

Effective methods for removing different types of dyes – modelling analysis, statistical physics treatment and DFT calculations: a review

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ABSTRACT

Organic dyes, a class of highly poisonous and carcinogenic chemicals that pose serious health risks to humans and aquatic life, are the most prevalent organic pollutants found in wastewater from sectors such as textiles, rubber, and cosmetics. Organic dyes, a class of highly poisonous and carcinogenic chemicals that pose serious health risks to humans and aquatic life, are the most prevalent organic pollutants found in wastewater from sectors such as textiles, rubber, and cosmetics. This review compares and contrasts several dye removals processes. Adsorption has proved to be a quick and efficient way to get colours out of wastewater. This research focuses on the most recent developments in porous materials for organic dye adsorption. Dyes were used to color food and other industrial items, textiles, plastics, cosmetics, and tannery. Non-ionic dyes, cationic dyes (basic dyes), and acid dyes are the three types of dyes (dispersed dyes). The process of removing dyes from sewage from industry has become increasingly essential from an environmental standpoint. In an aqueous system, cationic dyes have a net positive charge due to their sulphonate groups, while anionic dyes have a net negative charge. To avoid contamination of the aquatic environment, these waste dyes must be handled first. This dye's aromatic composition offers it increased durability and makes it tough to decompose. Color wastes were removed from waste water via oxidation, electrochemistry, coagulation, solvent extraction, photocatalytic degradation, ozonation, and adsorption, among other ways. However, the adsorption process is more advantageous than other ways. As a result of its ease of use, high effectiveness, simple design, easy availability of adsorbents, and most importantly, its low cost. Different porous materials' properties, functionalization, and modification are also discussed. Also discussed are the adsorption behaviors and mechanisms of these adsorbents in the adsorption of organic dyes. Finally, future research challenges and opportunities in the development of innovative materials for very efficient dye removal are suggested.

Keywords: Dyes; Adsorbents; Photocatalytic degradation

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