Chapter 52
Assessment of Advanced Biological Solid Waste Treatment Technologies for Sustainability

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ABSTRACT

53.8% of annually generated US Municipal Solid Waste was discarded in landfills by 2012. However, landfills fail to provide a sustainable solution to manage the waste. The State of Florida has responded to the need of establishing sustainable SWM systems by setting an ambitious 75% recycling goal to be achieved by 2020. To this end, Advanced Biological Treatment (ABT) and Thermal Treatment (ATT) of municipal solid waste premise a sustainable solution to manage the waste as it drastically reduces the volume of waste discarded in landfills and produces biogas that can be used to generate energy. In this chapter, ABT and ATT technologies are analyzed; and their advantages and disadvantages are examined from a sustainability perspective. A comprehensive top-to-bottom assessment of ABT technologies is provided for Florida using Analytic Hierarchy Process based on the collected subject matter expert rankings.

INTRODUCTION

According to World Energy Council, global energy use will double by 2050 with the growing world population (World Energy Council, 2013). Currently, 80% of the world's energy need is met by burning fossil fuels which is an unsustainable way of obtaining energy due to its resultant greenhouse gas emissions, the most important reason of global warming. Global warming is one of the most serious problems that people encounter in recent years. In order to prevent global warming, there need to be either substantial changes in people's energy consumption patterns or the necessary energy need to be

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obtained from other renewable sources. Wind power, solar power, geothermal energy, biomass energy, hydroelectric power, and hydrokinetic energy are different types of such renewable energy sources. Biomass energy is obtained from the organic portion of a variety of materials using combustion or advanced conversion technologies (Figure 1).

Renewable energy production from waste brings different benefits on earth other than generating energy. It reduces the amount of waste discarded in landfills and the pollution caused by landfills. Furthermore, waste is a renewable source which is produced everyday by households and industries. Thus, the waste should be managed in a way that people benefit from, instead of being discarded in landfills which brings several environmental problems.

Municipal solid waste (MSW) is defined as the garbage such as food waste, papers, packaging, furniture which is discarded by households and industries after daily use (EPA, 2015). MSW generation continues to increase every year due to growing world population and consumption. Amount of MSW generated globally is approximately 1.3 billion tons per year (World Bank Group, 2014) whereas approximately 254 million tons of the total MSW was generated only by United States during 2013 (EPA, 2015). 52.8% of this waste was discarded in landfills. However, discarding waste in landfills brings a number of environmental problems such as air pollution caused by emitted greenhouse gas emissions and ground water contamination from leachates. Furthermore, it diminishes the available space for humans, animals, and other living species since waste requires large amount of lands to be disposed. For approximately 30 years after closure of landfills, they still remain as a threat as emissions continue to be released. Until that time, they require post maintenance. Such and similar issues raised by the landfill disposal of waste has led to exploration and development of new and sustainable methods for MSW management. Advanced biological treatment (ABT) of MSW is one of these emerging methods for integrated and sustainable waste management. While they have been widely used for treatment of sewage sludge, their application for MSW treatment is relatively new. Another method for sustainable waste treatment is advanced thermal treatment (ATT) technologies which have recently been used for non-organic portion of MSW. Finally, nanotechnology has been recently studied to convert waste into energy and to form nanomaterials from waste. Nanotechnology is defined as the ability to work at the atomic and molecular levels to create structures with larger surfaces and new properties (Roco, 2005).

Figure 1. Renewable energy from waste