Sharon E. Borglin, Ph.D
Scientist, Earth Sciences Division
Lawrence Berkeley National Laboratory
1 Cyclotron Rd, MS 70A-3317
Berkeley, CA 94720
seborglin@lbl.gov

Terry C. Hazen, Ph.D
Curtis M. Oldenburg, Ph.D

Landfills are concentrated sources of contamination located in the vadose zone from which contaminant plumes may travel into both the vadose and the saturated zones. Designing a reliable in-situ storage for contaminants at landfill sites is essential for reducing or eliminating contaminant migration into the subsurface. The overall objective of this project was to develop a new biotreatment technology to be used in creating"smart" waste containments at landfill and waste storage sites to support long-term stewardship of landfill sites. To compare the use of aerobic and anaerobic biotreatment strategies, three 200-liter tanks filled with fresh waste materials were used to provide the following conditions: (a) aerobic (air injection with leachate recirculation), (b) anaerobic (leachate recirculation), and (c) a dry-tomb anaerobic landfill (no air injection, no water addition and no leachate recirculation). The tanks were monitored for metals leaching, nutrients, organic carbon, subsidence, gas composition, respiration rates, and microbiological activity for up to 500 days. Leachate from the aerobic tank had significantly lower concentrations of all potential contaminants, both organic and metal, after only a few weeks of operation. Respiration tests on the aerobic tank showed a steady decrease in oxygen consumption rates from 1.3 mol/day at 20 days to 0.1 mol/day at 300 days. Over the test period, the aerobic tank settled 35%, the anaerobic tank 21.7% and the dry-tomb tank 7.5%. The aerobic tank produced negligible odor compared to the anaerobic tanks. Metals leaching were low throughout the test period for the aerobic tanks, and decreased over time for the anaerobic tanks. Microbiological testing showed high biomass and diversity in both the aerobic and anaerobic bioreactors, high activity in the anoxic leachate, and low activity in the aerobic leachate. Results were modeled with a newly developed simulation capabilities (T2LBM: TOUGH2 Landfill Bioreactor Model), which can be used to model flow, transport, and biodegradation processes in landfills. This study demonstrated that maintaining the landfill as an aerobic bioreactor increased the rates of settling and stabilization and produced more environmentally benign leachate and gas. The reduction in noxious odors was a significant advantage of the aerobic system. These results suggest that aerobic management of landfills could increase the rate of stabilization, produce less potent greenhouse gases,

eliminate the need for leachate and air emissions treatment systems, reduce odor, and reduce the need for extensive containment strategies.