LANDFILL LEACHATE RECYCLING FOR LAND IRRIGATION AFTER ANAEROBIC STABILIZATION IN THE GROUNDWATER ZONE

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ABSTRACT

Leachate characteristics associated with landfilling of municipal wastes on pervious sandy soil in wetland areas are examined in this thesis. Treatment of high strength leachate by rapid infiltration through soils with a high Cation Exchange Capacity (CEC >5 meq/100g) in 4.5 cm diameter columns was found not only ineffective, but also led to the production of leachate containing a high COD but devoid of phosphate. This treatment is therefore inappropriate if the leachate is to be treated by biological processes.

Results of a series of soil column experiments using sandy soil with the leachate containing 4,000 mg/L to 21,000 mg/L COD and maintained under anaerobic conditions indicated that the major part of the COD was removed in the sand by methane fermentation. The process, however, is very slow for leachate with a high initial COD. At 21,000 mg/L influent COD, the methanogenic stage could not be established in the soil column even after 18 weeks.

Biological treatment of the high strength leachate in a sand layer beneath a solid waste layer in a lysimeter was also found capable of stabilising the leachate. Under saturated conditions, the methanogenic stage was difficult to establish in the solid waste layer because of low pH (5.3) associated with a very high COD. However, the methanogenic stage was established in the underlying sand layer. This process was examined in the laboratory lysimeter by introducing water through the bottom of the lysimeter upward to saturate the sand and solid waste and releasing the water gradually through a bottom drainage over a period of 2 years. By this method, appropriate dilution and detention of the leachate promoted establishment of the methane fermentation process.

The sand layer maintained stable methanogenic conditions when operated at organic loading rates as high as 873 g COD/m^3 pore volume/day. The removal efficiencies were 92% for COD and 99% for BOD_5 . An average gas production of 77 mL/day/Kg wet weight solid waste accompanied the COD removal. A mass balance analysis indicated that for every gram of COD removed, 500 mL of gas was generated in the lysimeter. The COD level and ammonia-N concentration in the effluent leachate after the methane fermentation remained relatively high at a around 2000 mg/L and 1350 mg/L respectively. Both pollutants are very mobile in soil water and therefore require further treatment.

Field leachate quality monitoring at a completed landfill in Bayswater, Perth indicated that nutrients in the leachate found their way into the adjoining Swan River through underground flow as well as surface discharge. The nutrient load was especially high during the few months after winter.

Recycling leachate through land irrigation by using stabilised leachate for growing grass was tested under field conditions in Perth. The grass in plots receiving leachate after 10 weeks irrigation produced biomass more than double the production in the control plots. The faecal coliform counts of the leachate was well below the maximum permissible limit for landscape irrigation with public access after a drying out period.

The results suggest that leachate control through natural in-situ methane fermentation followed by controlled irrigation is a viable option for solid waste landfilled in sandy soils of wetland areas.