UNIVERSITI TEKNOLOGI MARA

SANITARY LANDFILL LEACHATE TREATMENT BY PHYSICO-CHEMICAL AND BIOLOGICAL METHODS: A COMPARATIVE STUDY

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Thesis submitted in fulfillment of the requirements
for the degree of
Master of Science

Faculty of Applied Sciences

November 2008

Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other institution or non-academic institution for any other degree of qualification.

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ABSTRACT

Landfill is one of the most widely employed methods for the disposal of municipal solid waste (MSW). Up to 95% of total MSW collected worldwide is disposed of in landfills. After landfilling, solid waste undergoes physico-chemical and biological changes. Consequently, the degradation of the organic fraction of the wastes in combination with percolating rainwater leads to the generation of leachate. If not properly treated, leachate that seeps from a landfill can enter the underlying groundwater, thus posing potentially serious hazards to the surrounding environment and to public health. As a result, the search for effective and efficient treatment technologies landfill leachate has intensified in recent years. In this study, the applicability and treatment performance of physico-chemical methods and biological method (as either individual and/or combined) for landfill leachate are reviewed. The study on coagulation–flocculation and Fenton's reagent method as physico-chemical treatment process, while activated sludge and biofilter were used as biological treatment methods. The advantages and limitations of various techniques are evaluated. Their operating conditions such as pH, coagulant and coagulant aid dosage, characteristics of leachate in terms of COD, NH_3–N, total-nitrogen and color concentration and treatment efficiency are compared. The results obtained indicate that individual physico-chemical treatment is less effective than the integrated treatment. It is found that Fenton's reagent could remove highest, of COD, NH_3–N, total-nitrogen and color from landfill leachate, namely 89%, 95%, 86% and 81%, respectively, when compared to coagulation and flocculation process. A combination of physico-chemical and biological treatment has demonstrated high efficiency for the treatment of stabilized leachate. Almost complete removal of COD, NH_3–N, total-nitrogen and color from landfill leachate, has been accomplished by a combination of Fenton's reagent and a biofilter, namely 93.5%, 97.7%, 98.0% and 99.2%, respectively.

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CHAPTER 1

INTRODUCTION

1.1 Background

Land disposal of solid wastes has been practiced for centuries, dating back to prehistoric times. Municipal, industrial, agricultural, and urban activities produce huge amounts of wastes which require permanent disposal. Returning some of the solid wastes to the land is a practical approach for waste disposal. Because the human population rate increases every year, the solid waste generated increases each year. As the amount of waste rapidly increases, space for permanent disposal becomes crucial. Since the production of solid waste is increasing much more rapidly than its degradation, land space for disposal has become more difficult to obtain. There are several waste management options that can be used to reduce the amounts of waste requiring land disposal. Incineration of solid waste is one of an alternative but it is expensive and the emissions are of health concern. Therefore, landfilling is still a popular method for municipal solid waste (MSW). Up to 95% total MSW collected worldwide is disposed of in landfills (El-Fadel et al., 1997).

After landfilling, solid waste in a landfill is degraded through aerobic and anaerobic processes. Stabilization of the wastes is a very complex and variable event due to the site-specific characteristics of each landfill. Consequently, the degradation products generated from the stabilization process include leachate and gas. The landfill gas is generated due to the anaerobic biological degradation of organic material. Leachate is formed from the contact of water with refuse. The water, mainly from precipitation, dissolves soluble organics and inorganics including some toxic compounds if present in landfill material.