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# The removal optimization of Reactive Red X-3B through UV photocatalysis based on the response surface methodology

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**ABSTRACT**

The response surface methodology (RSM) was applied to optimize UV photocatalytic reaction conditions treating high-concentration Reactive Red X-3B. The molecular sieve F was made of fly ash by the hydrothermal synthesis method. The molecular sieve loaded nano-$TiO_2$ (Ti/F) was synthesized with the ion-exchange method. The molecular sieve F and Ti/F were the photocatalysts and its catalyst characteristics were analyzed by using scanning electron microscopy-energy-dispersive X-ray spectroscopy and Brunauer–Emmett–Teller-surface area. The effects of four operating variables, initial dye concentration, photocatalyst dosage, temperature and $H_2O_2$ concentration on the decolorization efficiency of Reactive Red X-3B were optimized by RSM based on Box–Behnken design. The pseudo-first-order model could fit the photocatalysis kinetic data well at 20°C. And the pseudo-second-order model could fit the photocatalysis kinetic data well at 40°C. Analysis of variance indicated that the proposed quadratic model could be used to navigate the design space. The maximum removal rate of Reactive Red X-3B was 97.83% when the following optimum conditions were used: Ti/F dosage of 0.80 g/L, $H_2O_2$ dosage of 2.01 ml/L, the temperature of 32.5°C, and initial Reactive Red X-3B concentration of 1,824 mg/L. In the regeneration experiments, the removal rate of Reactive Red X-3B gradually decreased with increasing the number of photocatalytic cycles. The regeneration experiments indicated that Ti/F was stable and reusable. The molecular sieve Ti/F could be used as an effective and economical photocatalyst in the removal of Reactive Red X-3B. Maybe the study can be applied in future engineering practice.

*Keywords:* $TiO_2$; Reactive Red X-3B; Photocatalysis; Response surface methodology

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