PHOTOCATALYTIC DEGRADATION OF ORGANIC DYES IN THE PRESENCE OF NANOSTRUCTURE METAL OXIDES

By

Amira Abd El-Salam Abd El-Hakeem El-Maddah

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Chemical Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

Photocatalytic Degradation of Organic Dyes in the Presence of Nanostructure Metal Oxides

Key Words:
ZnO; Photocatalyst; Acid yellow 99; Kinetics; Fluorescence

Summary:

The purpose of the present research is to remove organic dyes from wastewater and mineralize it to CO_2 and H_2O using photocatalytic degradation process with ZnO as a primarily metal oxide and Acid Yellow99 dye as a model of the organic compound, enhancing the photocatalytic activity of the metal oxide by loading an appropriate amount of metallic silver on it, and obtain the optimum conditions of the photodegradation process which give the highest removal of organic compounds. Commercial ZnO and Ag/ZnO photocatalysts were used for the treatment of aqueous solutions containing AY99 under UV light illumination. Photocatalytic activity of commercial zinc oxide nanoparticles (ZnO) has been investigated and its photocatalytic efficiency improved by loading silver. Loading of silver on ZnO was done with various mol % (1, 3, 5, 7 and 9) of Ag, and the optimal experimental conditions were determined. A preliminary design and cost evaluation of a photocatalytic treatment unit which treats 216 m^3 per day of effluents was achieved based on the experimental work.

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List of Symbols and Abbreviation

Ag: Silver.

$AgNO_3$: Silver Nitrate

Au: Gold

AR88: Acid Red 88

AY99: Acid Yellow 99 dye

BET: Brunauer-Emmett-Teller

BGY: brilliant golden yellow dye

Bi_2WO_6: Russellite

$BiVO_4$: Bismuth vanadate

BOD: biochemical and oxygen demand

CB: conduction band

CD: Cyclodextrin

Co: Cobalt

COD: chemical oxygen demand

CW: Constructed wetland

CuO: Copper oxide

CdSe: Cadmium selenide

Cr (VI): hexavalent chromium

Cr: chromium

Cu: Copper

CO_2: Carbon Dioxide

DS: dissolved solids

DDT: 1,1,1-trichloro- 2,2-di(4-chlorophenyl)ethane

EDX: Elemental distribution

Fe: Iron

Fe (II): ferrous oxide

g-C_3N_4: Graphitic carbon nitride

H_2O_2: Hydrogen peroxide

KNO_3: Potassium nitrate

$K_2Cr_2O_7$: potassium dichromate

LCD: Liquid-crystal display

LED: Light-emitting diode