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Production and characterization of Ti-doped $SrAl_2O_4$ via volume combustion synthesis: application for dye removal

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ABSTRACT

Titanium-doped strontium aluminate (Ti-$SrAl_2O_4$) composites were synthesized by volume combustion synthesis using various Ti amounts (0–20 wt.%). The composites were characterized by X-ray diffraction (XRD), scanning electron microscope and energy dispersive spectrometer analysis. XRD results showed that SrO-Sr phases, which are the residues of $SrAl_2O_4$ production, were eliminated after doping with Ti. The adsorption capacities of the composite samples were examined using Orange II dye in batch system for several parameters such as Ti loading amount, solution pH, contact time and temperature. Freundlich adsorption isotherm model was the best-suited model to describe the isotherm data and the maximum adsorption capacity was found to be 136.99 mg g^{-1} at natural pH level. In acidic medium, the highest Orange II adsorption (80%) was observed, while in basic medium the adsorption of Orange II decreased to 64%. This study showed that Ti-$SrAl_2O_4$ could be used as an adsorbent with high adsorption capacity for removal of Orange II dye. Three-factor three-level Box–Behnken experimental design with response surface modeling was applied for statistical analysis of the experiments. Ti amount (0%–20%), solution pH (2–12) and temperature (298–318 K) were chosen as independent variables, while Orange II adsorption capacity indicated the response. Analysis of variance was used to examine the significance of independent variables and their interactions.

Keywords: Ti-doped $SrAl_2O_4$; Volume combustion synthesis; Orange II; Adsorption; Box–Behnken experimental design

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