CHAPTER I

INTRODUCTION

1.1 Motivations

One of the most crucial environmental problems is water pollution generated by wastewater containing toxic contaminants. Pulp and paper industry is one of the high pollution load industry of which not only organic pollutants but also toxic substances. The effluent from the pulp and paper industry would increase the amount of toxic substances in the water, causing death to the aquatic life in ecosystem as well as profoundly affecting the terrestrial ecosystem. Phenolic compounds are considered as one of toxic substances found in the pulp and paper wastewater. These phenolic compounds are also harmful to aquatic life in the ecosystem. It requires treating such compounds prior to discharge to any environmental systems There are various treatment technologies including biological and chemical processes developed for treating such toxic contaminated wastewater. Regarding the biological technology, the treatment might not be successful as the microorganisms would possibly be killed by those toxic substances (Sawyer et al., 1994). The precipitation and adsorption might result the higher treating efficiency, but the toxicity could be remained in the sludge or the spent adsorbent. By means of these methods, the pollutants are transformed from one to other forms without a complete mineralization. Advanced oxidation processes (AOPs) are attractive alternative technologies for mineralizing toxic organic pollutants (Oppenländer, 2003). One of the most promising methods of AOP for environmental applications is photocatalytic process (Hoffmann et al., 1995; Mills and Hunte, 1997; Watanabe et al., 1999; Bhatkhande, 2001). Moreover, photocatalytic process has several advantages over the conventional oxidation processes including completing mineralization of pollutants, utilizing the near-UV light without addition of chemicals (Ksibi et al., 2003). It is enthusiastically to apply photocatalysis for phenolic compounds degradation.

As already known that photocatalysis is the process that accelerate the photochemical reaction by utilizing catalysts. Titanium dioxide is commonly used as a catalyst.

However, in this study the titanium dioxide and tin-doped titanium dioxide were synthesized in forms of nanocrystalline in order to increase the degradation efficiency.

1.2 Objectives

The main objective of this research was to utilize the synthesized nanocrystalline titanium dioxide and tin-doped titanium dioxide as catalyst for photocatalytic degradation of phenolic compounds. The sub objectives are as follows:

1. To synthesize nanocrystalline titanium dioxide and tin-doped titanium dioxide by sol-gel technique to use as the catalyst for photocatalysis.
2. To determine the optimum temperature for the synthesized nanocrystalline of titanium dioxide by identification of the physical and chemical characteristics and its photocatalytic activity.
3. To determine the optimum ratio for synthesized tin-doped titanium dioxide by identification the physical and chemical characteristics and its photocatalytic activity. The synthesized material was obtained and used for phtocatalytic experiments.
4. To perform the photocatalytic reaction of the synthesized materials with phenolic compounds for intermediates investigation.
5. To perform the photocatalytic reaction of synthesized materials with phenolic compounds: synthetic wastewater of pulp and paper both of individual solution and mixed solution.
6. To perform photocatalysis with real wastewater by using synthesized material.

1.4 Scope of the Study

1. Photacatalytic testing was carried in batch vessel of 200 ml at the ambient temperature for all experiments.
2. Determinations of optimum temperature and optimum ratio were tested on phenol solution and evaluated as the phenol degradation efficiency.
3. The commercial catalyst used was Sigma Aldrich (Aanatase, 99.8%)
4. The real wastewater was taken from the pulp and paper mill located in Ubonrattana Destrict, Khon Kaen Province

1.5 Expected Outcomes

1. Obtaining the effective nonocrystalline titanium dioxide and tin-doped titanium dioxide catalysts
2. Obtaining the high efficiency photocatalyst for phenolic compounds degradation
3. Understanding the pathway and kinetic of degradation of phenolic compounds.
4. Alternative treatment by advance oxidation process for pulp and paper wastewater.