

Chapter 8

Emerging Contaminants in Landfill Leachate and Their Treatment Methods

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ABSTRACT

This chapter presents an overview of emerging contaminants in landfill leachate and their treatment methods. In addition to introducing the conventional contaminants present in the leachate, the chapter also details emerging contaminants such as poly-aromatic hydrocarbons (PAHs) and phthalate acid esters (PAEs) and their concentrations in various environmental matrices. PAHs and PAEs are highly carcinogenic, mutagenic, and teratogenic substances which is why they have attracted a lot of concern in the studies of water, air, and soil pollution. They affect the endocrinal activities in animals and humans, therefore they are known as endocrine disrupting compounds. Drawing on the treatment methods of leachate, the chapter explains physico-chemical, biological, and advanced oxidation processes. The chapter also advances the discussion on their importance and efficiency in the leachate treatment.

INTRODUCTION

This chapter discusses emerging micro-pollutants detected in the leachate mainly poly-aromatic hydrocarbons (PAHs) and phthalate acid esters (PAEs) and their treatment methods. At the beginning of the chapter, landfill composition, significance of landfill leachate, landfill age and various micro-pollutants were discussed. Various leachate treatment methods viz. physico-chemical, biological and advanced oxidation processes (AOPs) are discussed. The reaction mechanism of various AOPs such as Fenton, Photo-Fenton and E-Fenton are discussed in detail along with studies conducted on leachate treatment using these AOPs.

Landfill Leachate and Micro-Pollutants

Uncontrolled generation of leachate is the inevitable problem in landfilling. Leachate is the contaminated wastewater generated in the landfills due to percolation of rainwater through the layers of landfill. The layers of landfill consist of various types of hazardous waste including medical waste, sludge from treatment plants, lab chemicals, waste ash, refractory materials and halogenated organics. The hazardous landfill is closely monitored to avoid challenges like emission of landfill gases into atmosphere and damage of membrane which leads to contamination of ground water and other environmental media. The landfill gas contains many obnoxious gases and chemicals detrimental to environment promoting global warming. On the other hand, leachate contains high concentration of ammoniacal nitrogen, heavy metals and posses low BOD₅/COD ratio (Biglarijoo, Mirbagheri, Bagheri, & Ehteshami, 2017). Recently with technological improvements in the analytical methods, various micro-pollutants/emerging pollutants are being detected in the landfill leachate. The compounds which are found in the environment in low concentrations ranging from parts per billion (ppb) to parts per trillion (ppt) are said to be micro-pollutants or emerging pollutants (Clara et al., 2005). Many compounds are expected to be present in leachate in concentrations far below the quantification limits of standard analytical methods. On the other hand these compounds are hazardous and they do not overrule the environmental threats even at low concentrations (Öman & Junestedt, 2008). These pollutants include cosmetics, industrial compounds, pharmaceuticals, perfumes, waterproofing agents, insulating foams, plasticizers and drugs. The frequently detected micro-pollutants are pharmaceuticals and endocrine disrupting compounds. The age of the landfill also has significant impact on pollutants. In one of the studies conducted by Kulikowska and Klimiuk (2008) reported that the organic content expressed in terms of COD decreased from 1800 mg/L to 610 mg/L over a period of 4 years. Also few other studies reported that young landfills have higher COD concentrations as compared to older landfills. Similarly, the concentration of aromatic hydrocarbons decreases over a period of time depending on degradation with the landfill gas of each compound (Christensen et al., 2001). Previous studies also have reported the presence of micro-pollutants in surface water, groundwater, drinking water, industrial and domestic wastewater, hospital effluents, and runoff from agriculture (Kim, Cho, Kim, Vanderford, & Snyder, 2007; Ribeiro, Nunes, Pereira, & Silva, 2015). The detailed study of the micro-pollutants (PAHs and PAEs) is as described below.

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