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A laboratory investigation of the effects of water content and waste composition on leachate and gas generation from simulated MSW

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ABSTRACT

Leachate emitted by landfilled municipal solid waste may cause many and cumulative adverse effects ranging from health problems to environmental impacts. South Africa is one of the few countries in the developing world to have a sound regulatory framework for waste disposal by landfill. Municipal solid waste, however, is not differentiated by content. It is well established that the characteristics of waste produced by affluent suburbs are very different from poor suburbs and informal settlements. The regulatory framework for landfilling is presented as a set of the Minimum Requirements that specifies the design of landfills on the basis of the potential to generate leachate and the type of waste being disposed. The current study interrogates aspects of the Minimum Requirements classification system, namely the classification of waste and climatic water balance. The climatic water balance is used as a guiding tool to assess the potential for a landfill to generate leachate. The end result of this classification is a determination of the proposed site falls under B^+ (water surplus) or B^- (water deficient) class. The Minimum Requirements ensure that all sites which fall under the B^+ class must be equipped with an underliner owing to the potential for leachate generation, while B^- sites do not require any underliner since leachate will be only generated sporadically. However, there is no differentiation on the basis of the content of municipal solid waste from rich and poor suburbs. The present study investigates the generation of leachate from landfills situated on the borderline between B^+ and B^- sites, as well as the degradation of refuse having a range of basic constituents, and representing waste from rich and poor suburbs, as well as a mixture of the two.

Laboratory lysimeters were filled with synthetic waste consisting of varying proportions of paper, putrescible material (grass cuttings) and coal ash (power station fly ash was used to ensure consistency). This was intended mimic the waste coming from “poor” and “rich” suburbs in South Africa. The effect of waste types grading from “poor” to “rich” on leachate quality was investigated. It has been found that a content of 60 % of ash on a dry mass basis, characterizing poor waste, has a neutralizing capacity which results in a better leachate quality than waste with little or no ash, mimicking rich waste. It has been

also established that poor waste has lower leachate generation rates than a 1:1 mix of poor and rich waste as well as rich waste alone. A range of water applications was made bracketing the climatic divide between B^+ and B^-. It was also established that poor waste is characterized by high degradation owing to the high percentage of ash as compared to ash deficient rich waste. It was also noted that different standards for landfills receiving either only poor or only rich waste under the same climatic conditions (B^+ and B^-) in the Minimum Requirements may be advantageous. A relaxation of Minimum Requirements for landfills receiving poor waste could significantly reduce the cost of establishing a landfill under this range of climatic water balance conditions.