Chapter 13
Advanced Oxidation Processes (AOPs) in Landfill Leachate Treatment

Mohamad Anuar Kamaruddin
Universiti Sains Malaysia, Malaysia

ABSTRACT

Sanitary landfilling is the most acceptable method to eliminate solid urban wastes. However, it is known that sanitary landfill generates large amount of heavily polluted leachate. High concentrations of recalcitrant organics make its degradation more complicated and high concentration of organic material can be toxic and reduce bioremediation process. Landfill leachate treatment by advanced oxidation processes (AOPs) have been intensively studied with high successful rate for removing refractory pollutants (biological degradation) from leachate. Fenton reaction which is one basic AOPs is based on the addition of hydrogen peroxide to the leachate in the presence of ferrous salt as a catalyst. Because of that, many improvement and development of new Fenton-based methods have been reported in the literature. This review discussed the application of Fenton and related processes in terms of wide application in landfill leachate treatment. The effects of various operating parameters and their optimum ranges for organics contaminant removed were also discussed.

INTRODUCTION

Municipal solid waste (MSW) can be defined as the wastes arising from domestic, commercial, industrial, and institutional activities in urban areas (Bartone, 1990). Malaysian solid waste consists of an extremely high concentration of organic waste which leads to a high moisture content and a bulk density above 200 kg/m^3. The major components of Malaysian wastes are food, paper, and plastic which include about 80% of overall weight based on waste characterisation (Kamaruddin, Yusoff, Ibrahim, & Zawawi, 2017). Besides, a study done by **** also implied that organic waste components represent the most waste characteristics from a case study done in Kelantan, Malaysia as shown in Figure 1. These characteristics reveal the nature and lifestyle of the Malaysian population. Economic development and population grows

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at a rapid rate, poor transportation and lack of expertise contributes to the management of municipal solid waste being one of Malaysia's most vital environmental problems (Manaf, Samah, & Zukki, 2009).

The waste components were determined after sorting a known weight of sample in to different waste streams (15 components) and divided from the total weight accumulated. Based on Figure 1, the major fractions of MSW component analysed consists of organics, papers and tetra Pak component. Meanwhile, plastics (film and rigid), napkins, textiles, rubber, leather, wood and garden wastes made up in the ranges of 0.4 to 14.84% of total MSW components. The results for organic components were in the range of 28 to 43% of total wastes and prevailed for all three-studied area. The waste is mostly dominated by kitchen and food waste (Periathamby, Hamid, & Khidzir, 2009). Such high organic waste in the study area could be due to the high consumption of edible products such as dairy, processed food, and unprocessed food. The fractions also indicated that residents of Kota Bharu produced the lowest organic fraction (33.13%) followed by Gua Musang (27.94%) and Kuala Krai (42.86).

As comparison, normal organic waste fraction for Malaysian according to the data from Ministry of Local Government and Housing stood at 45% of total MSW (Hamatschek, Entwicklungszentrum, Tee, & Faulstich, 2010). The results also indicated that paper waste was the second largest fraction in terms of weight which might be due to the increasing usage of paper in daily packaging including foods, hardware and dairy products. Besides, the main fractions of paper waste ascertained in the study were cardboards and other packaging papers. Tetra Pak waste was the third largest fraction in term of weight. This could be due to the increasing soft drink sold at cheaper price than conventional metal can drinks.

Figure 1. Typical waste composition of Malaysian wastes (as disposed)