

Influence of tropical seasonal variations on landfill leachate characteristics—Results from lysimeter studies

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Abstract

Considering the quality of design and construction of landfills in developing countries, little information can be derived from randomly taken leachate samples. Leachate generation and composition under monsoon conditions have been studied using lysimeters to simulate sanitary landfills and open cell settings. In this study, lysimeters were filled with domestic waste, highly organic market waste and pre-treated waste. Results over two subsequent dry and rainy seasons indicate that the open cell lysimeter simulation showed the highest leachate generation throughout the rainy season, with leachate flow in all lysimeters coming to a halt during the dry periods. More than 60% of the precipitation was found in the form of leachate. The specific COD and TKN load discharged from the open cell was 20% and 180% more than that of the sanitary landfill lysimeters. Types of waste material and kind of pre-treatment prior to landfilling strongly influenced the pollutant load. Compared to the sanitary landfill lysimeter filled with domestic waste, the specific COD and TKN load discharged from the pre-treated waste lysimeter accounted for only 4% and 16%, respectively. Considering the local settings of tropical landfills, these results suggest that landfill design and operation has to be adjusted. Leachate can be collected and stored during the rainy season, and recirculation of leachate is recommended to maintain a steady and even accelerated degradation during the prolonged dry season. The open cell approach in combination with leachate recirculation is suggested as an option for interim landfill operations.

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1. Landfilling under tropical conditions

Open dumps—unfortunately still mostly observed in developing countries—where the waste is dumped in an uncontrolled manner, can be detrimental to the urban environment (Zurbrugg, 2003). In South and Southeast Asia, more than 90% of all landfills are non-engineered disposal facilities. With the accelerated generation of waste caused by an ever-increasing population, urbanization and industrialization, the problem has become one of the primary urban environmental issues.

Leachate generation of landfills in the region is influenced by a distinct dry season of up to 150 days a year, a wet season with intensive rainfall events within a few

hours, high temperatures and high solar radiation (Tränkler and Manandhar, 2000; Tränkler et al., 2001). The major limitation for successful treatment of landfill leachate is the difficulty in identifying and quantifying a typical composition and characteristics. If leachate treatment plants were designed to handle the average leachate quality only, it would occasionally be overloaded in practice due to high discharge of leachate during certain times of the year. Therefore, the leachate treatment plant has to be designed to take into consideration the maximum concentration of pollutants (Tatsi and Zouboulis, 2002). Hence, climate differences need to be considered, specific approaches pursued and strategies concerning landfill design and operation investigated if a transition from dumpsites to engineered sanitary landfills is to be successfully managed in the Asian context (Visvanathan et al., 2002).

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