ANALYSES OF LEACHATE TREATMENT TECHNOLOGIES

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1. Introduction

Despite the intensive efforts that are directed to the recycling and recovery of solid wastes, landfills remain and will remain an integral part of most solid waste management plans. One of the byproducts of the landfilling process is the generation of leachate. Once the precipitation occurs, the water percolates through the waste matrix in the landfill and several chemical and biological reactions are taking place. As a result, organic and inorganic compounds leach out from the waste leading to the formation of high strength wastewater known as leachate. Unless managed and treated properly, leachate will lead to adverse environmental impacts such as odor and groundwater contamination.

Various methods and technologies were tested, applied and proposed to treat the landfill leachate. These methods are ranging from simple methods, such as recirculation of leachate through the landfill, to sophisticated ones, such as combination of physical, chemical and biological processes. The applied treatment methods have met various degrees of success. Some were very efficient in leachate treatment, while others were not. This variability in the treatment efficiency is attributed to the fact that the process designers ignore the temporal and spatial variation of the leachate characteristics. Thus, the landfill managers are facing a challenge when thinking about the application of the proper treatment leachate technology. This paper reviews the factors that affect the leachate characteristics and the methods of leachate treatment with a special focus on the recent trends in the treatment processes. The information and analysis in this study will serve as guidelines for better decisions making in selecting the proper leachate treatment processes, so as to mitigate the adverse environmental impacts associated with the leachate generation and to select the most economical processes.

2. Factors Affecting Leachate Characteristics

As the leachate quantity and composition varied with time, it is important to continuously monitor its characteristics, in order to secure the successful selection of the treatment options. Leachate characteristics produced from a certain landfill may be governed by the following factors:

1. Composition of the waste being landfilled
2. Climatic and hydrogeological conditions prevailing within the landfill area
3. Age of the waste
4. Leachate collection and management system used

3. Methods of Leachate Treatment

Compared to municipal wastewater treatment, landfill leachate treatment has a relatively limited past history. In addition, the regulations of leachate treatment are varied greatly from one place to another. Some countries have very specific and strict regulations; other countries require simply to collect the leachate, while others have no definitive requirements. Despite these facts, the trend nowadays in many countries of the world is to apply certain type of leachate treatment.

The goal of leachate treatment is to reduce the concentration of pollutants to levels that will allow either to reuse, discharge or pre- treat to a certain degree that permits to transfer into a municipal wastewater treatment plant, where it will be subjected for further treatment. Depending on the leachate quality and quantity, and the resources available, the treatment technologies may be one or combination of the following processes:

1. **Physical processes** : evaporation, recirculation, dilute and disperse, sedimentation, filtration, membrane separation, adsorption, stripping,

2. **Chemical treatment**: oxidation, reduction, coagulation, precipitation, neutralization, ion exchange

3. **Biological process**es: constructed wetland, stabilization ponds, rotating biological contactors, activated sludge, trickling filters, anaerobic digestion.

The recent trends in leachate treatment are mainly to utilize the membrane separation processes such as, reverse osmosis and nanofiltration. The progress achieved in the membrane technology allowed to manufacture membranes that are capable to treat leachate and other types of wastewater with high efficiency. It should be noted that, prior the deciding the final treatment process, leachate treatability study should be conducted so as to achieve better result.