“Fundamental assessment and performance evaluation of the cellulose nanocrystals integrated magnetic-metal organic framework composites”

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In this work, the facile preparation of a series of low-cost, eco-friendly and new functionalized MOFs, CNCs and integrated composites via low temperature assisted hydrothermal technique has been succeeded. The surface porosity, structural morphology, surface functionalities and crystallinity were featured by microscopic pore-textural characterization, elemental constitution analysis, scanning electron microscopy, transmission electron microscopy, Fourier transform infrared spectroscopy, X-ray diffraction and thermogravimetric analysis. The adsorptive performance of composite was evaluated in a batch experiment by adopting different classes of water pollutants, specifically 2,4-dichlorophenoxyacetic acid (2,4-D), methylene blue (MB) and acetaminophen. The equilibrium uptakes were analyzed with respect to the non-linearized Langmuir, Freundlich and Tempkin isotherm equations. The equilibrium data of 2,4-D, MB and acetaminophen were found to be in good agreement with the Langmuir isotherm model, with the monolayer adsorption capacities (*Qo*) exceeding 300 mg/g for 2,4-D, 400 mg/g for MB, and 250 mg/g for acetaminophen. These eco-friendly composites have been proven to be a potent adsorbent for the adsorptive removal of the toxic contaminants from the aqueous solutions, as compared to commercial activated carbon and other functionalized adsorbents. The adsorption kinetics was rapid, with exceeding 50% of the adsorbate loading has been completed within the first 5 min of contact time, and best described by the pseudo-second order kinetic equation. The high adsorptive potential and well-developed structural property, supported by the sustainable preparation methodology, rendered these composites as promising adsorbents for the effective decontamination of both cationic and anionic water pollutants. This fundamental knowledge within this research will be an important asset for the future studies, moving towards the novel concept of “Turn Waste into Wealth”, new product development and commercialization, and propose a multidisciplinary approach for solving part of the environmental pollution problems, in an environmental-friendly manner.

Keywords: Adsorption; Cellulose nanocrystal; Composite; Hydrothermal; Metal organic framework.

Funded by Toray Science Foundation, Japan