CHAPTER I

INTRODUCTION

1.1 Motivations

Recently, an innovation technology, relating to photocatalysis process in aqueous solution of semiconductors which was received considerable attention in view of light energy conversion (Zhang and Crittenden, 1994). This photocatalytic process exhibits rapid and high efficiency in destroying in the environmental pollutants mainly found in wastewater and air.

Photocatalytic processes have been of continuous interest in the treatment and purification of air and water since they can complete the reduction of metal ions. Furthermore, organic species can be completely mineralized to carbon dioxide or become nontoxic materials (Fu et al., 1998). Titanium dioxide (TiO_2) has been widely used as a photocatalyst due to its activity, photostability, non-toxicity and commercial availability (Oppenlander, 2003). Several techniques (Srikanth et al., 2001) have been developed to immobilize TiO_2 on different substrates with suitable properties to propose a highly active surface area and photoactivity. The post treatment of suspended TiO_2 after treatment process can be avoided by attaching a layer of TiO_2 on the solid support via the sol-gel method in producing thin film TiO_2. Thus, in the real application stream flow can also be irradiate and the photocatalysis process can occur along the water path. For this research, the prototype model of photocatalysis, which produced by thin film TiO_2 to remove hexavalence chromium (VI), was innovated.

Chromium (VI) is a highly toxic heavy metal as well as highly soluble substance over a wide range of pH conditions. It is used in a variety of industrial processes, consisted of wood treating, plating, and tanning as well as in the power industry. Naturally chromium occurs in the trivalent form, Chromium (III), and has limited solubility (except in extremely acidic conditions). Failure to treat Chromium (VI) contamination in a quick manner, results in larger future expenditures as

groundwater plumes continue to spread, unless remediate (Thomasser and Rouse, 2001). All of them are very hazard to the human-being life. Furthermore, recently public investigate the most efficiency way for solve this problem and photocatalysis reactor in one choice for this implement.

In this research, Rotating Disc photocatalytic reactor was selected as an implement method. Rotating Disc reactor in this work incorporating TiO_2 catalyst and UV radiation was used for the photocatalytic reduction of chromium (VI) in water. In this research RDPR was expected to remove Chromium (VI) and the operation parameters that were investigated in this work included initial pH of wastewater, waste stream flow rate, rotating disc speed, amount of TiO_2 coating surface area and the initial concentration of chromium.

1.2 Objectives

The main objective of this research was to investigate effect of operating parameters on chromium (VI) removal efficiency using RDPR. The specific objectives were:

1.2.1 To innovate the prototype model of photocatalysis for completely removes chromium (VI) from wastewater.

1.2.2 To investigate the effect of initial pH of wastewater, waste stream flow rate, rotating disc speed, TiO_2 coating surface area and initial concentration of chromium (VI) on photocatalytic activity of chromium (VI) removal.

1.3 Hypotheses

Rotating Disc Photocatalytic Reactor (RDPR) can efficiently remove Chromium (VI) from the wastewater. The studies operating parameters including initial pH of wastewater, waste stream flow rate, rotating disc speed or rpm, amount of TiO_2 coating surface area and initial concentration of chromium (VI) solution are the major factors affecting the efficiency of RDPR.

1.4 Scope of the study

All experiments in this research were conducted on laboratory scale. The scopes of this work were as follows:

1.4.1 RDPR was designed and set up.

1.4.2 TiO_2 thin films were prepared by sol-gel dip-coating technique.

1.4.3 The thin film characteristics were measured for photocatalysis purposes only. This characteristic study was not involved optical or electrochemical aspects.

1.4.4 Synthetic industrial wastewater with a concentration of chromium (VI) corresponding with real wastewater was used.

1.4.5 The photoreduction of chromium (VI) was tested with major operating parameters of RDPR including initial pH of wastewater, flow rate of continuous mode, rotating disc speed or rpm, TiO_2 coating surface area and initial concentration of chromium (VI) solution.

1.5 Benefits of this work

Results from this research can be further used to prepare TiO_2 thin film on stainless steel discs plate by sol-gel technique. Moreover, they can be applied to design a full-scale photoreactor that is practically used in industrial wastewater treatment containing chromium (VI) by photocatalytic process.