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Leachate Recycle Process Offers Pros And Cons*

Alternate disposal options are a thriving topic in the 90s and federal regulations have brought one disposal concern into the limelight — leachate.

Recycling leachate in municipal solid waste (MSW) landfills can provide a means of disposal, enhance the rate of landfill stabilization (fermentation leading to gas) and can save money when leachate recycling is not available at a publicly owned treatment works. Leachate recycling also has been spurred by problems with dry-tomb landfilling, which can postpone, rather than prevent, groundwater pollution from landfill leachate.

Although leachate recycling is gaining recognition, the merits of recycling MSW leachate are controversial. In the mid-1980s, some regulatory agencies encouraged leachate recycling in MSW landfills, while others prohibited it. Critics said that because it increases the hydraulic loading to the landfill, it can increase the rate of groundwater pollution.

While leachate recycling can be conducted in single-composite-lined landfills that conform to Subtitle D requirements, groundwater monitoring programs for lined landfills have little chance of detecting pollution if it leaks through a composite liner. Because the initial leakage from an FML-lined landfill, such as a Subtitle D landfill, comes through holes, rips, tears and areas of deterioration in the FML, this type of leakage produces finger-plumes of leachate-contaminated groundwater that can go undetected between the vertical monitoring wells.

A double-composite lined landfill, in which the lower composite liner is a full-landfill area pan lysimeter leak detection system for the upper composite liner, can help prevent groundwater pollution. This system allows operators to detect leakage of the upper composite liner before the groundwater is polluted. When leachate is found in the lysimeter system, recycling must stop and the waste exhumed if the leakage through the upper composite can't be stopped.

Plastic bags can prevent recycled leachate from interacting with the MSW. Since landfill gas production rates depend on the waste's moisture content, waste that is not exposed to the recycled leachate will produce landfill gas at a slower rate than fully-exposed wastes. Shredding waste before burial can help shorten the duration of landfill gas production and decrease the time for landfill stabilization.

While leachate recycle can reduce the strength of some MSW leachate, it still can pollute large amounts of groundwater. Leachate recycling is best used during the early stage in a fermentation/leaching, wet-cell approach to MSW management. In that approach, the leachate recycle-accelerated stabilization period is followed by a period of washing the fermented MSW residues with clean water. During this time, residues that would leak out of the landfill and pollute groundwaters are deliberately leached out of the wastes in a controlled manner. Without the clean-water leaching step and a leak detection system, leachate recycle will not protect groundwater resources. At this time, however, Subtitle D regulations prohibit adding clean-water to leach removable components of waste, which is an integral part of the wet-cell approach.

Leachate recycle offers several pros and cons, all of which should be carefully weighed.

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Additional writings on issues of leachate recycle, MSW management in landfills, and groundwater quality protection from landfill leachate are available on the authors' website https://www.gfredlee.com

Advantages and Limitations of Leachate Recycle in MSW Landfills

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Increasing attention is being given to leachate recycle in municipal solid waste (MSW) landfills as a means of leachate disposal and to enhance the rate of landfill "stabilization." When inexpensive leachate disposal is not available at a nearby POTW, leachate recycle can save the landfill operator considerable money for leachate management. It is becoming well-recognized that the "dry tomb" landfilling approach that US EPA adopted for MSW management in October 1991 only postpones, rather than prevents, the occurrence of groundwater pollution from landfill leachate. As a result, increasing attention is being given to the practice of what is sometimes called "wet-cell" landfilling or "bio-reactors" in which leachate recycle is practiced. However, there has been and continues to be considerable controversy over the merits of MSW leachate recycle.

In the mid-1980's, the authors conducted a comprehensive review of the practice of leachate recycle in MSW landfills and its impact on the character of MSW landfill leachate (Lee *et al.,* 1985; 1986). While the practice was encouraged by some at that time, several states prohibited it. The primary criticism of leachate recycle was that it increases the hydraulic (water) loading to the landfill and therefore could increase the rate of groundwater pollution by leachate. While the US EPA and some states allow leachate recycle to be conducted in single-composite-lined landfills, such a practice would be expected to increase the rate at which such landfills pollute groundwaters. The groundwater monitoring programs that are being prescribed for lined landfills under US EPA Subtitle D (incorporating vertical wells with zones of capture of about 1 ft about the well, and spaced hundreds to a thousand or 50 feet apart) have a low probability of detecting pollution of groundwater by leachate leakage through a composite liner before widespread groundwater pollution has occurred. This is because the initial leakage from an FML-lined landfill, such as a Subtitle D landfill, will be through holes, rips, tears, and/or areas of deterioration in the FML. As discussed by Cherry (1990), such leakage will produce finger plumes of leachate-contaminated groundwater that can readily pass undetected between the vertical monitoring wells.

The increased potential for groundwater pollution associated with leachate recycle can be addressed by conducting the operations in a double-composite-lined landfill in which the lower composite "liner" is established as a full-landfill-area pan lysimeter leak detection system for the upper composite liner (Lee and Jones-Lee, 1994). Such a system allows the opportunity to detect leakage of the upper composite liner before the groundwater becomes contaminated and while there is time to take action to prevent groundwater pollution. When leachate is found in the leak detection system, it is obvious that the leachate recycle must be terminated. If the leakage of the upper composite liner could not

be stopped, it would be necessary to exhume the waste since it would only be a matter of time until the lower composite liner would also be breached.

One of the advantages cited as being offered by leachate recycle is an increase in the rate of landfill " stabilization," i.e., a decrease in the time needed for fermentation of the fermentable organics and a decrease in the time over which landfill gas will be produced. However, the reduction in duration of landfill gas production that has been found in laboratory studies and in some field studies, such as those conducted in Sonoma County, California in the 1970's by EMCON (1975; 1976), will likely have limited applicability to today's landfills. Much of the MSW that is landfilled today is in plastic bags. For a period of time, plastic bags will serve as barriers to the interaction of recycled leachate with MSW. Since landfill gas production rates are highly dependent on the moisture content of the wastes, those parts of the waste that are not exposed to the recycled leachate will produce landfill gas at a very slow rate compared to wastes that are fully exposed to the recycled leachate. In order for leachate recycle to significantly shorten the duration of landfill gas production in today's landfills and thereby decrease the time for landfill "stabilization,"it is necessary to shred the wastes before burial.

An important aspect of leachate recycle that is not generally understood is that it does not ultimately result in a leachate that has limited potential for groundwater pollution. While leachate recycle tends to reduce the strength of some constituents in MSW leachate, the leachate produced after recycle has been terminated (when gas production ceases) still has the ability to pollute large amounts of groundwater with hazardous or otherwise deleterious chemicals which render the groundwater and associated aquifer unusable for domestic water supply purposes and can cause a homeowner or a water utility to have to abandon the groundwater well as a source of water supply.

The greatest utility for leachate recycle is as the early stage in a fermentation/leaching wet-cell approach to MSW management (Lee and Jones, 1990; Lee and Jones-Lee, 1993). In that approach, the leachate recycle-enhanced stabilization period is followed by a 10 to 15-year period of washing of the fermented MSW residues with clean water which is sent for treatment for surface-water disposal after a single pass or limited number of passes through the landfill. In that washing period, residues that would otherwise eventually leak out of the landfill and pollute groundwaters, are deliberately leached out of the wastes in a controlled manner. Without the clean-water leaching step, leachate recycle will not prevent groundwater pollution.

In summary, the authors advise against the disposal of leachate in classical unlined sanitary landfills or in single-composite-lined, Subtitle D landfills because of the increased potential for groundwater pollution. Leachate recycle should only be practiced in appropriate, double-composite-lined landfills wherein the wastes have been shredded wastes; the process must be terminated when the upper-composite liner fails to prevent leachate migration through it that could lead to groundwater pollution. In order to effect a meaningful reduction in the pollution potential of landfill leachate, leachate recycle needs to be followed by adequate clean-water washing/leaching of the fermented residues. Before in situ leaching in a properly designed, constructed, and operated

fermentation/leaching wet-cell landfill can be practiced, Subtitle D regulations will have to be changed to allow the introduction of water into the landfill to accomplish this leaching.

References

Cherry, J., "Groundwater Monitoring: Some Deficiencies and Opportunities " IN: Hazardous Waste Site Investigations: Towards Better Decisions, Proc. 10th Oak Ridge National Laboratories' Life Sciences Symposium, Gatlinburg, TN, Lewis Publishers, May (1990).

EMCON, "Sonoma County Solid Waste Stabilization Study and Twelve-Month Extension Sonoma County Solid Waste Stabilization Study," Report SW-65d. 1., US Environmental Protection Agency Office of Solid Waste, Washington, DC (1975; 1976).

Lee, G. F., and Jones, R. A., "Managed Fermentation and Leaching: An Alternative to MSW Landfills," *Biocycle* 31(5):78-80,83, May (1990).

Lee, G. F., and Jones-Lee, A., "Landfills and Groundwater Pollution Issues: 'Dry Tomb' vs F/L Wet-Cell Landfills," Proc. CISA Sardinia '93 IV International Landfill Symposium, Sardinia, Italy, pp.1787-1796 (1993).

Lee, G. F., and Jones-Lee, A., "US EPA's Groundwater Monitoring Program for Landfills Flawed," Accepted for publication in *Environmental Science & Technology*, American Chemical Society, August (1994).

Lee, G. F., Jones, R. A., and Ray, C., "Review of the Efficacy of Sanitary Landfill Leachate Recycle as a Means of Leachate Treatment and Landfill Stabilization," Report of the US Army Construction Engineering Research Laboratory, Champaign, IL (1985).

Lee, G. F., Jones, R. A., and Ray, C., "Sanitary Landfill Leachate Recycle," *Biocycle* 27:36-38 (1986).

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