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# Response surface analysis of removal of a textile dye by a Turkish coal powder

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**Abstract.** In the present study, an experimental design methodology was used to optimize the adsorptive removal of Basic Yellow 13 (BY13) using Turkish coal powder. A central composite design (CCD) consisting of 31 experiments was employed to evaluate the simple and combined effects of the four independent variables, initial dye concentration (mg/L), adsorbent dosage (g/L), temperature (°C) and contact time (min) on the color removal (CR) efficiency (%) and optimizing the process response. Analysis of variance (ANOVA) showed a high coefficient of determination value ($R^2$ = 0.947) and satisfactory prediction of the polynomial regression model was derived. Results indicated that the CR efficiency was not significantly affected by temperature in the range of 12-60°C. While all other variables significantly influenced response. The highest CR (95.14%), estimated by multivariate experimental design, was found at the optimal experimental conditions of initial dye concentration 30 mg/L, adsorbent dosage 1.5 g/L, temperature 25°C and contact time 10 min.

**Keywords:** adsorption; coal; organic dye; experimental design; optimization

## 1. Introduction

The dye effluents are considered to be harmful to aquatic environments and interfere with light penetration in the receiving water bodies which ultimately disturb the biological processes (Garg *et al*. 2004). To treat dye-containing effluents, several physical and chemical processes, such as coagulation/flocculation, biosorption, photocatalytic degradation, ultrafiltration and advanced oxidation processes (AOPs) have been applied (Sadri Moghaddam *et al*. 2010, Kousha *et al*. 2012, Mozia *et al*. 2008, Dong *et al*. 2011, Khataee *et al*. 2011, Modirshahla *et al*. 2011, Chen *et al*. 2005). The literature indicates that in the recent years adsorption techniques have received much attention for this purpose, offering significant reduction of expenses and efficient removal of dyes. Since the adsorption of dye by an adsorbent is strongly influenced by many factors, including adsorbent dosage, initial effluent pH, initial concentration of dye, temperature and the contact time of adsorbent with dye, it is crucial to search for the key influencing factor(s) and discover the experimental conditions in which the best possible response can be obtained. Performing such

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