## Chapter 10 vical Treatment

### Biological Treatment Technology for Landfill Leachate

Husnul Azan Bin Tajarudin Universiti Sains Malaysia, Malaysia

Mohd Firdaus Bin Othman Universiti Sains Malaysia, Malaysia Noor Aziah Binti Serri Universiti Sains Malaysia, Malaysia

Muhammad Redzwan Bin Tamat Universiti Sains Malaysia, Malaysia

#### ABSTRACT

Biological process for environmental preservation and treatment is not a new technology. It was used a decade ago until now. The most important tools in biological processes are the microorganism and upstream instruments (bioreactor, pond and others) to run the process. Furthermore, the efficiency of the process depends on many factors such as temperature, pH, type of microorganism, conditions, and other nutrients. To understand the factors that will affect the process, mechanisms of microorganisms to treat or protect the environment must be considered. For leachate treatment, biological process is one of the most widely used techniques for low cost and environmentally friendly.

#### INTRODUCTION

An understanding about the mechanism and principle of microorganism is advantageous to ensure the success of leachate treatment by biological process. Therefore, this chapter starts with an explanation on the principle of microorganism, followed by the mechanism of leachate treatment through biological process. Biological treatment could be divided into two processes; upstream and downstream. Upstream is related to process in the lagoon, bioreactor, pretreatment or additional treatment. Meanwhile, downstream is a process to purify effluent and discharge to river or return to landfill. Both of these systems are the main topic of discussion in this chapter. The dangers of untreated leachate to biological life such as human and environment are discussed at the end of this chapter.

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#### PRINCIPLE OF BIOLOGICAL TREATMENT

Biological treatment is a type of treatment that uses biological material as an activator like microorganism and organic material. Leachate treatment using biological process is due to the respect to the environment and cost of process. Several requirements are needed by biological or microorganism in order to grow, such as nutrients, microbiological components, environmental condition, inhibition factors and pretreatment process. We will further discuss the topic about the concept and requirements of biological treatment for landfill leachate, especially by microorganisms. Microorganism is a small and tiny biological creature. It can be grouped as bacteria, fungi, algae and yeast. Classification is based on their characteristics through biochemistry test and DNA sequencing.

#### Nutrients

Nutrients are one of the most important things to a microorganism. It provides energy sources to the bacteria and supports cellular biosynthesis. In a natural environment, certain bacteria can grow in a certain environment due to the compounds that contain some amount of nutrient. Requirement of nutrients varies due to types of microorganism and environment. These nutrients can be found in the form of organic and inorganic compound, water, macromolecules and micro molecules. These nutrients serve several functions of the cell. Table 1 shows the function of every major nutrient to the bacteria cell.

Other nutrients that are needed by the microorganism, but in a small amount, are called as trace elements. These elements are needed due to their function as a cofactor for the essential enzymatic reaction in the cell of microorganism or as a vitamin for the microorganism. The trace nutrient usually comes out in the form of ion elements like Mn, Co, Zn, Cu, and Mo. Table 2 shows the function of those nutrients to the microorganism cell.

Nutrition consumption and metabolic adaption can be used as an indicator to characterize microorganism. Nutrients are consumed by microorganisms to build up the organic molecules and thus, enhance

Nutrient	Source	Function
Carbon, C	Organic compounds, CO <sub>2</sub>	Main constituent of cellular material
Oxygen, O	Water, Organic compounds, CO <sub>2</sub> , O <sub>2</sub>	Constituent of cell material and cell water, $O_2$ is electron acceptor in aerobic respiration
Nitrogen, N	NH <sub>3</sub> , NO <sub>3</sub> , Organic compounds, N <sub>2</sub>	Constituent of amino acids, nucleic acids nucleotides, and coenzymes
Hydrogen, H	Water, Organic compounds, H <sub>2</sub>	Main constituent of organic compounds and cell water
Phosphorus, P	PO <sub>4</sub>	Constituent of nucleic acids, nucleotides, phospholipids, LPS, teichoic acids
Sulphur, S	SO <sub>4</sub> , H <sub>2</sub> S, organic sulphur compounds	Constituent of cysteine, methionine, glutathione, several coenzymes
Potassium, P	Potassium salts	Main cellular inorganic cation and cofactor for certain enzymes
Magnesium, Mg	Magnesium salts	Inorganic cellular cation, cofactor for certain enzymatic reactions
Calcium, Ca	Calcium salts	Inorganic cellular cation, cofactor for certain enzymes and a component of endospores
Iron, Fe	Iron salts	Component of cytochromes and certain nonheme iron-protein and a cofactor for some enzymatic reactions

Table 1. Major nutrients of bacteria and its functions (Todar, 2012)

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