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Photodegradation of Reactive Blue 4 Using Suspension of Anatase-Titanium Dioxide and Corn Cob

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Abstract. Textile dyeing often employs reactive dyes. The dye wastewater contains hazardous materials and is toxic to humans and the environment. Photodegradation using a semiconductor photocatalyst is a promising alternative approach for water purification and wastewater treatment. However, the photocatalyst's low adsorption ability is a problem in the photocatalysis process. To compensate for this shortcoming, photocatalyst content must be combined with an adsorbent. Raw corn cob and titanium dioxide (TiO_2) were used in this photocatalysis. Due to a synergistic impact, raw corn cob's ability to adsorb and titanium dioxide's ability to photodegrade organic pollutants from water bodies is expected to boost the removal performance. The degradation of Reactive Blue 4 (RB4) as a targeted dye was carried out in this research using a suspended mixture of commercial anatase TiO_2 and raw corn cob under UV light. The effect of initial pH solution, initial dye concentration and contact time, TiO_2-corn cob dosages, and the influence of other pollutants were investigated as factors influencing photodegradation-adsorption of RB4. FTIR and SEM analyses were performed to characterize the prepared materials. The high removal rate of RB4 was obtained at a low pH of 2 and RB4 concentration of 40 ppm. The increased dose of TiO_2-corn cob improved the RB4 dye removal performance. The optimum percentage removal of RB4 was 92.65 % at pH 2, 40 ppm of RB4 concentration mixed with 1.2 g of TiO_2-corn cob in 60 minutes of UV light irradiation. SEM observation revealed that corn cob surfaces are uneven and very porous in nature. FTIR test indicate the presence of functional group on the TiO_2-corn cob helps in the adsorption of the RB4. In conclusion, combining photodegradation and adsorption systems as a hybrid treatment method resulted in a synergistic increase in RB4 removal performance.

Introduction

Reactive dyes are the second largest class of textile dyes after azo dyes. Cotton, wool, and polyamide fibres are often dyed with this form of dye [1]. The use of reactive dyes is due to their high stability, synthetic cost effectiveness, and huge colour range [2]. Reactive Blue 4 (RB4) is a reactive anthraquinone-based chlorotriazine dye that is widely utilized in dyeing of cellulosic fibers and industrial textile dyes. RB4 was found to be the cause of long-term neurotoxic effects such as vision problems and skin irritation [3]. RB4 degrades slowly under aerobic conditions, rendering it a potentially mutagenic and carcinogenic waste [4]. Furthermore, since RB4 is highly water soluble and has a poor rate of fibres fixation, it can contribute to the development of high coloring effluents [1,5,6]. The high colour of dyes will cause aesthetic harm to water bodies because only a small amount of dyes present in water is highly visible. The highly coloured dye waste has the potential to alter the quality (colour and odour) of the public water supply system, rendering it unfit for drinking. Also, the colour of dye waste can affect aquatic plants because it prevents light from passing through the water environment [7], inhibiting photosynthesis of aquatic plants [8]. Water pollution arising from