

# Mesoscale Laboratory Models of the Biodegradation of Municipal Landfill Materials

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Stabilization of municipal landfills is a critical issue involving land reuse, leachate treatment, and odor control. In an effort to increase landfill stabilization rates and decrease leachate treatment costs, municipal landfills can be operated as active aerobic or anaerobic bioreactors. Rates of settling and biodegradation were compared in three different treatments of municipal landfill materials in laboratory-scale bioreactors. Each of the three fifty-five-gallon clear acrylic tanks was fitted with pressure transducers, thermistors, neutron probe access tubes, a leachate recirculation system, gas vents, and air injection ports. The treatments applied to the tanks were (a) aerobic (air injection with leachate recirculation and venting from the top), (b) anaerobic (leachate recirculation with passive venting from the top), and (c) a control tank (passive venting from the top and no leachate recirculation). All tanks contained a 10-cm-thick layer of pea gravel at the bottom, overlain by a mixture of fresh waste materials on the order of 5-10 cm in size to an initial height of 0.55 m. Concentrations of O<sub>2</sub>, CO<sub>2</sub> and CH<sub>4</sub> were measured at the gas vent, and leachate was collected at the bottom drain. The water saturation in the aerobic and anaerobic tanks averaged 17 % and the control tank averaged 1 %. Relative degradation rates between the tanks were monitored by CO<sub>2</sub> and CH<sub>4</sub> production rates and O<sub>2</sub> respiration rates. Respiration tests on the aerobic tank show a decrease in oxygen consumption rates from 1.3 mol/day at 20 days to 0.1 mol/day at 300 days, indicating usable organics are being depleted. The anaerobic tank produced measurable methane after 300 days that increased to 41% by volume after 370 days. Over the test period, the aerobic tank settled 30%, the anaerobic tank 18.5 %, and the control tank 11.1 %. The concentrations of metals, nitrate, phosphate, and total organic carbon in the aerobic tank leachate are an order of magnitude lower than in the anaerobic tank leachate.

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