APPENDIX D

LEACHATE RECIRCULATION

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Leachate is the liquid that drains or 'leaches' from a landfill; it varies widely in composition depending on the age of the landfill and the types of waste that it contains. In addition, as the infiltration component of precipitation percolates through the waste, it reacts with the products of decomposition, chemicals, and other materials in the waste to produce the leachate.

Leachate recirculation has been accomplished at landfills by a variety of methods, including pre-wetting of the waste, direct discharge into the working face, spraying, infiltration ponds, vertical injection wells, horizontal gravity distribution systems, and pressure distribution systems. The success of the various recirculation systems has depended on a variety of factors that include the type of waste, the permeability of cover material, homogeneity of the waste, and understanding of how to operate the system.

Leachate recirculation was initially implemented as a means of low cost leachate management. Added benefits of recirculation have been realized at many sites where waste compaction rates have increased and additional settlement has recovered airspace. For example, in a pilot study at the Keele Valley Landfill (Toronto, Canada), Mosher et al. (1997) documented a 100-percent increase in monthly settlement rates between dry portions of the landfill (2-3 inches/month) and areas where moisture had been added (4-5 inches/month). As a second example, Griffin et al. (1997) reported a 5-percent gain in refuse disposal capacity for the Worcester County Central Landfill (Worcester, Maryland) in the 13 years that its Cell 1 operated as a leachate recirculation cell (with a rather simple system of spraying leachate over the active face and "filling" vertical "wells" made of wire mesh filled with gravel).

A demonstration initiative in Yolo County, California, was designed and constructed in 1993 (Augenstein et al., 1997). The demonstration project consisted of two separate 100 feet by 100 feet cells, with a thickness of refuse of 40 feet, constructed to investigate the impacts of leachate recirculation. The surface of the waste was completely overlain by a layer of shredded-tire chips that was about 18 inches thick, for gas collection. The layer of shredded tires was covered by a geotextile that was in turn covered by 2 feet of compacted clay and a 40-mil low-density polyethylene (LDPE) membrane. The cover system was weighted down by a layer of random soil. The test cell received leachate, recirculated at regular intervals, while the second cell was kept "dry" and served as control. Leachate was pumped to a distribution manifold located at the top of the test cell and from there was introduced at 25 locations across the footprint of the cell through leachate injection pipes imbedded in the layer of shredded-tire chips. Warming of recirculating leachate and pH buffering were considered as additional enhancement efforts. The fill was instrumented with pressure transducers to monitor hydraulic head, temperature probes, and survey monuments to monitor settlement.

According to a 1999 article in MSW Management Magazine by John Pacey, entitled *BioReactor – Landfill Performance Expectations*, "Most of the bio-reactor-related settlement will occur within 10 – 15 years of closure. This raises the question of whether the individual landfill cells (phases) should be filled to final design grade or whether there should be an allowance for expected settlement. This could mean overfilling by 20 to 25 percent above design grade in anticipation of the refuse being stabilized within 10 or 15 years following closure of a cell or phase of construction." Assuming that refuse will be wetted during placement or liquids are strategically injected into the waste, a minimum 20-percent increase in capacity could be achieved.

The success of landfills to recirculate the majority of leachate depends on the amount of leachate storage available on-site, how well operations can manage stormwater when new cells are opened, the control of infiltration, and the effective utilization of the waste absorptive capacity.

An important factor that often prevents landfills from considering recirculation for leachate management is the difficulty in gaining regulatory approval. California regulations allow for leachate to be returned to the unit from which it came ((Section 20340(g) of Title 27 of the California Code of Regulations)), subject to the restriction that the leachate head on the liner be kept to less than 12 inches. As to the addition of other liquids to a landfill cell, the Yolo County demonstration project indicates that at least one of the Regional Water Quality Control Boards (RWQCB) is willing to consider a proposal for this type of technology (it should be noted that the Yolo County demonstration cell is double-lined).

Landfill sites that have recirculated leachate for extended periods have often experienced many operational difficulties, such as channeling of moisture through the refuse, non-homogeneous wetting of the refuse, leachate outbreaks at the surface, and clogged piping. One of the big concerns is the fact that LCRS systems are not typically designed for the volume of water needed for recirculation which is potentially several times the one-time through volume. In addition, first time leachate and recirculated leachate can overtax the system – a problem with retrofitting a cell not designed as a bioreactor. Also, the first layers just above the LCRS turn to sludge first as they are saturated – this can lead to clogging of the LCRS and cause flow problems. Both of these lead to leachate mounding. The type of cover soils and lack of cover soil stripping are contributing factors to these problems and may potentially prevent recirculation. Furthermore, daily covers are graded to slope away from the center of the landfill, so any leachate ponded on the buried daily cover would eventually migrate downslope.

The solutions to these problems are scarification of the underlying daily soil cover prior to building a new cell, replacement of the daily soil cover by a permeable alternative daily cover (or elimination of the cover by the use of tarps), and reversing the grading of the daily cover so that it drains toward the center of the landfill (at least during the dry months). In addition, as previously mentioned, spraying leachate or fresh refuse prior to compaction and application of daily cover could eliminate these concerns and increase settlement and biodegradation.

The availability of sufficient leachate and gas condensate at the landfill is also an issue especially for Southern California landfills which are in a very dry climate and do not produce as much leachate as wet landfills.