Designing design of expert for the treatment of sulphur black dye in textile effluents using zinc-oxide nanobioadsorbents

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The present study uses biogenic fabricated ZnO and ZnO-ME nanomaterials to extract sulphur black (SB) dye from textile effluents. In this study, response surface methodology-central composite design (RSM-CCD) was used to optimize the batch adsorption experiments instead of standard one-variable-at-a-time method. The optimum parameters for removing textile dye with desirability of 1 were 22 mg adsorbent dosage at room temperature (30°C) and 137 min of contact time and the colour adsorption efficiency was found to be 67% and 76% of ZnO and ZnO-ME nanomaterials respectively. Validation of the model showed that the estimated response was consistent with the experimental results. The model demonstrated excellent fit for SB dye removal utilizing ZnO and ZnO-ME nanomaterials, which had adjusted R^2 values of 0.9991 and 0.9952 and predicted R^2 values of 0.9961 and 0.9972 respectively.

Keywords: Biogenic adsorbent, response surface methodology, sulphur black dye, textile effluents, zinc-oxide nanomaterials.

sulphur black (SB) is the most widely and consistently used in textiles[5].

In recent years, various physical, chemical and biological approaches have been developed to remove dyes from dyeing effluents. However, because of their intricate chemical makeup, dyes are resistant to degradation[6], making dye removal difficult. Dye removal from aqueous media can be achieved through various physico-chemical or biological processes like chemical precipitation, ultrafiltration, microbial degradation, coagulation/flocculation, advanced oxidation, electrochemical treatment, reverse osmosis and adsorption. However, traditional methods have limitations, such as ion exchange causing contamination, iron fouling and organic matter adsorption. Reverse osmosis is expensive and can cause membrane fouling during water treatment[7]. Advanced alternatives like nanoparticle (NPs)-based adsorption techniques effectively remove dye from aqueous effluents, offering flexibility, efficiency and energy efficiency[8]. Numerous adsorbents have been explored for removing dye and contaminants from dye-contaminated water, including zeolites, polymers, biogas