A Superior Approach to Recirculation

By Jay Warzinski, B. Todd Watermolen, Mark J. Torresani and Douglas R. Genthe

Leachate recirculation is degrading ... and that's one of its good points.

Although regulations often encourage dry tombing waste, leachate recirculation continues to surface as a viable landfill option. In fact, the positive experiences of small-scale experiments and demonstration projects have prompted many landfill owners to consider leachate recirculation systems.

One of the nation's largest solid waste companies, Superior Services Inc., West Allis, Wis., recognized the potential benefits of leachate recirculation in 1997, and now the company is approved to recirculate leachate at facilities in Wisconsin and Alabama.

Seven Mile Creek Landfill

Superior's experience with leachate recirculation systems began in 1997 with its acquisition of the Eau Claire County Landfill in Eau Claire, Wis. Two years earlier, the state approved a two-phase project to evaluate hydraulic loading and leachate quality at the site. The first phase became operational in 1995 and included a pressurized drain field with eight 4-foot wide and 200-foot long trenches. Tire chips were used as trench backfill around the perforated pipes in lieu of an aggregate. Trenches were 12 feet to 15 feet below grade and were connected to two 10,000-gallon storage tanks, which were filled by a tanker truck.

During Phase 1, approximately 1.5 million gallons of leachate were recirculated over six months at a daily rate of between 4,000 gallons and 20,000 gallons per acre (gpad). Unfortunately, there wasn't enough leachate generated to maintain a constant head.

General observations included:

- Leachate heads of 0 feet to 5 feet immediately below the trenches;
- Seeps occurred where active trenches were within 100 feet of the sideslopes;
- Leachate heads on the liner system increasing 6 inches during the project's final two months;
- Settlements of 1.5 feet to 2 feet within the recirculation area; and
- Gas generation increasing by 25 percent, resulting in significant odor.

Phase 2, conducted by Superior in 1997, consisted of four trenches spaced 50 feet apart. Three trenches were 300 feet long, and one trench was 500 feet long. Collection pipes at the base of the landfill immediately below the system were used to evaluate the leachate quality. Leachate was introduced through a vertical riser connected to a horizontal pipe from a 3,000-gallon tanker truck.

During this phase, approximately 3 million gallons of leachate were recirculated.

The most notable observations included increased gas generation, which created significant odor; leachate introduction rates of 500 gallons to 600 gallons per minute, which prevented leachate from dropping out and appeared to oversaturate the far end of the trench; and no significant trends in leachate quality.

Nevertheless, Superior believed that if designed and operated properly, leachate recirculation systems would not diminish or adversely affect the ability of landfill systems to protect the health, safety or welfare of the communities they serve.

Superior currently is seeking approval for a full-scale recirculation system at this facility using the horizontal distribution line method as well as application at the working face.

FCR Landfill

Superior's FCR Landfill in Buffalo, Minn, is concluding a three-year leachate recirculation demonstration project. The system, which began operation in June 1997, included three horizontal distribution trenches that each were approximately 600 feet long and sloped between 1 percent and 2 percent.

Trenches were spaced 100 feet apart over a 10-acre lined area. The 3-foot wide by 3-foot thick trenches included a 6-inch high-density polyethylene (HDPE), 4-hole perforated pipe in an envelope of clean stone. The trenches were covered with a light geotextile and backfilled with the excavated waste. A bentonite plug at the end of each trench minimized potential leachate migration to the sideslope.

Distribution pipes were connected to a central header-forcemain by a 6-inch butterfly valve. The valve regulated the rate and quantity of leachate flowing into the trench.

In the leachate loadout area, a conveyance line directed liquid from its storage tank into the forcemain line. The loadout pump then moved the leachate into the recirculation system.

When the storage tank achieves 80 percent capacity, the operator recirculates leachate by manually opening the trench's valve to receive the leachate and turning on the loadout pump.

Since June 1997, approximately 3.5 million gallons of leachate have been recirculated, including 2 million gallons during the first nine months of operation. The acceleration of waste decomposition resulted in such significant gas generation that the gas extraction system had to be connected to the recirculation lines to control odors. The gas quality consistently exceeded 40 percent methane when applying over 10 inches of negative pressure. Connecting the gas extraction system significantly reduced odors from the leachate recirculation system.

While several problems arose — increased gas generation and sideslope seeps — several positive observations were made:

- **Leachate quality stabilized.** Concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds, chemical oxygen demand, biological oxygen demand and total suspended solids either were reduced or stabilized. Leachate pH rose only slightly.
- **Settlements of more than 8 feet were observed.** Typically, settlements were estimated to be 4 feet to 5 feet since recirculation began.
- **There was no leachate head build-up at the liner.**

Emerald Park Landfill

Building on the FCR landfill's design, Superior installed a similar leachate recirculation system at the Emerald Park Landfill, Muskego, Wis., in July 1998. This design, however, accommodated for accelerated gas generation rates and, as a result, is Superior's most advanced and automated system.

Three horizontal distribution trenches initially were installed. The trenches were spaced 100 feet to 200 feet apart, ranging in length from 600 feet to 900 feet. Located over 23 acres of lined area, the 3-foot wide by 3-foot deep trenches consist of a 6-inch HDPE, 4-hole perforated pipe in an envelope of clean stone. The trenches were covered with a light geotextile and backfilled with the excavated waste. A bentonite plug at the end of the trench minimizes

Recirculation Methods and Design Concepts

There are several ways to recirculate leachate:

Trench Fill: Here, an excavated trench is filled with leachate, which quickly dissipates into the mass. The trench can be recharged continuously to maintain a constant head. This is a cost-effective method, but environmental, health and safety, or other aesthetic-related issues can be raised.

Vertical Injection Well: The well diameter, depth and backfill material; the need for, and the type of piping; and the injection rates all vary in vertical injection well designs. This method can be designed and operated manually or automated, which initially costs more. This recirculation alternative is preferred for environmental, health and safety, and aesthetic reasons.

Horizontal Distribution Trench: The widely used horizontal distribution trench method slowly introduces leachate into the waste. The system works similar to a septic system's leach field. The trench shape, the piping type and perforation patterns, the pipe slope, and the infiltration rate all vary in their design. The system can be automated at a higher initial cost. This method also is a good alternative for recirculating leachate.

Surface Application: This cost-effective method provides a good distribution of liquids. Leachate is applied directly to the working face of a landfill, immediately wetting the waste before compaction. This reduces rebound or expansion, which typically can result in a lower waste density. Leachate can be pumped to a central temporary holding tank from the site's collection and removal system, or to the sprayer's holding tank. Either a hose sprays leachate from the holding tank onto the waste, or a soaker hose above the working face allows the leachate to seep into the open surface. The leachate also can be carried in a water truck to the working face. While application at the working face may be the most effective way to recirculate leachate, it can be the most operationally intensive method and can raise safety and air emission concerns.

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potential leachate migration to the sideslope. The trenches were sloped at between 1 percent and 2 percent.

At the leachate lift station, an additional pump conveys the liquid to a valved manifold located within the waste. The 3-inch diameter line branches off at the manifold to each 6-inch diameter horizontal distribution line. Leachate is directed to one or more of the trenches at the valved manifold during recirculation. The valved manifold also controls the rate at which leachate enters the trench.

Each 3-inch diameter line is connected to the lower portion of a 6-inch diameter vertical riser pipe. The vertical riser pipe is connected to the horizontal distribution pipe in the trench, as well as to a lateral pipe connected to the gas extraction system's header pipe. A 4-inch butterfly valve, sampling ports and flexible pipe create a gas wellhead to regulate the vacuum within the leachate trench.

The quality of the gas from the trenches consistently ranges from 40 percent to more than 60 percent methane when applying between 5 inches and 19 inches of negative pressure. Gas flow from the horizontal distribution lines ranges from 60 cubic feet per minute (cfm) to 120 cfm.

Additional gas system information is being collected to help correlate the trench's capacity to accept leachate and hopefully determine each recirculation line's life. Once the waste's absorption capacity has been achieved, horizontal distribution lines only will be used for gas extraction.

To minimize gas and odor, Superior uses an aggressive placement of clay intermediate cover soil.

Sideslope seeps have not been issues at this facility because of the 50-foot to 100-foot setback distances, depending on waste type, from the landfill's outboard/exterior slopes.

Between August 1998 and December 1999, approximately 2.5 million gallons of leachate (525 gpad) have been recirculated. The system has been in operation for only 16 months with no significant trends in leachate quality.

Additionally, two recirculation lines recently have become operational. The landfill has requested approval of a full-scale system in its most recent permit application.

Glacier Ridge Landfill

The Glacier Ridge Landfill, located in Mayville, Wis., began recirculation operations in September 1999 using a surface application method. Landfill personnel modified a 2,000-gallon tanker roll-off by welding a sprayer bar on a discharge port on the tank's backend. Hoses attached to the sprayer bar drag across the waste and trickle out the leachate. The tanker is placed in an articulated dump truck, which moves across the landfill's working face.

The landfill has experimented with spraying the leachate over the working face using a fiberglass hose with a spray nozzle. The hose was connected to a 6,000-gallon tanker truck used to haul leachate to the wastewater treatment plant. Because it has been difficult to position the tanker close enough to the working face without disrupting operations, the landfill is considering other ways to use the fiberglass hose method.

Since operations began, Glacier Ridge has recirculated more than 500,000 gallons of leachate with no negative impacts. Surface application has not led to additional odors, safety or other aesthetic issues at the working face that often are associated with this method. Using the articulated dump truck also minimized any interference with the operation of the landfill.

To recirculate leachate, Superior installed horizontal trenches, which then were covered with a light geotextile and backfilled with the excavated waste.

By modifying the horizontal distribution system to eliminate problems, the benefits at the Glacier Ridge landfill offset most, if not all, the system's drawbacks. Installation of a horizontal distribution system can be expensive, but it often pays for itself in the first year of operation, according to Superior.

Long-Term Benefits

In testing leachate recirculation systems over the past three years, Superior facilities have realized increased waste density, increased gas generation, improved and/or stabilized leachate quality, greater operational flexibility in managing leachate and reduced leachate treatment costs.

With this in mind, Superior and its contractor, Madison, Wis.-based RMT believe that as leachate recirculation becomes more accepted by regulators, converting and dedicating vertical injection wells or horizontal distribution lines to gas extraction may replace more traditional gas extraction methods. This would defer leachate recirculation lines' installation costs and promote earlier installation of gas extraction systems.

And as landfills begin to accept liquids because they can manage the hydraulic load and minimize the environmental risk, these experiences will provide a basis for reversing the dry tomb regulatory policy.

Leachate Recirculation's Advantages

Leachate recirculation offers potential environmental and economic advantages:

- Maximizes waste disposal capacity;
- Increases the final cover system's performance;
- Increases leachate management and treatment flexibility;
- Increases waste biodegradation and gas production, and hastens and improves waste stabilization;
- Improves leachate quality; and
- Reduces leachate treatment costs.

Although many components of leachate recirculation systems often are abandoned once waste has reached its absorptive capacity, Superior has proven that horizontal distribution lines, if incorporated in the original design, can be used for gas extraction.

Using the leachate distribution system as a long-term horizontal gas extraction system also can provide excellent odor and air emission control during operating life, rather than waiting to install active gas extraction after waste placement is complete.

Although many advanced and automated leachate recirculation systems have been installed at sites with high treatment or transportation costs, based on Superior's positive experiences, even the most basic system — if conducted in an environmentally safe manner — can reap many of the same benefits. WA

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Leachate Directory

Aardvark Corp.
Circle 141 on reply card
Aeromix Systems Inc.
Circle 142 on reply card
Atlantic Screen & Mfg.
Circle 144 on reply card
Blackhawk Environ.
Circle 146 on reply card
Central Plastics
Circle 147 on reply card
CES-Landtec
Circle 148 on reply card
Charles Machine Works
Circle 191 on reply card
Clean Environ. Equip.
Circle 149 on reply card
CSR PolyPipe
Circle 150 on reply card
Delta Controls Corp.
Circle 151 on reply card
Ecogas Corp.
Circle 153 on reply card
Emcon/OWT Solid Waste
Circle 154 on reply card
ESC
Circle 155 on reply card
EPG Companies
Circle 156 on reply card
Fen-Tech Environ.
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Fluid Controls
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Forrer Supply Co.
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Handex Environmental
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This article is based on a presentation that will be made at the National Solid Wastes Management Association's Waste Tech 2000 conference on March 5-8 at the Wyndham Orlando, Fla., resort. For registration and program information contact Sandra Geiger: (800) 424-2869. E-mail: sgeiger@envasns.org