

Chapter 5

Design and Operation of Semi–Aerobic Landfill

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ABSTRACT

Landfilling is broadly recognized as a proper waste disposal method. Although ranked at the bottom of sustainable waste management hierarchy, final waste disposal technologies like sanitary landfill remain crucial for development country due to increasing waste generation. Since landfill is a permanent disposal site that could cause serious environmental pollution, a proper planning and development of landfill are important in avoiding problems in the future. In this chapter the general principles of landfill design and operation is given at the beginning. Then the following discussions were focusing on the design and operation of semi-aerobic landfill. The revision for design and operation of semi-aerobic landfill working phase were reported separately. Finally the summary of the discussion were given at the end of this chapter.

INTRODUCTION

Solid waste management is a systematic practice of waste generation storage, collection, transport, treatment and disposal (Agamuthu, 2010). Sanitary landfill is one of the important methods for solid waste disposal in waste management system. Even though there are more advance disposal methods have been developed, the sanitary landfill remains as an ideal method for developing country (Idris & Hassan, 2004). The sanitary landfill is a final disposal method that treats and restores the organic portions of the waste to the nature which emphasizing the technical aspects like siting, design, operation and long-term environmental addedment (Hans & Ramke 2001).

Unlike open dumpsite, the sanitary landfill is designed to deal with leachate, landfill gas and odor management. The collected wastes are handled at a disposal facility that is designed and operated at a constraint of public health and environment protection. The primary purpose of landfill site is to imple-

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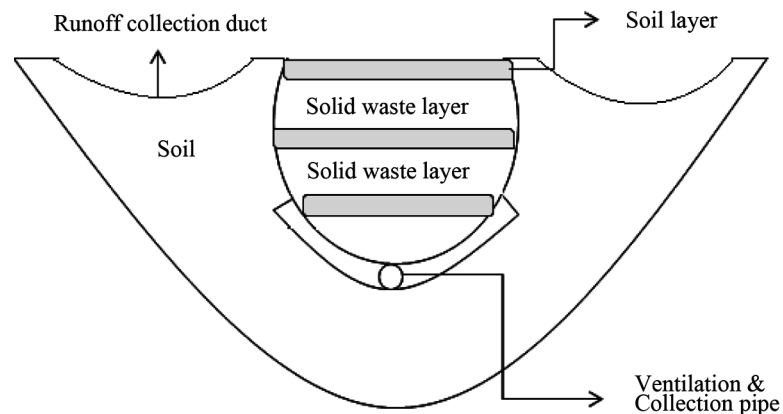
ment final disposal of the waste with minimum environmental impact. Besides, the sanitary landfill system can be classified based on decomposition process employed. Table 1 describes the characteristics of the landfill types.

Among others sanitary landfill system, the semi-aerobic landfill is the most desirable landfill design (MHLG, 2004). It is also referred to as “passive aeration” by the United Nations (UN) and was approved as a new Clean Development Mechanism (CDM) (Tashiro, 2011). Initiated by Prof. Masataka Hanashima of Fukuoka University, pilot semi-aerobic landfill was first tested in 1975 at Shin-Kamata Landfill in Fukuoka, Japan (Chong & Hassan, 2005). Interestingly, the semi aerobic landfill is largely implemented in the eastern part of Asia (Zhang et al., 2013; Sangjae et al., 2014). This is most probably due to the leachate and waste stabilization via passive aeration without using any type of mechanical equipment (Toshishiko et al., 2015). Figure 1 shows the schematic diagram of semi aerobic landfill. In semi-aerobic landfill system, oxygen flows into the waste mass through the leachate collection pipes by passive ventilation to accelerate an aerobic microbial decomposition in the waste body. It hastens waste stabilization and improves leachate water quality (Theng & Mohd, 2005).

Table 1. Landfill classification system based on decomposition process employed

Landfill Type	Characteristics
Anaerobic landfill	Solid wastes are filled in dug area of plane field or valley. Waste is commingled with water in anaerobic condition.
Anaerobic sanitary landfill covered daily	Solid waste is covered in a sandwich shape. Condition in solid waste is same as anaerobic landfill.
Improved anaerobic sanitary landfill	Leachate collection system is installed at the bottom of the landfill site. Others are the same as anaerobic sanitary landfill. The conditions are still anaerobic but the moisture content is much less than anaerobic sanitary landfill.
Semi-aerobic landfill with natural ventilation and leachate collection facilities	Leachate collection duct is bigger than the one of improved sanitary landfill. The opening of the duct is surrounded by air and the duct is covered with small crushed stones. Moisture content in solid waste is low. Oxygen is supplied to the solid waste from leachate collection duct.
Aerobic landfill with forced aeration	The leachate collection pipe and air supply pipes are attached. Air is forced to enter the solid waste causing it becomes more aerobic than semi-aerobic landfill.

Figure 1. The schematic diagram of semi aerobic landfill



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