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Upenyu Guyo, Nyasha Matewere, Kaina Matina, Tichaona Nharingo, Mambo Moyo

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Fabrication of a sustainable maize stover-graft-methyl methacrylate biopolymer for remediation of methyl red contaminated wasters

Upenyu Guyo[a*], Nyasha Matewere[a], Kaina Matina[a], Tichaona Nharingo[a] and Mambo Moyo[a]

[a]Department of Chemical Technology, Midlands State University, Private Bag 9055, Senga, Gweru, Zimbabwe.

[*]Corresponding author: Email upguyo@gmail.com, phone: +263 542 60464, fax: +263 542 60303

Abstract

In the present study, a sustainable maize stover-g-methyl methacrylate (MS-g-MMA) biopolymer was synthesized by free radical polymerization using benzoyl peroxide initiator and applied in the removal of methyl red dye from aqueous solutions. Monomer concentration, initiator concentration, temperature and reaction time were the synthesis independent variables. The prepared biopolymer was characterized by scanning electron microscope (SEM) coupled with energy dispersive spectroscopy (EDS) and fourier transform infrared spectroscopy (FTIR). The effects of pH (2 – 11), contact time (5 – 300 min), initial concentration (5 – 50 mg/L), adsorbent dosage (0.2 – 2 g) and temperature (20 – 50 ^{0}C) were investigated through batch adsorption studies. The optimum conditions were determined to be pH 6, contact time 120 min, adsorbent dosage 0.2 g and initial concentration 5 mgL^{-1}. The adsorption kinetic, isotherm and thermodynamic parameters were studied. The kinetic and isotherm data followed pseudo-second-order and Langmuir models, respectively. The maximum adsorption capacities of 13.58 and 23.47 mg/g were achieved for raw and modified maize stover, respectively. The adsorption process was endothermic, spontaneous and chemisorption. This study showed that MS-g-MMA could be applied as a potential biopolymer for the removal of methyl red from aqueous solutions.

Key words

Maize stover, Methyl methacrylate; Graft copolymerization; Methyl red adsorption; Kinetics