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Review

Guar gum based nanocomposites: Role in water purification through efficient removal of dyes and metal ions

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ABSTRACT

Researchers nowadays are relentlessly on a race exploring sustainable materials and techniques for the sequestration of toxic dyes and metal ions from water bodies. Biopolymers such as guar gum, owing to its high abundance, low cost and non-toxicity, are potential candidates in this field. Plenty of hydroxyl groups in the polymer backbone enable guar gum to be functionalised or grafted in a versatile manner proving itself as an excellent starting substance for fabricating upgraded materials meant for diverse applications. This review offers a comprehensive coverage of the role of guar gum-based nanocomposites in removal of dyes and heavy metal ions from waste water through adsorption and photo-catalytic degradation. Isotherm and kinetics models, fabrication routes, characterisation techniques, swelling properties and reusability as well as adsorption and degradation mechanisms are outlined. A detailed analysis with convincing results suggests a good future perspective of implementation of these materials in real-time wastewater treatment technology.

1. Introduction

Deterioration of water quality due to the rapid pace of urbanisation and industrialisation on a large scale has led to to scarcity of clean water which has eventually become a matter of worldwide concern. Research communities over the years have been paying extensive attention on the eradication or in the least, reduction of organic and inorganic pollutants from waste water especially from industrial effluents. (Barakat, 2011; Tchounwou, Yedjou, Patlolla, & Sutton., 2012). Dyes and metal ions which are the major components of effluents from industries such as dyes prove to be toxic for all aquatic life forms which gets transferred through the food chain and on the worst side, may be correlated to mutagenic and carcinogenic effects leading to severe damage to human beings such as dysfunction of various organ systems including kidneys, liver, brain, etc. (Dinçer, Günes, Karakaya, & Günes, 2007; Kadirvelu et al., 2003; Shen et al., 2009). Even a minute concentration of organic dye (1×10^{-3} mg L^{-1}) can prove highly toxic to humans and other animals. (Benedek, Sebestyén, & Bartók, 2018; Robinson, Chandran, & Nigam, 2002). Apart from dyes, there is a growing concern over contamination of water bodies by metal ions especially heavy metals