Plant Based Adsorbents for Caffeine Removal: Current Research and Future Outlook

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ABSTRACT

Pharmaceutical wastes, due to their recalcitrant nature, are emerging contaminants in wastewater that have been the focus of researchers and scientists. One pollutant of interest is caffeine, which is one of the most detected in a global context. Although commonly present in beverages such as coffee, caffeine can be harmful to both humans and animals when disposed of in bodies of water. Current wastewater treatment approaches not only pose ineffective results in removing the mentioned stimulant but also entail high financial concerns in applying the treatment technology. Recent studies have revealed the potential of adsorbents derived from plant sources such as husks, fruit peels, and other plant fibers from biomass to reduce caffeine concentrations in wastewater effectively with a removal efficiency in the range of 8.04 to 171.23 mg/g. Moreover, the adsorption phenomena exhibited a Langmuir isotherm model and pseudo-second-order kinetics. This review paper study aims to comprehensively present and analyze the current literature and prospects of utilizing plant-based adsorbents in addressing the impact of caffeine on the environment. Specifically, the review will focus on the efficiency of the said adsorbents in removing caffeine, considering the specific surface area, adsorbent dosage, pH level, maximum adsorption capacity, the adsorption isotherms and kinetics, and the predicted optimum conditions for adsorption using RSM. The objective is to identify the most suitable adsorbents to be used in wastewater treatment plants. This study will serve as a valuable reference for future research.

Keywords: *Adsorbent, pharmaceutical wastes, Caffeine, Removal, Wastewater*