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Abstract

The quest for the application of a high solar-photon sensitive photocatalysts for rapid photodegradation of recalcitrant dye molecules with deleterious environmental impacts remains a major setback for the adoption of photocatalysis in the treatment of industrial effluent. This brought about the development and use of a novel solar-driven photocatalyst mediated with Fenton-reagents for the treatability of dye effluent. However, the degradation efficiency of the process hinges on the reaction kinetics, synergistic or antagonistic interactive effects of three independent process variables such as the pH of the system (5–7), photocatalyst dosage (20–50 mg/L) and irradiation time (30–90 min) on the modeling and optimization photocatalysis of methylene blue dye in effluent. The result of the statistical study suggested the quadratic model which accurately predicts the response variables, having strong correlation values of 0.9984 and 0.9994 and variances < 0.2. The optimized variables for the photocatalytic process investigated by the analysis of variance were shown to be statistically significant (p-values < 0.0001), with the main interaction effects on the percentage degradation of dye being the pH, catalyst dosage, and irradiation period. Experimental optimum conditions attained were at pH = 5, dosage = 20 mg/L and irradiation time of 90 min for 97.019% degradation of methylene blue dye.