UNIVERSITI TEKNOLOGI MARA

TiO_2 THIN FILM PHOTOCATALYST WITH SOLAR ENERGY IN TEXTILE INDUSTRIAL WASTEWATER TREATMENT

NUR FADZEELAH ABU KASSIM

Thesis submitted in fulfillment of the requirements
for the degree of
Master of Science

Faculty of Chemical Engineering

August 2007

Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and the result of my own work, unless otherwise indicated or acknowledge as reference work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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Candidate's Name	:	Nur Fadzeelah Binti Abu Kassim
Candidate's ID no.	:	2003357879
Programme	:	Master of Science (Chemical Engineering) – EH780
Faculty	:	Chemical Engineering
Thesis Title	:	TiO_2 Thin Film Photocatalyst with Solar Energy in Textile Industrial Wastewater Treatment

Signature of Candidate : 

Date : 31 August 2007

ABSTRACT

Among the new methods of treatment of wastewater containing dyes is photocatalytic degradation in solutions illuminated with UV irradiation containing titanium dioxide (TiO_2) as suitable photocatalyst. Photocatalytic degradation is gaining importance in the area of wastewater treatment, mainly in textile industry.A serpentine solar flow photocatalytic reactor was developed for this purpose. This kind of reactor achieved a uniform flow distribution and irradiation of the entire photocatalyst surface TiO_2 thin films photocatalyst supported on the stainless steel 304 plate as a substrate. This photocatalyst was prepared using sol-gel dip coating method from the system containing alkoxide solutions with two polyethylene glycol (PEG) molecular weight, PEG400 and PEG2000. The prepared photocatalyst was characterized using X-Ray Diffractometer (XRD), Thermo Gravimetric Analyzer (TGA) and Scanning Electron Micrograph (SEM).

Five experimental conditions were studied to investigate the decreasing of Chemical Oxygen Demand (COD) on the solar photocatalytic activity of textile industry wastewater, i.e. photolysis (without TiO_2), TiO_2 thin film without solar, TiO_2 thin film, TiO_2 thin film with aeration and TiO_2 powder (suspended system). The transition from amorphous to crystalline phase (anatase) was observed obviously after calcinations for both PEG molecular weights. However, PEG2000 is more photoreactive than PEG400 due to high peak intensity formation. SEM results showed that the spherical pores and macroporous structure formed using PEG2000. The larger molecular weight of PEG, the higher possibility of forming the porous TiO_2 thin films. From the photocatalysis experiments, sample TiO_2 thin film with aeration revealed the highest COD removal, which is 17.13% compared with another four samples after four hours irradiation time. Thus, dissolved oxygen is significantly affected on the photocatalytic degradation. Finally, photocatalysis using solar had successfully removed 58.92% of SS (Suspended Solid), 17.13% of COD and 4.68% of TOC (Total Organic Carbon).

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Water is a limited resource for various applications in many developing countries. However, increasing in industrialization and population growth has caused tremendous contamination of surface water during the past decades. As a consequence, the laws regarding environmental protection have been tightened in many countries to protect the water from being seriously polluted. To fulfill these regulations means increasing the number and the efficiency of wastewater treatment methods. Thus, water pollution and contamination have prompted scientific research to determine effective methods among all the wastewater treatment methods, in order to remove the pollutants and contaminants.

Industrial wastewater is becoming more and more complex with its ever increasing variety in composition and toxicity. In the textile industry alone; the effluents contribute 21.5% of the total volume of industrial wastewater generated in Malaysia (Industry & Environment in Asia – Malaysia, 2005). The textile industry produces large amounts of effluents, which are both toxic and resistant to destruction by physicochemical methods and biodegradation. According to Banat *et al.* (1996), the textile industry consumes substantial volumes of water and chemicals for wet processing. These chemicals are used for resizing, scouring, bleaching, dyeing, printing and finishing processes. The variety of chemicals is extensive from inorganic compounds and elements to polymers and organic products. Hence, numerous textile manufacturers, in many countries, are experiencing great difficulty in complying with increasingly stringent federal and state regulations concerning dye polluted wastewater. Textile wastewater is usually treated in order to reduce its pollution load in terms of effluents prior discharge in the water. However, certain