

Catalytic thermolysis in treating Cibacron Blue in aqueous solution: Kinetics and degradation pathway

Abstract

A thermal degradation pathway of the decolourisation of Reactive Cibacron Blue F3GA (RCB) in aqueous solution through catalytic thermolysis is established. Catalytic thermolysis is suitable for the removal of dyes from wastewater as it breaks down the complex dye molecules instead of only transferring them into another phase. RCB is a reactive dye that consists of three main groups, namely anthraquinone, benzene and triazine groups. Through catalytic thermolysis, the bonds that hold the three groups together were effectively broken and at the same time, the complex molecules degraded to form simple molecules of lower molecular weight. The degradation pathway and products were characterized and determined through UV-Vis, FT-IR and GCMS analysis. RCB dye molecule was successfully broken down into simpler molecules, namely, benzene derivatives, amines and triazine. The addition of copper sulphate, CuSO₄, as a catalyst, hastens the thermal degradation of RCB by aiding in the breakdown of large, complex molecules. At pH 2 and catalyst mass loading of 5 g/L, an optimum colour removal of 66.14% was observed. The degradation rate of RCB is well explained by first order kinetics model.

Keywords

Anthraquinone; Benzene; Kinetics; Mechanism; Thermal degradation; Triazine