

Chapter 11

Physical Treatment Technologies for Landfill Leachate: Performance and Limitation

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ABSTRACT

Landfill leachate is a refractory wastewater and highly polluted with heterogeneous materials which is harmful to the environment and living organisms. Thus, leachate requires efficient treatment system to ensure the quality of final discharge is within the standard limit. Moreover the treatment process must be cost effective in order to be accepted. Many treatment processes were examined for leachate treatment including biological, chemical and physical process. This chapter discuss the treatability of leachate using physical processes such as evaporation, flotation, adsorption, membrane, ultrasonication, air stripping. It can be concluded that physical processes are not recommended to stand alone for leachate treatment. Nevertheless, adsorption and membrane technologies are very effective for post treatment of leachate. Aeration, sedimentation, evaporation, and sonication can be used effectively as pre-treatment processes.

INTRODUCTION

Landfill leachate is considered as a highly polluted wastewater with heterogeneous contaminants that are harmful to the environment and living organisms. Typically, leachates characteristics varied according to the age of the landfill. The young leachate normally consists of biodegradable materials which are suitable to be treated by biological processes. However, intermediate and old leachate mostly contains

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of recalcitrant materials which are less biodegradable. Thus, physical or chemical treatment is a better solution for this type of contaminant (Bashir et al., 2014).

Satisfactory disposal of landfill leachate is dependent on its treatment prior to disposal. An acceptable treatment is required to avoid pollution of receiving waters to a level which might interfere with their best or future use (Bashir et al., 2014). Technologies for treating landfill leachate can be divided into three categories: chemical methods, physical methods, and biological methods. In this chapter, detail discussions concerning landfill leachate treatment via various physical processes are presented.

Physical methods of wastewater treatment achieve the removal of pollutants by using naturally occurring forces, such as gravity, electrical attraction, and van der Waal forces, as well as by using physical barriers (membrane technology). In general, the mechanisms involved in physical treatment do not result in the chemical structure changes of the target substances. In some cases, physical state is changed, as in vaporization. In other cases dispersed substances are caused to agglomerate, as happens during filtration. Physical methods of wastewater treatment include sedimentation, aeration, evaporation, flotation, and adsorption, as well as membranes (Woodard & Curran Inc., 2006).

The common examples of physical methods would be coarse screening to eliminate larger entrained objects and sedimentation (or clarification). In the sedimentation process, physical phenomena related to the settling of solid particles by gravity are allowed to operate. Usually, this process consists of simply holding a wastewater for a short period of time in a tank under quiescent conditions, allowing the heavier solids to settle, and removing the “clarified” effluent. Sedimentation for solids separation is a very common process operation and is routinely employed at the beginning and end of wastewater treatment operations. Another physical treatment process consists of aeration which is, physically adding air, usually to provide oxygen to the wastewater. Nevertheless, application of basic physical processes such as screening, sedimentation and aeration in treating landfill leachate is ineffective. This is due to the nature and the characteristic of the leachate. Therefore, in this chapter, the authors aim to discuss the mechanism, performance and usefulness of using other physical processes (e.g., evaporation, flotation, adsorption, separation via physical barriers, and sonication) in treating the landfill leachate. It should be noted that the additional physical phenomena used in the treatment of leachate consists of filtration (adsorption). The leachate is passed through a filter medium to separate the solids. As an example, the usage of sand filters or activated carbon filters to further remove entrained solids from a treated wastewater. Then, the flotation is used to float the surface area of the leachate and then skimming or physically remove it from the leachate was carried out as part of the overall treatment process. Moreover, evaporation, membrane technology, and ultrasound are commonly used as a post or a pretreatment of the leachate.

PHYSICAL TREATMENT PROCESSES

Short review and definitions of the most significant physical treatment technologies utilized for the landfill leachate treatment are reported in this section. Comprehensive discussions are presented to provide better understanding about each mechanism process, performance, and limitation.

Evaporation

An evaporation process seems to offer an attractive option for leachate treatment that can cover all ages of the landfill leachate. Evaporation is a treatment process that is able to utilize natural climate condition

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