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ABSTRACT

According to United Nations, a safe water source is one that is improved, available, accessible, free from faecal and chemical contaminations. However, millions of people living in the rural areas have no access to safe water, particularly in Sub-Saharan Africa and some parts of Asia. This has led to continued incidence of water borne diseases with severe cases if complications and sometimes death. Attempts to use silica sand-based materials for production of filters by researchers is still evolving. This study therefore produced optimized hybrid clay-nanoparticulate agro-waste blend water filter with appropriate porosity and flow rate for a contaminant free water filtration. The composite filters were produced using hydraulic pressing and sintering process. Four different blends of clay, nano particle coconut shell and activated carbon (60:10:30, 60:20:20, 60:10:30, and 60:0:40 wt %) were mixed and fired at 700 °C, 750 °C, 800 °C, 850°C, 900 °C, 950 °C, and 1000 °C respectively at the rate of 75 °C/hr. The physical properties (pore size, pore volume and surface area) of the filters were tested using Brunauer Emmet Teller (BET) method, the phase change with temperature was characterized using X-Ray Diffractometer (XRD) and the composition and microstructural analysis was carried out using scanning electron microscope and energy-dispersive X-ray spectroscopy (SEM/EDS). Physio-chemical and microbial tests were carried out on the influent water collected from Lagos Lagoon and effluent water samples filtered using the produced samples. Mathematical models were developed for the prediction of flow rate and pore size of a filter at different firing temperatures using regression analysis (Newton-Gregory forward difference). The result of water tests revealed that more than 60 % of the filter samples produced filters with 100% removal of Escherichia Coliform (E. coli), total coliform and turbidity with 90% removal of Iron, Nitrate and total dissolved solids. Blend of 60:10:30 fired at 900 °C showed optimum properties with an improved flow rate value of 2.48 L/hr and corroborative results of high pore size and volume from the BET result. In conclusion, the study established that synthesis of nanoparticle coconut shell and activated carbon is a viable material for producing clay composite filters that can purify water to WHO drinking water quality acceptable level and the resulting mathematical model from this study is suitable for predicting the pore size and flow rate of a filter fired at different temperature.

Keywords: Clay, ceramic water filter, Nano particle coconut shell, water treatment, mathematical model