CHAPTER 1

INTRODUCTION

1.1 General

Landfilling is the most utilized method of solid waste disposal in the world today. This is because its ability to be designed, constructed, and operated at less cost than other solid waste management options. However, environmental awareness associated with adverse impacts created by leachate and gas emanating from improperly managed waste disposal sites is rapidly growing. This result in more stringent regulations governing the establishment of new facilities or the expansion of existing facilities so as to prevent the reoccurrence of such events. This has led to an increase in capital, operating, and monitoring costs of modern municipal solid waste (MSW) landfills. Along with, appropriate sites within a reasonable hauling distance from collection or transfer stations are becoming more difficult to acquire. Therefore, available space in landfill for ultimate disposal of solid wastes is going to shrink, while the amount of waste generated by communities is increasing.

The design and operation of MSW landfills has improved due to the collaborative efforts from public and private sectors through extensive research conducted in laboratory-, and field-scale landfills. This research emphasizes efficient utilization of available landfill volume, acquisition of additional space within landfill cells through innovative design of the containment system, reduction of solid waste stabilization time, and landfill reclamation. Among these studies, innovative techniques for containment, cell development, separation, and closure, along with accelerated waste stabilization achieved through leachate recirculation has received attention, since benefits gained from these techniques in terms of space saving, compression of necessary stabilization time as well as enhancement of leachate and gas management are significant.

The amounts of leachate and gas produced are unpredictable and unavoidable, therefore typical modern landfill must have an impermeable bottom liner and is capped with an impermeable cover immediately after filling up to contain degradation

products and to prevent moisture penetration. However, these caps act to limit the moisture introduction which is an essential factor for biodegradation. Without adequate moisture, the degradation will slowly proceed and landfill will serve only as a big temporary waste storage pile.

Under proper conditions, the rate of biodegradation in a landfill can be stimulated, enhanced and controlled within certain limits. Parameters, which can exert influence upon biodegradation activities, are, for example, pH, temperature, nutrients, absence of toxins, moisture content, particle size and oxidation-reduction potential. One of the most critical parameters affecting biodegradation has been found to be moisture content of solid waste. Moisture addition has a stimulating effect on biological stabilization of landfill. Leachate recirculation appears to be the most effective method to increase moisture content in a controlled fashion. Leachate recirculation provides a means of optimizing environmental conditions within the landfill, providing enhanced stabilization of landfill contents as well as treatment of leachate moving through the fill. It has been suggested that leachate recirculation could reduce the time required for landfill stabilization from several decades to 2-3 years, thus minimizing the opportunity for long term adverse environmental impact.

This research emphasized the leachate recirculation scheme in bioreactor landfill that enhances gas production and reduces stabilization time for organic waste, which is the major element of waste in Thailand. Analysis of the results provides a basis for field application and for further research needs.

1.2 Objectives of Study

1. To conduct three different leachate recirculation schemes.
2. To compare the impacts of each leachate recirculation scheme on the landfill stabilization of organic waste.

1.3 Scopes of Study

1. Setting up three lab scale bioreactor landfills.

2. Synthetic solid waste consists of vegetables and fruits waste is loaded to each reactor to assure accelerated stabilization and to establish the identity and maximize the homogeneity of the refuse.
3. Each reactor would be treated with different leachate recycle scheme to compare the impacts of each scheme on the stabilization rate and gas production.
    1. No Recycling (Single-pass Reactor)
    2. Recycling based on leachate volume and percent methane
        - Easy to control and measure both input and output
        - Recirculation starts in acidogenesis phase
    3. Recycling based on COD mass and volume of methane
        - By mass balance principle.

    4. The change in the leachate recycle phase is reflected by number of parameters for instance; pH, gas production, ORP, COD, percent methane, alkalinity, ammonia nitrogen, and orthophosphate.