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Gum karaya based hydrogel nanocomposites for the effective removal of cationic dyes from aqueous solutions

Hemant Mittala,b,∗, Arjun Maitya,b, Suprakas Sinha Raya,b,∗

aDepartment of Applied Chemistry, University of Johannesburg, Doornfontein 2028, South Africa

bDST/CSIR National Centre for Nanostructured Materials, Council for Scientific and Industrial Research, Pretoria 0001, South Africa

Abstract

Biodegradable hydrogel nanocomposites (HNC) of gum karaya (GK) grafted with poly(acrylic acid) (PAA) incorporated silicon carbide nanoparticles (SiC NPs) were synthesized using the in situ graft copolymerization method and tested for the adsorption of cationic dyes from aqueous solution. The structure and morphology of the HNC were characterized using different spectroscopic and microscopic techniques. The results showed that the surface area and porosity of the hydrogel polymer significantly increased after nanocomposite formation with SiC NPs. The HNC was employed for the removal of cationic dyes, i.e., malachite green (MG) and rhodamine B (RhB) from the aqueous solution. The HNC was found to remove 91% (MG) and 86% (RhB) of dyes with a polymer dose of 0.5 and 0.6 g l(sup-1) in neutral medium, respectively. The adsorption process was found to be highly pH dependent and followed the pseudo-second-order rate model. The adsorption isotherm data fitted well with the Langmuir adsorption isotherm with a maximum adsorption capacity of 757.57 and 497.51 mg g(sup-1) for MG and RhB, respectively. Furthermore, the HNC was demonstrated as a versatile adsorbent for the removal of both cationic and anionic dyes from the simulated wastewater. The HNC showed excellent regeneration capacity and was successfully used for the three cycles of adsorption–desorption. In summary, the HNC has shown its potential as an environment friendly and efficient adsorbent for the adsorption of cationic dyes from contaminated water.