









## Review

# Recent and Emerging Trends in Remediation of Methylene Blue Dye from Wastewater by Using Zinc Oxide Nanoparticles

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**Abstract:** Due to the increased demand for clothes by the growing population, the dye-based sectors have seen fast growth in the recent decade. Among all the dyes, methylene blue dye is the most commonly used in textiles, resulting in dye effluent contamination. It is carcinogenic, which raises the stakes for the environment. The numerous sources of methylene blue dye and their effective treatment procedures are addressed in the current review. Even among nanoparticles, photocatalytic materials, such as TiO<sub>2</sub>, ZnO, and Fe<sub>3</sub>O<sub>4</sub>, have shown greater potential for photocatalytic methylene blue degradation. Such nano-sized metal oxides are the most ideal materials for the removal of water pollutants, as these materials are related to the qualities of flexibility, simplicity, efficiency, versatility, and high surface reactivity. The use of nanoparticles generated from waste materials to remediate methylene blue is highlighted in the present review.

**Keywords:** photocatalytic; effluents; auxochrome; polyvinylpyrrolidone; hazardous amines

## 1. Introduction

The contamination of water is a severe ecological concern and a threat to the climate's perfect balance [1]. The dumping of wastewater into natural water resources has also grown as a result of growing development. One of the pollutants found in wastewater is dye, which is widely used in a variety of industries, including textiles, food, and paper [2]. According to the color index, there are currently over 10,000 different types of dyes accessible around the globe, with over 700,000 tonnes produced annually [3]. Every year, over  $2 \times 10^5$  tons of dyes are released as effluents during dyeing and finishing operations in the textile sector, due to the ineffectiveness of the dyeing process [4]. Because of their