



SYNTHESIS OF COMPOSITE PHOTOCATALYSTS FOR THE PHOTODEGRADATION OF DYES UNDER UV AND VISIBLE IRRADIATION

Abstract:

This thesis has the general objective of synthesizing new photocatalysts for the degradation of dyes under ultraviolet and visible light, the dyes that have been chosen as a pollutant to examine the photocatalytic efficiency of the synthesized photocatalysts are crystal violet as a cationic dye and red acid as an anionic dye.

The first part of this work presents the hydrothermal synthesis of the ZnAl₂O₄/CuS nanocomposite. The prepared catalyst was characterized by different characterization techniques. X-ray diffraction indicates that CuS and ZnAl₂O₄ present 70% and 30% respectively of ZnAl₂O₄/CuS. The results of photocatalytic tests showed that this new photocatalyst can degrade 95% of a solution of Acid Red 1 (20ppm) in 150 min under ultraviolet illumination, on the other hand, CuS or ZnAl₂O₄ alone present a weak photocatalytic degradation, this indicates that the combination between the two catalysts (CuS and ZnAl₂O₄) can enhance the photocatalytic activity of ZnAl₂O₄/CuS. It was found, according to the results of free radical scavenging experiments that the superoxide ions (O₂^{·-}) and hydroxyl radicals (OH[·]) are the responsible of Acid Red 1 photodegradation. In addition, ZnAl₂O₄/CuS catalyst exhibited a high photocatalytic stability after even five cycles. Finely, the effects of operating parameters (dye concentration, catalyst amount and medium pH) were studied.

In the second part, a new nanocomposite named SZCo (River sediments @ zinc oxide doped by the Cobalt) was synthesized by a chemical co-precipitation followed by wet impregnation. All the characterisation techniques used to examine the prepared catalyst indicate that the synthesis was successively done for the two mass percentages (10 and 20%) of zinc oxide doped by Cobalt (ZCo). The photocatalytic activity of these catalysts was evaluated on the degradation crystal violet dye (CV) under visible light illumination. The effects of ZCo percentage, concentration of crystal violet solution and reaction medium pH on the photodegradation of crystal violet were studied using the Box-Behnken model, as a result, pH and ZCo amount affect highly the photocatalytic performance of SZCo. The photocatalytic experiments done under the obtained Box – Behnken conditions shown that SZCo20% degrade completely 20mg/l of a crystal violet solution under visible light irradiation in 40 minutes with a good stability in the reuse of this catalyst until five cycles. Superoxide ions and hydroxyl radicals are practically the responsible of this high photocatalytic performance according to the results of free radical scavenging experiments. Finely, a germination test was done to conform the high degradation performance of the SZCo20%.

Key Words: Photocatalysis, Semiconductors, Dyes, UV light, Visible light, anocomposites, Degradation.