How to Minimize CCR Landfill Leachate and Contact Water Management

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ABSTRACT

Learn how to minimize leachate and contact water management at coal combustion residual (CCR) landfills using good design, physical controls, and operational practices. Through our presentation of case studies, you will learn how to assess leachate and contact water management issues, and implement techniques to minimize leachate and contact water management at your landfill.

Leachate management and contact water management at CCR landfills can be expensive, cause operational headaches, and divert valuable resources from other critical plant needs. Our presentation will provide you with useful tools to ensure your landfill is designed and operated to effectively reduce leachate and contact water and alleviate operator stress. We will present case studies that highlight how design features, physical controls, and operational practices have effectively decreased leachate and contact water management at CCR landfills.

INTRODUCTION

Precipitation is the number one producer of leachate and contact water at CCR landfills. With an annual rainfall of approximately 35 inches in the Upper Midwest, almost 1 million gallons of water are produced per acre per year. Therefore, great thought should be put into minimizing leachate and contact water management at CCR landfills. Minimizing the management of leachate and contact water can alleviate operational headaches and can reduce the amount of plant personnel needed for management. Alliant Energy has used landfill design and proper operation to effectively reduce management of leachate and contact water at a number of their active CCR landfills.

LEACHATE AND CONTACT WATER MANAGEMENT

Leachate is water that has percolated through a solid (i.e., CCR) and leached out some of the wastes constituents[1]. Leachate is conveyed by the landfill leachate collection system via gravity flow through a drainage layer, piping, and eventually pumps.
40 CFR § 257.70 requires landfill operators to collect the leachate produced at landfills. If the landfill is located at the power plant, leachate is often treated on site along with other generating facility wastewaters. If the landfill is not located at the power plant, hauling leachate by trucks or having leachate pumped through a force main to a publicly owned treatment works (POTWs) are ways to convey leachate off site for treatment.

Contact water is any surface water that has come into contact with solid waste (i.e., CCR). Contact water is typically conveyed through gravity systems such as swales. Contact water regulation differs from state to state. In some states, contact water is regulated as acceptable surface water if it meets water standards without treatment. The standards are dependent on site permits.

Leachate is typically stored in ponds or tanks (above or below ground). Contact water is typically stored in ponds. The tanks or ponds are pumped through force mains or to haul trucks that convey the water to its final destination. The final destination may be surface waters, ponds, or POTWs.

Initially, liquid generation rates are high following landfill cell construction when there is a large area of exposed leachate drainage layer and limited CCR in place. At this stage leachate, contact water, and clean storm water are often comingled. Once a majority of the leachate drainage layer is covered and enough CCR has been placed, we begin to see some segregation in these liquid streams. Over the long term, leachate generation rates for CCRs are typically low unless the landfilled material is uniformly granular (e.g., bottom ash or slag) and/or large open areas of permeable CCR exist. Contact water generation rates are directly linked to precipitation rates. There can be large volumes of contact water generated when there are large open areas of exposed CCR or exposed CCR has low permeability (i.e., high runoff coefficient). Contact water can also have a high erosion potential.

**TREATMENT AND OPERATIONAL ISSUES**

Treatment of leachate and contact water is accomplished in a number of ways. Currently, it is common to treat leachate and contact water with existing ash ponds. However, with the rapid closure of ash ponds across the country, treating leachate and contact water will become more costly due to technology and logistics. Focusing on reducing leachate and contact water generation (upstream) or reusing these liquids (midstream) rather than treatment (downstream), will minimize the volume of liquids to be managed/treated, which is likely to reduce costs and operational issues.

Operational issues due to contact water or leachate include hauling distance, treatment cost, erosion maintenance, and overall employee headaches. There are a number of solutions that will minimize the volume of liquids generated or requiring treatment, which can cause these issues. A list and description of methods for minimizing leachate and contact water leachate are listed below:
- **Temporary Covers.** Temporary cover systems such as rain flaps or rain covers separate clean storm water from producing contact water or leachate and are deployed initially once the landfill cell or module is constructed. Rain flaps convey storm water to areas where the storm water will be pumped to an outfall, swale, or pond. Covers also protect leachate drainage materials or CCR materials from erosion. Covers can be used over exposed CCR material to reduce the amount of leachate or contact water produced.

- **Contact/Leachate Ponds.** Ponds help with evaporation and settling of contact water or leachate. Water removed from contact/leachate ponds is used for moisture conditioning CCR material or for dust control within the landfill footprint. Leachate or contact water from ponds may also be treated by pumping through a force main to a treatment system or hauled to a POTW.

- **Intermediate Cover.** Placement of intermediate cover on exposed waste can help reduce the amount of contact water or leachate produced. Intermediate cover placement occurs on areas where there will not be filling of CCR for an extended period. Intermediate cover placement also occurs in areas where there may be a future overlay of materials. Intermediate cover decreases the chances of CCR erosion issues.

- **Final Cover System.** Installation of final cover at a CCR landfill needs to be completed as soon as feasible. Once design final waste grades are reached, final cover should be installed in order to eliminate leachate and contact water generation. Final cover systems may consist of clay, low permeability soils, geosynthetic clay liners (GCLs), or geomembranes. Above the clay or synthetic component of the cover system a drainage system is installed. Finally, a vegetative component including a rooting zone layer and topsoil will be installed.

- **Storm Water Features.** Storm water features can help convey water away from a landfill cell or module, therefore reducing leachate and contact water production. Using swales, diversion berms, or dissipaters can help with both water conveyance, but also erosion issues. Reviewing run on to contact water/leachate ponds or landfill cells will help determine if storm water features may be necessary.

- **Build Smaller Landfill Cells/Modules.** Building smaller cells or modules will help to decrease the production of contact water or leachate by reducing the exposed area of the leachate drainage materials.

- **Reuse.** If allowed by local regulators, reuse of leachate and contact water for moisture conditioning of the CCR material when placed in the landfill or as a dust control within the CCR landfill limits, are each ways to decrease contact water volumes.
CASE STUDIES

Described below are three case studies where these minimization techniques were used at Alliant Energy sites to decrease the amount of leachate and contact water that was produced and ultimately had to be managed.

Case Study No. 1 – Use of a Rain Cover
Case Study No. 1 is Alliant’s Ottumwa Midland CCR landfill in southern Iowa. A new landfill cell was constructed with an area of approximately 9 acres. The leachate drainage layer is constructed of sand placed over a 60-mil high density polyethylene (HDPE) geomembrane with HDPE collection piping. The leachate drainage layer material is expected to be exposed due to CCR disposal rates. Three sides of the cell have long side slopes on the order of 150 feet. The remaining side (north side) of the cell has a short side slope, which exposes the cell periodically to very windy conditions.

Due to the long side slopes and CCR filling rate, the exposed drainage layer material started to erode after construction of the cell. Because of the erosion and the potential for high leachate and contact water generation rates, the solution proposed was to install a rain cover over approximately three quarters of the cell area and separate clean storm water from leachate and contact water.

The material chosen for the rain cover was a Raven Duraskrim 12 mil reinforced HDPE membrane. The material was installed in panels and sewn together. Due to the potential for high winds at the landfill, the membrane was ballasted with a Wind Defender material. The Wind Defender material was also sewn together after installation.

After installation of the rain cover system, storm water was collected above the existing leachate sump and pumped north of the constructed cell to a storm water pond. As CCR was placed in the landfill cell, sections of the rain cover will be removed to make room for additional CCR placement. Temporary berms will be constructed to allow for continued use of the rain cover until there is no longer usable space in the cell for the rain cover.

The use of the rain cover has allowed for the separation of storm water from becoming contact water or leachate. By diverting clean storm water away from the leachate and contact water collection systems, Alliant significantly reduced the volume of liquid managed that required treatment. To provide perspective, if the site receives approximately 35 inches of precipitation per year, the rain cover is saving Alliant from managing 950,400 gallons per acre each year as leachate or contact water that must be reused or treated. For the approximate 7-acre rain cover, that is approximately 6.5 million gallons of liquid that can be discharged as clean storm water rather than hauled for treatment each year.
Case Study No. 2 – Use of a Rain Cover, Intermediate Cover, and Final Cover  
Case Study No. 2 is Alliant’s Columbia CCR landfill site in central Wisconsin. The existing contact water/leachate pond at this site was evaluated and it holds a 25-year, 24-hour storm event with up to approximately 6.3 acres of open landfill area. The existing pond is fed through a gravity leachate system and a gravity contact water system. Due to the amount of the current open area at the time and the need for another landfill cell, sections of the CCR landfill were closed with final cover or had intermediate cover placed. A rain cover was also placed over the newly constructed cell to limit the amount of leachate or contact water sent to the pond.

For the cover construction, final cover was installed over approximately 2.8 acres of the CCR landfill, and intermediate cover was installed over 5.9 acres of the CCR landfill. Final cover was installed in areas that had reached designed final waste grades. The intermediate cover was placed in areas where the CCR had reached temporary waste grades, mostly in areas where there is future overlay of CCR material. The final cover consisted of a 3-inch grading layer, followed by a composite liner, a 1-foot drainage layer, a 1-foot rooting zone, and a 6-inch topsoil layer. The composite liner consisted of GCL and a textured 40-mil linear low-density polyethylene (LLDPE) geomembrane. The intermediate cover consisted of a minimum of 24 inches of general fill soil and 6 inches of top soil.

Drainage swale diversion berms were installed after the installation of the final cover and intermediate covers. Storm water drained over the final cover or intermediate cover areas to the diversion berms. From the diversion berms the storm water traveled down downslope channels or rock chutes to perimeter swales. The perimeter swales eventually fed into a storm water pond.

A 4-acre cell was constructed adjacent to the final cover and intermediate cover installation. The cell consisted of a composite liner (clay, GCL, and 60-mil geomembrane) and a leachate drainage collection system. After the cell was constructed, a 12 mil Raven Duraskrim 12 mil reinforced HDPE membrane was installed across the cell. The rain cover material was sewn together and ballasted with sand bags that were roped together. Clean storm water collected at the east end of the cell above the rain cover and was pumped to a perimeter swale.

The use of the final cover system, intermediate cover placement, and rain cover installation allowed for the separation of storm water from becoming contact water or leachate. To provide similar perspective as Case Study No. 1, if the site receives 35 inches per year, then the rain cover saves Alliant from managing 950,400 gallons per acre per year. For a 4-acre rain cover, that is approximately 4 million gallons of liquid that can be discharged as clean storm water rather than hauled for treatment each year. For the combined 8.7 acres of final cover and intermediate cover placement, that is over 8 million gallons of water that is conveyed away from the landfill and potentially becoming contact water or leachate.
Case Study No. 3 – Study of Run On and Final Cover Systems

Case Study No. 3 is Alliant’s I-43 CCR landfill site in eastern Wisconsin. This site previously had an existing CCR landfill that gravity drained to a leachate and contact water pond. The site continues to pump water from the pond and hauls the water for treatment. The site was looking to see if there were possible solutions to cutting down the amount of water that was accumulating in the pond. After an evaluation of the current topography at the site, there were areas around the existing pond that drained to the pond unnecessarily.

There is an existing perimeter swale that drains clean site storm water around the existing pond. Areas that were draining to the leachate and contact water pond were graded to drain to the perimeter swale. This grading cut down on the amount of unnecessary clean storm water draining to the leachate and contact water pond. The site also started to use the contact water from the pond for conditioning the CCR placed in the landfill. Water is pumped from the leachate and contact pond to the adjacent open landfill area and applied to the CCR.

The site also constructed final cover on portions of the landfill that had reached final waste grades. The final cover consisted of a composite liner followed by a rooting zone and topsoil layer. The composite liner consisted of 2 feet of compacted clay, a double-sided textured 40 mil LLDPE, and a geocomposite for drainage. The final cover areas drained to perimeter swales and eventually to storm water ponds.

In this case study, the areas around the existing leachate and contact water pond were graded away from the pond, the site has used water from the pond to recondition the CCR material in the landfill, and the site installed final cover on waste at final waste grades. These items help to cut down on the amount of liquid going to the pond and assists with reducing water generation. The reduction of water generation in the pond reduces the amount of water that has to be managed and ultimately treated.

COST VS. OPERATIONS

Methods used for minimizing leachate and contact water management may be very cost effective. By minimizing leachate and contact water, there will be less hauling costs, less treatment costs, and less operator time. At the same time, these methods will also limit operational headaches due to less pump maintenance, less drainage layer maintenance, and less water erosion maintenance.

CONCLUSION

When looking at leachate and contact water minimization techniques, the first step is to look for potential cover systems that will prevent generation of leachate and contact water. Temporary covers such as rain covers or rain flaps, intermediate cover systems, or final cover systems are all methods of reducing leachate or contact water generation. Each method needs to be constructed at the right time in the landfill construction sequence. Diverting water away from contact/leachate ponds or landfill cells using
storm water methods will help prevent unnecessary generation of contact water or leachate. Inspecting cover systems and diversion features at a landfill is key for potential future erosion and maintaining features that are operating correctly. Reuse of leachate and contact water for moisture conditioning of the CCR material when placed in the landfill or as a dust control within the CCR landfill limits are other ways to decrease contact water volumes.

Planning for the next area of a CCR landfill construction sequence is crucial. The need for a potential cover system or the diversion of water should be on every landfill operator’s mind. By planning for future cells and the orientation of where waste is placed and graded, in conjunction with cover systems and water diversion, it will help any site minimize their leachate or contact water generation. By planning for the future, costs can be effectively managed and operational headaches can be limited.

REFERENCES
