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Preparation and characterisation of high performing magnesitehalloysite nanocomposite and its application in the removal of methylene blue dye

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Abstract

Nanoparticles have novel characteristics enabling them to efficiently decontaminate water hence the application of nanotechnology in wastewater treatment is being widely explored to tackle water pollution challenges. Industries are in a quest for decolouration and contaminant depollution technologies. In that regard, this study was designed with the aim of preparing a nanocomposite from calcined cryptocrystalline magnesite and halloysite nanoclay and then evaluating the influence of several parameters in the removal of Methylene Blue (MB) from aqueous solution by the prepared nanocomposite. Physicochemical characterisation was carried out to get an insight of pre- and - post adsorption characteristics of the material. According to the results, the uptake of MB was rapid, and the maximum adsorption capacity and percentage removal were observed to be 0.65 mg/g and 99.66% respectively. Two adsorption isotherms and kinetic models were applied to describe the dye adsorption behaviour. Experimental results fitted the Langmuir (R(sup)2 ¼ 0.98) and pseudo-second order models (R(sup)2 ¼1) perfectly hence demonstrating that adsorption took place on a homogenous adsorbent layer via chemisorption. Furthermore, regeneration results showed that the nanocomposite can be used repeatedly recording a 35% removal at the 4th regeneration cycle. In overall, the results suggested that the nanocomposite is a suitable adsorbent for decolourising industrial wastewater. Due to its local availability and non-toxic nature, calcined cryptocrystalline magnesite e halloysite nanocomposite can be considered a good alternative of conventional dye adsorbents commonly used in wastewater treatment especially in developing countries like South Africa.