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REVIEW

Magnetite nanoparticles as sorbents for dye removal: a review

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Abstract

Pollution of industrial wastewaters containing dyes is a major concern for health in many countries, calling for advanced remediation techniques. Here, we review dye classification, toxicity, and removal with focus on adsorption using nanomaterials and magnetic nanoparticles. We present isotherm modeling and kinetic studies. We discuss factors controlling dye adsorption, such as pH, dye concentration, adsorbent amount, and temperature. Adsorption using magnetic nanoparticles appear as a simple and cost-effective technique. Removal efficiency increases with adsorbent concentration but declines sharply with increasing pH. Temperature is also highly influencing the removal.

Keywords Dye removal · Modified magnetite nanoparticles · Low-cost adsorbents · Greener adsorbents · Activated carbon · Wastewater treatment

Abbreviations

BET	Brunauer–Emmett–Teller
CMCH	Carboxymethylated chitosan
CPTES	3-Chloropropyltriethoxysilane
CTAB	Cetyltrimethylammonium bromide
D–R	Dubinin–Radushkevich model
EMCN	Ethylenediamine-modified magnetic chitosan nanoparticles
FHH	Frenkel–Halsey–Hill
FTIR	Fourier transform infrared spectroscopy
HHSS	Hierarchical hollow silica spheres
HRTEM	High-resolution transmission electron microscopy
MB	Methylene blue
MNPs	Magnetite nanoparticles
NPs	Nanoparticles
Ms	Specific saturation magnetization value
MSCM	Magnetic mesoporous silica-coated nanostructures
PAR	4-(2-Pyridylazo) resorcinol
PFO	Pseudo-first-order
PSO	Pseudo-second-order
RSD %	Relative standard deviation percent
SDS	Sodium dodecyl sulfate
SEM	Scanning electron microscopy
TEM	Transmission electron microscopy
VSM	Vibrating-sample magnetometer
XRD	X-ray diffraction

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Introduction

A dye is a chemical compound that is used as a colored substance that binds to the substrate to which it is being applied. Nowadays, dyes are broadly used in many industries including textiles, paper, plastic, rubber, automotive, trucking, marine industries, food industries, paint industries, and coating, etc. Dyes generally have an artificial starting place

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