Chapter 1

General Introduction

1.1 Introduction

In a big city as Bangkok, there are a lot of restaurants, food shops and food centers, which everyday make large amounts of wastewater. The direct discharge of wastewater from these restaurants and food shops to the drainage system is a huge extra burden to the municipal wastewater collection and treatment works. The oil and grease contained in the wastewater aggregate and foul the sewer system and generate an unpleasant odor.

Basically, restaurant wastewater treatment facilities must be highly efficient in removing oil and grease, cause no food contamination and be compact size. Low capital and operating costs are important because profit margins of most restaurants are small. In addition, the technology has to be simple so that it can be operated easily either by a chef or a waiter [1].

Conventional biological processes are therefore ruled out due to the requirement of large space, long residence time and skilled technicians. Chemical coagulation/settlement is not practicable because of the low efficiency in removing light and finely dispersed oil particles and possible contamination of foods by chemicals. The G-bag approach, which uses a bag of absorbent to capture the pollutants and degrade the pollutants with the immobilized microorganisms on the absorbent, seems to be a good

alternative only if the system can be designed as simple and free from fouling [1].

Electrochemistry is a clean, versatile and powerful tool for the destruction of organic pollutants in water. Electrochemical oxidation of organic compounds in aqueous solution is an anodic process occurring in the potential region of water discharge to produce oxygen. Two different pathways are described in the literatures for the anode oxidation of undesired organic pollutants [2].

Electrochemical conversion transforms only the toxic non-biocompatible pollutants into biocompatible organics, so that biological treatment is still required after the electrochemical oxidation [3]. The ideal electrode material which can be used in the electrochemical conversion method must have high electrochemical activity for aromatic ring opening and low electrochemical activity for further oxidation of the aliphatic carboxylic acids which are in general biocompatible [3].

Electrochemical combustion method completely oxidizes the organic pollutants to CO_2 by physisorbed hydroxyl radicals. In this case, the electrode material must have high electrocatalytic activity towards the electrochemical oxidation of organics to CO_2 and H_2O [3].

Comparison of different anode materials, SnO_2 is one of the best candidates for removal of organic pollutants from wastewater by electrochemical oxidation [2]. There are varieties of methods suitable for preparing the SnO_2 layer for obtaining dimensionally stable anodes such as reactive sputtering, sol-gel dip coating, spray-pyrolysis or chemical vapor deposition [2].

Chemical vapor deposition (CVD) is very attractive for thin film coating. It has advantages for growing thin films such as good conformal coverage on patterned or rough surfaces because of high throwing power of gaseous reagents and a good ability for large-scale production. CVD is particularly well adapted to uniform deposition on complex-shaped base material with a relatively high growth rate [4]. Furthermore, using metal–organic chemical vapor deposition (MOCVD) permits decreasing significantly the deposition temperature and obtaining high purity of deposited layer.

In this research, metal-organic chemical vapor deposition was used as the technique for the preparation of electrocatalytic electrodes for electrochemical oxidation of organic pollutants presented in restaurant wastewater. The effects of substrate materials, SnO_2 active layer thickness and current density on pollutants removal efficiency of prepared electrodes were investigated.

1.2 Objectives

1. Design and fabricate the continuous electrochemical oxidation system for restaurant wastewater treatment
2. Determine the efficiency of pollutant reduction by electrochemical oxidation in continuous process
3. Prepare the economical evaluation for restaurant wastewater treatment by electrochemical oxidation in continuous process

1.3 The steps of work

- Literature surveys, that will continue throughout the research work.

- Part I Batch process

1. Prepare electrodes by metal-organic chemical vapor deposition and characterize the prepared electrodes by SEM and XRD.
2. Study and determine the optimum condition for removal of organic pollutants by using oxalic acid as model solution in batch electrochemical oxidation by using the prepared electrodes;
    - SnO_2/Ta electrode
    - SnO_2/TaC/Ta electrode
    - SnO_2/Ir/Ti electrode

- Part II Continuous process

1. Fabricate the continuous electrochemical oxidation system.
2. Study and determine the organic pollutants removal efficiency from actual restaurant wastewater in the continuous process by using the optimum condition of batch experiment.
3. Result interpretation and discussions.

- Part III Economic evaluation

1. Analyse economic aspects of restaurant wastewater treatment by the electrochemical oxidation in the continuous process
2. Conclude, write of dissertation manuscript and publish technical papers