CHAPTER I
INTRODUCTION

A large amount of toxic wastes, approximately 1.6 million tons per year, has been generated and only 20% of the waste has been properly treated and reduced (Vidchayarangsalid, 2002). Sludge is one of the most abundant toxic wastes. Sludge is defined as the residual material that remains after wastewater treatment. It can be classified into three major types; municipal sewage sludge, waste sludge from potable processes and waste sludge from industrial wastewater treatment process. API sludge, the industrial waste sludge, is one of the major types of sludge found in the oil refineries, generated from American Petroleum Institute (API) separator. The major components of API sludge are water, liquid oil and solid organic/inorganic material. From the report of PTT Public Co, Ltd., approximately 20,000 liters per three years or 6,700 liters per year of API sludge was generated (Kalambaheti, 2002).

Attempts have been made to dispose API sludge by several methods such as incineration, chemical treatment, and land filling. With incineration, the completeness of waste sludge disposal can be obtained; however, it produces toxic emission to environment. In chemical treatment processes, API sludge is transformed to be non-toxic materials, but it is rather difficult to find suitable treating conditions. Land filling is the easiest and the most economical way to dispose waste sludge but if it is not treated properly, toxic chemicals can escape to environment. Pyrolysis, recently, is seen to be an alternative technique since it does not only handle the sludge disposal, but it can recover the energy from sludge. In addition, it has also been proven to be an alternative way to eliminate many wastes such as plastic waste (Shibai *et al.*, 2002) and biomass waste (John *et al.*, 1997).

Pyrolysis, a thermal decomposition process of concerned solid material in the absence of oxygen, is the first step in the gasification and combustion process (Font *et al.*, 2001). The application is specifically devised to cleave large macromolecules into smaller fragment molecules by breaking carbon-carbon bonds that link organic molecules, leading to the formation of a mixture of liquid (tarry composition), gases and a highly reactive carbonaceous char. Temperature, pressure, heating rate, and reaction time influence the proportions and characteristics of the main products (Inguanzo *et al.*, 2002). For example, products from Poly (vinyl alcohol) pyrolysis were 5.85 wt% of residual mass, 54 wt% of gaseous products, 16.74 wt% of liquid oil, and 23.31 wt% of reaction water at 400-800°C (Shie *et al*, 2002). However, products from pyrolysis of putrescible garbage, sewage sludge, and ash mixtures were 46 wt% of residual mass, 27 wt% of gaseous products, 17 wt% of liquid oil, and 10 wt% of reaction water at 400-550°C (Shen *et al*, 2001).

The aim of this work was to investigate pyrolysis of API sludge and kinetic behavior by means of Thermogravimetric Analysis (TGA). Pyrolysis products were analyzed by Mass Spectroscopy (MS) to elucidate possible pyrolysis mechanisms.