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Extraction and modification of cellulose from peanut shells and cornstalks and for use as adsorbents for removal of lead

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ABSTRACT

The requirement for novel adsorbents from inexpensive sources, directs this research towards innovation of new adsorbent materials through extracting and modifying cellulose fibres from peanut shells and corn stalk. The processes involved delignification, alkaline hydrolysis, acetylation of pure cellulose and the adsorption of Lead Pb^{2+}. The adsorbents obtained are pure celluloses of peanut shells (PSC), Corn stalk (CSC) and Acetyled Celluloses of Peanut Shells (PSCA) and Corn Stalk (CSCA). The Structural and functional properties were analyzed by Fourier transform infrared spectroscopy (FTIR) and Atomic Absorption Spectrometer (AAS). The four adsorbents all exhibited high removal percentage of Lead from the solutions. However, acetyled Cellulose of peanut shells exhibited the highest adsorption capacity of 397.5 mg/g with final Lead (Pb) concentration of 0.125 mg/L, the removal of Lead from solution amounted to 99.3% as compared to the other adsorbents. This research proved the efficiency of agro-waste cellulose acetate for use as novel adsorbents through the Lead Adsorption. An extensive exploration in researches involving biodegradable waste materials is required to utilize this source and control environmental pollution.

1. Introduction

It has become a challenging quest to replace toxic and non-renewable petrochemical products in the world with hopes of reducing contamination of the Ecosystems. These Ecological concerns have resulted in a renewed interest in natural, renewable resources- based and compostable materials. For these reasons, material components such as natural fibers, biodegradable polymers can be considered 'environmentally safe' alternatives for the development of new biodegradable adsorbents, which can be used as media for pollution control [1]. It is of utmost relevance that environmental pollution in affected parts of Nigeria and other developing states should be tackled with in order to ensure healthy progression of these nations. The purification of water and other systems against heavy metals has long been under study using low-cost absorbents from plant wastes. Bioremediation and other conventional methods of purification have been implored but have not yet proven satisfactory due to some technical and economical constraints.

Cellulose is one of the most widespread biopolymer found globally, existing in a variety of living species such as plant, bacteria and some amoebas [2]. Cellulose is the primary component of the cell walls of higher plants. It comprises at least one third of the vegetable matter of the world [3].

Natural fibers mainly consist of cellulose, lignin, and hemicellulose but also include low quantities of pectin, pigments and extracts. The natural fibers themselves act as composite materials, assembling in a mainly lignin matrix [4]. These cellulosic materials are well known for their abundance, economic and environmental advantages.

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