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ADSORPTIVE REMOVAL OF METHYLENE BLUE FROM AQUEOUS SOLUTIONS BY POST-CONSUMER POLY(ETHYLENE TEREPHTHALATE)/CASSAVA STARCH BASED MICROBEADS

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Plastic pollution represents a significant environmental challenge. As global demand for plastic rises, poly(ethylene terephthalate) (PET), a widely used synthetic polymer, has been identified as a major contributor to this issue. Recycling and reuse of post-consumer PET was attempted as a solution for this issue in this study. Microbeads from post-consumer PET were prepared by inotropic gelation method by dissolving it in a mixture of trichloroacetic acid:dichloromethane (1:1). The PET microbeads prepared were tested as an adsorbent to remove methylene blue (MB) dye from aqueous solutions. To increase biodegradability and low adsorption, a biopolymer cassava starch was introduced to the PET microbeads. The PET/cassava starch microbeads were synthesised using inotropic gelation method by mixing PET solution with cassava starch dissolved in trichloroacetic acid. The microbeads were characterised using Fourier transform infrared (FTIR) spectroscopy and scanning electron microscopy (SEM). Batch experiments were carried out to optimise parameters for the adsorption of MB on PET/cassava starch microbeads, and the remaining dye concentrations after adsorption were determined using UV-visible spectrophotometer. All measurements were taken in three replicates. The results of FTIR indicated the presence of O-H stretch around 3293 cm^{-1} and C=O stretch around 1730 cm^{-1} responsible for cassava starch and PET, respectively. The morphology of microbeads showed a rough surface before and after adsorption as revealed by SEM analysis. The optimised parameters for methylene blue adsorption on PET/cassava starch microbeads were recorded as 20 mg L^{-1} initial dye concentration, pH of 6.0, 75.0 min of shaking time, 11.0 min of settling time and 0.040 g of dosage. The extent of dye removal with PET/cassava-based microbeads was calculated as 41.83%, while it was 38.75% with PET only microbeads. The data fit well to the pseudo-second order kinetics model indicating that the rate determining step is chemisorption. Adsorption data fit to the Langmuir adsorption isotherm revealing that monolayer adsorption takes place. Regeneration of PET/cassava starch microbeads was carried out using 1.0 mol L^{-1} HCl and desorption efficiency was found to be 25.33%. The results indicate that post-consumer PET bottles and cassava starch are good sources for microbeads synthesis for adsorptive removal of methylene blue from aqueous solutions.

Keywords: Cassava starch, Methylene blue, Microbeads, Poly(ethylene terephthalate)