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Adsorption equilibrium studies of *p*-Nitrophenol in aqueous solutions *onto* activated carbon from macadamia nutshell waste

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Abstract

Water pollution by organic pollutants has been a source of major concern because they tend to accumulate in the body to toxic levels [1]. *P*-Nitrophenol (PNP), has negative effects on humans such as cancer, immune system suppression, and gastrointestinal [2]. Various technologies have been developed for its removal from the water such as chemical precipitation, distillation, and solvent extraction but are expensive. Adsorption became reliable and cheap method hence this study dealt with adsorption equilibrium studies of *p*-Nitrophenol onto Macadamia nutshell in non-activated and activated form [3]. The methods of scanning electron microscopy (SEM) and Fourier-transform infrared analysis (FT-IR) were utilized for characterization in this study and results further investigated on the optimization batch experiments. Initial PNP ions increased with an increase in adsorption capacity between (5 – 60) mg/L, from (0.52-0.77) mg/g and (2.38-3.14) mg/g for the unmodified macadamia nutshell (UMNS) and modified macadamia nutshell (MMNS) respectively. The highest PNP ions uptake was recorded at pH 4 and the sorbent dosage in terms of PNP percentage removal increased from 67.53%, to 87.97% and 87.97% to 94.22 % with increase in the dose of 0.05 g and 0.2 g at fixed PNP concentration for both the UMNS and MMNS. This is designated to a bigger number of active adsorption sites with greater availability for adsorption process in the modified material. Adsorption equilibrium for the UMNS and MMNS was attained after 30 minutes with an optimum dose of 0.1g. The presence of the amides, hydroxyl, asymmetric and antisymmetric vibrations (C-H) and amines

functional groups was detected using FTIR which captured change in the pores and functional groups on the material surface after modification. Surface structure and morphology of the adsorbents was analyzed by the SEM. From the equilibrium models, the sorption behaviour fitted well with and the Langmuir isotherm. The technique proved to be remarkably efficient in the production of a newly developed activated carbon that serves as an alternative to commercial carbon. I worked on non-activated carbon and activated carbon, but the focus of our consideration is currently on activated carbon.

Keywords: macadamia, activated carbon, p-Nitrophenol, adsorption capacity, wastewater