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# Chemical Modification Cellulose Pulp as Crude Oil Absorbent

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**Abstract:** The crude oil absorption behaviour of chemically modified celluloses was investigated. The result showed that only three out of eleven modified celluloses are effective as crude oil absorbents; benzoyl modified cellulose BMC, toluene diisocyanate cellulose TDC, toluenediisocyanate cellulose blown TDC$^b$. These three crude oil absorbents posses the same functional group; the carbonyl. The IR of these three cellulose absorbents showed the presence of carbonyl group 1425.51 $cm^{-1}$, 1533.06 $cm^{-1}$ and 1535.82 $cm^{-1}$, respectively for BMC, TDC and TDC$^b$. The order of crude oil absorptivity are TDC$^b$ > BMC > TDC.

**Key words:** Cellulose, crude oil, absorbent, biodegradable materials

## INTRODUCTION

Cellulose is a polysaccharide derived from plants which is composed of Beta-D-glycopyranose. Cellulose has a general formula $(C_6 H_{10} O_5)_n$, where n = 5 or more glucose units[1].

It is one of the most abundant polysaccharide in the plant king dom. Cellulose serves as food for plants, protective organ, sources of food for ruminant animals and insects of is a source of raw materials for paper textile and pharmaceutical industries[2].

Crude oil is a liquid, which comprises of mixtures of various substances. They are principally compounds comprising of carbon and hydrogen also called hydrocarbons. Sulphur, oxygen and Nitrogen are also present in crude oil[3]. Nigeria's crude oil contains an insignificant proportion of sulphur[4] Nigeria's crude oil is formed from decomposition of aquatic substances, such as marine animals and plants which have been buried under various layers of mud and silt. Over the years the sediment exerts great pressure and high temperature occurs, as less oxygen is present at depths. The buried organisms are transformed into crude oil and gas.

The Nigeria Delta Basin contains vast quantities of sedimentary rock and crude oil is manly found around such rock[4].

Crude oil and its refined products are one of the major environmental pollutants in crude producing nations of Nigeria, Saudi Arabia, Russia, China, Iraq, Iran, USA, Kuwait, Jordan, United Arab-Emirates, Egypt[5]. There are several methods used in crude oil pollution remediation, such as containment, evaporation, dissolution, sinking, burning, dispersion and absorption by different absorbents[5]. The absorption of spilled crude oil is only for clean up exercise after other methods have been carried out. The use of biodegradable absorbents such as straw, rice-husks, sawdust, discrimate between heavy and light crude oil fraction[5]. But other modified biodegradable materials, though costly are nondiscriminatory;

Silicone treated paper, polyurethane foam, sandol are bulky non- biodegradable[5].

We, therefore, reports crude oil absorptive behaviour of modified cellulose as biodegradable crude oil absorbents

## MATERIALS AND METHODS

Crude oil sample were procured from shell petroleum development company, Port Harcourt, River state, Nigeria. Waste Newsprints were collected from dumping sites. All chemicals used for the analysis are analytical grade reagents. Alkaline waste paper recycling method was used to obtain the cellulose pulp[6].

The cellulose pulps were used in the chemical modification processes of estherification and etherification[7].

Forty grams of cellulose pulp, each was used in refluxing process using eleven different chemicals for each refluxing operation. Each refluxing operation lasted for two and half hour. IR vmax (Kbr") $cm^{-1}$ for

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Table1: percentage crude oil absorbed by modified

| Absorbent type | Weighs of used | Crude oil spilled | % Crude oil spilled |
|---|---|---|---|
| Benzolmodified cellulose. (BMC | 1000 mg | 0.60 mL | 96.23±0.3 |
| Toluenediisocyana cellulose TDC) | 1000 mg | 0.60 mL | 98.42±0.1 |
| Toluenediisosocyanate cellulose blown | 1000 mg | 0.60 mL | 88.88±0.1 |
| Proprietary absorbent sanol ® | 1000 mg | 0.60 mL | 75.50±0.2 |

Cellulose absorbents, Values are means of four-determinations±standard deviation

each of the eleven modified cellulose are; methyl cellulose (no recorded peaks), dim ethyl cellulose, 3457.33 $cm^{-1,}$

Ethyl cellulose, 1649.92 $cm^{-1,}$ 3420.49 $cm^{-1}$ 3440 $cm^{-1}$-propyl cellulose 419.67$cm^{-1,}$ 464.12$cm^{-1}$-497.21 $cm^{-1}$, Butylcellulose 415.65 $cm^{-1}$benzyl cellulose 364.72.5 $cm^{-1}$, 3160-40 $cm^{-1}$, 3231.30 $cm^{-1}$, benzoyl cellulose1425.51 $cm^{-1}$, 2340.86 $cm^{-1}$, 2361.81 $cm^{-1}$, isocyanatobenzy/ cellulose, 694.68 $cm^{-1}$, 752.60 $cm^{-1}$, 1312 $cm^{-1}$, toluenediisocyanate cellulose; 1533.06 $cm^{-1}$, 1220.55 $cm^{-1}$, 2358.75 $cm^{-1}$, toluenediisocyanate, cellulose blown 1312.79 $cm^{-1}$, 420.84 $cm^{-1}$, 1071.99 $cm^{-1}$.

A preliminary crude oil absorbency test for each of these eleven modified celluloses resulted in the selection of three modified cellulose; benzoyl modified cellulose, BMC, toluene diisocyanate cellulose TDC and toluenediisocyanate cellulose blown with superior crude oil absorptive behaviour. Further absorptive studies of the three selected modified celluloses were carried out using simulated crude oil spill model, developed.

## RESULTS AND DISCUSSION

The IR Vmax (KB") for the three modified cellulose with superior crude oil absorbency showed the presence of carbonyl functional group 1425.51 $cm^{-1}$, 153306 $cm^{-1}$ and 1535.82 cm, for benzoyl modified cellulose, BMC, toluenediisocyanate cellulose blown, respectively. The presence of the same functional group; carbonyl, among these three selected modified cellulose absorbents from the eleven modified celluloses strongly indicated the possession of carbonyl group by any modified cellulose as pre-requisite for crude oil absorbency.

Table 1 showed the percentage crude oil absorbent by the three modified cellulose absorbents developed. The absorptive capacities of each of the crude oil absorbent are more than eighty percent. These three cellulose absorbents developed absorb more crude oil when compared to the proprietary crude oil absorbent sanol ® presently used by most crude oil exploration and production companies in Nigeria. These three modified cellulose absorbents developed are biodegradable, cost effective and the raw materials for the production are abundant, readily available.

This study has vertified usefulness of chemically modified cellulose possessing carbonyl functional group as crude oil absorbent that could be used in the crude oil spill clean up operation that is cheap, available locally, effective and biodegradable.

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