CHAPTER I

INTRODUCTION

1.1 Motivations

Chromium has been widely used in several industries, such as metal plating military purposes and tanning of leather, as well as in the pigment and refractory industries. Normally chromium can exist in the form of several oxidation states. Chromium occurs in two common oxidation states in nature as chromium(III) and chromium(VI). Hexavalent chromium with concentrations higher than 0.05 ppm is toxic to most organisms, carcinogenic in animals, and causes irritation and corrosion of the skin in humans(Khalil et al., 1998) while trivalent chromium is easily precipitated or adsorbed on a variety of inorganic substances at neural or basic pH (Kajitvichyanukul et al., 2004). Treatment of contaminated chromium(VI) can be achieved by chemical precipitation, ion exchange, bioremediation and adsorption on coal or activated carbon. Nevertheless, most of these methods require either high energy or large quantities of chemicals (Khalil et al., 1998).

Photocatalysis is a novel technology for environmental abatement. As an efficient means for pollution treatment, this technology is widely investigated to remove organic and inorganic contaminants from water and wastewater. The most suitable catalyst for photocatalytic is titaniumdioxide (TiO_2) (Rajeshwar et al.,1997). Titanium dioxide (TiO_2) has been widely used as a photocatalyst due to its activity, photostability, non-toxicity and commercial availability. There are previous studies show that chromium(VI) can undergo photocatalytic reduction and deposit on the surface of titanium dioxide (Lin et al., 1993; Ku and Jung, 2001; Kajitvichyanukul and Watcharenwong, 2003; Tuprakay, 2005). However, there are some problems when TiO_2 is used as catalytic in photocatalytic process which are low adsorption activity and the difficulty in separating the catalyst from the effluent. The latter problem could be avoided by using the TiO_2 films applied on different types of substrates (Fujima, 2000.). As results, many research works have been used the TiO_2 in an immobilized from to treat pollutants from water/wastewater. Recently, many

research works were focused on solving the first problem, the improvement of adsorption ability of TiO_2. In this recent work, the synthesis of new composite material as TiO_2/chitosan film was purposed with the major objective was to enhance the adsorption ability of TiO_2 in photocatalytic process. Chitosan is biopolymer material produced from N- deacetylation of chitin. It has superb ability in adsorption pollutants especially metal ions. It is a powerful chelating agent, which is easy to form complexes with the combination of chitosan on TiO_2 film. It was expected that the adsorption ability of TiO_2 would be enhanced.

The TiO_2/chitosan film was prepared by using TiO_2 (degussa P-25) mixed with chitosan as chitosan from crab shells (Fluka, Sigma-aldrich co., plc) which was highly viscosity (411 MPas) in the solvent as acetic acid. The effects of chitosan and titanium quantity on the film properties, adsorption and photocatalytic activities were studied. The obtained material was characterized by Scanning Electron Microscope (SEM), X-Ray Diffraction (XRD).

Equilibrium adsorption isotherm of composite material was determined by Langmuir and Freundlich equations. The photocatalytic activity was evaluated by decreasing of chromium(IV) concentration after irradiation. The photocatytic kinetic pattern of the composite material as TiO_2/chitosan film was investigated in this work.

1.2 Objectives

The main objective of this work was synthesis of new composite material as TiO_2/chitosan film to enhance the adsorption ability of TiO_2 in photocatalytic process. The specific objectives were as follow:

1.2.1 To investigate effects of chitosan quantity on film properties, adsorption and photocatalytic activities for chromium(IV) removal.

1.2.2 To investigate effects of titanium quantity on film properties, adsorption and photocatalytic activities for chromium(IV) removal.

1.2.3 To investigate equilibrium adsorption isotherm of TiO_2/chitosan film adsorption activity for chromium (VI) removal.

1.2.4 To determine kinetic constant, k_{obs} of TiO_2/chitosan film on photocatalytic activity for chromium(VI) removal.

1.3 Hypotheses

TiO_2/chitosan film could efficiently remove chromium(VI) from wastewater. The studied parameters including quantity of chitosan, titanium and initial concentration of chromium(VI) in synthetic wastewater were the major factors that effect on film properties, adsorption and photocatalytic activities for chromium(VI) removal.

1.4 Scopes of the study

All of experiments in this research were conducted on laboratory scale. Scopes of this study work were as followed :

1.4.1 Chitosan and TiO_2/chitosan films were prepared by modified Sukkunta's film preparation (Sukkunta., 2005).

1.4.2 The factors that effect on film properties studied in this work included :

- Chitosan quantity
- Titanium quantity

1.4.3 The studied characteristics of TiO_2/chitosan film were based on film properties. Major properties to study included surface morphology and crystal structure.

1.4.4 Adsorption activity of TiO_2/chitosan film was measured using chromium(IV) removal in synthetic wastewater.

1.4.5 Photocatalytic activity of TiO_2/chitosan film was measured using chromium(IV) removal in synthetic wastewater. The mechanism of chromium(VI) photoreduction did not include in this study.

1.5 Benefits of this work

Result from this research can be further used to prepare TiO_2/chitosan film. Moreover, they can applied to design a full-scale photoreactor that is practically used in industrial wastewater treatment containing chromium(VI) by photocatalytic process.