CHAPTER 1

INTRODUCTION

1.1 General

At present, municipal solid waste is a serious problem for Thailand. Municipal solid waste in Thailand in 2002 was about 22 million tons annually. The various components of municipal solid waste in Thailand were for example; food waste, paper, plastics, textiles, rubber, wood, yard wastes, glass, metal, etc. Most of the above wastes was fruit/vegetable and accounted for about 45% of all waste. Landfills are the most widely used method of solid waste disposal in Thailand today. This is primarily due to its ability to be designed, installed and operated at lower costs than other solid waste management alternatives. However, landfill has its own problems and is being developed to overcome problems such as leachate, gas emission, odor, etc. Production of leachate has led to many documented cases of groundwater and surface water pollution. Landfill gas emission can lead to malodorous circumstances, adverse health effects, explosive conditions, and global warming. Traffic, dust, animal and insert vectors of disease and noise often are objectionable to neighbors.

Now, the main problem from landfill leachate migration is contamination of groundwater by heavy metals. Pollution Control Department (PCD), 1998 showed that groundwater has been significantly contaminated by heavy metals and other harmful substances in the areas around numerous waste sites in Northern and Central Thailand. This problem may be caused by inappropriate management of landfill system with respect to both design and operation, as well as no proper separation of the wastes. The contamination of household hazardous waste in municipal waste is one cause to this problem. According to a survey conducted by Public Health Research Institute of Thailand (Public Cleaning Bangkok Metropolitan Admin (BMA), 1997), the contamination of household hazardous waste in municipal solid waste in Bangkok in 1993 was 22 tons per day and the trend would increase. The

household hazardous wastes are oil tires, used oil, automobile battery, household battery, mobile battery, etc.

The major sources of heavy metals in landfills are the co-disposed industrial wastes, incinerator ashes, mine wastes and household hazardous substances such as batteries, paints, dyes, inks, etc. (Forstner, 1991). Common heavy metals in landfills are iron, cadmium, copper, zinc and nickel (Flyhammer, 1998). These heavy metals are toxic and thus liable to produce serious problems on health of population and on maintenance of the biosphere. Consumer batteries contribute significantly to this problem. Heavy metal concentrations in leachate do not appear to follow degradation patterns of organic indicators such as COD, BOD, nutrients, or major ions. Heavy metal release is a function of characteristics of leachate such as pH, ORP, and concentration of complexing agents (Forstner, 1991).

Solubility of metals in leachate depends on pH, redox potential, and solubility of the deposited metal species, concentration of complexing agents (NH_3/ NH_4^+, organic acids) and ionic strength (Forstner, 1991). Metal solubilities in the leachate increase as pH decreases. The highest metal concentrations are observed during the acid formation phase of waste stabilization when pH values are low. Therefore, methanogenic conditions and neutral pH must be established within landfill site so as to form insoluble metals in the reducing atmosphere before the co-disposal commences (Greedy, 1993, Campbell, 1994). Under methanogenic conditions, soluble metals precipitate as insoluble sulfides, carbonates, hydroxides and possibly phosphates in landfills (Pohland, 1991). However, in the presence of sulfides, most of heavy metals except chromium form extremely insoluble sulfide salts (Pohland, 2000).

The focus of this study was to examine the impact of nickel and zinc on degradation of organic waste as indicated by leachate and gas production parameters, especially during acidogenic and methanogenic phases.

1.2 Objectives of the study

The main objective of this work is to study the impact of nickel and zinc on degradation process of organic waste. In order to achieve this goal, the following subobjectives are set:

1. To study leaching behavior of nickel and zinc added during acidogenic and methanogenic phases of landfill stabilization

2. To study impact of nickel and zinc on landfill stabilization process as indicated by leachate and gas production parameters, during acidogenic and methanogenic phases

1.3 Scopes of the study

1. Construction and operation of reactors capable of running landfill stabilization experiment with leachate recycle scheme. The landfill will be filled up with organics waste from Sri-Mum-Muan Market
2. Addition of nickel and zinc during acidogenic and methanogenic phases
3. Assessment of the degree of leaching out for nickel and zinc during acidogenic and methanogenic phases
4. Assessment of impacts of nickel and zinc on landfill stabilization process