodegradable in marine water environment than Oil based drilling mud . Therefore it's recommended that since most oiler drilling activities in Nigeria are administered in marine environment, water based drilling mud should be the simplest option due to its high degradability rate. In the course of this study it has been revealed that the two drilling fluids is somehow toxic to some microorganisms and therefore reduced the number of microorganisms in the sample as the days goes by. The most frequently isolated microorganisms that degrade drilling fluids are Pseudomonas followed by Bacillus, Micrococcus and Enterobacter However, it is important to note that the persistence and degradation effect in deep marine seawater/sediments may vary from the data that were obtained in the laboratory tests due to other factors that can affect the ultimate biodegradation rate of the fluids. Since environmental conditions in the sea vary from one location to another, it is not possible to develop a standardized procedure for biodegradability that covers all environmental conditions.

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