https://www.waste360.com/Landfill_Management/maximize-landfill-lifespan-201103

Lengthening a Landfill's Lifespan

Landfill operators can use a variety of techniques and technologies to maximize the life spans of their sites.

Jerry L. McGraner and Tom Flannagan | Mar 01, 2011

Airspace is the primary asset of any landfill owner. Consider all of the factors that impact the value of that airspace. There is price of the property along with the costs of permitting, grading, road construction, pond construction, liner installation, leachate collection system installation and a host of other infrastructure expenses. Then there are the operational costs associated with that airspace, such as leachate collection, transport and treatment; equipment expenses; labor costs; host fees; repair and maintenance costs; and power expenses. And let's not forget the closure and post-closure costs that factor into the value of this commodity. All in all, airspace is a pretty pricy asset.

This article will help landfill owners and operators manage their facilities to meet their needs for as long as possible. Some owners will have different perspectives on the lives of their assets. A private company may want to take in as much waste as it can in as short a period of time as possible. This maximizes revenue while minimizing the time frame during which many operational expenses are incurred. A government-owned facility is typically providing a service to community residents. Given the cost of these assets, owners of these facilities want to make them last as long as possible in order to serve their communities and minimize further capital expenditures. Many of the activities discussed in this article are applicable to both groups, but some will only make sense to the owners of public facilities.

Of course, managing airspace begins with an efficient site design. The investment in equipment and labor at your site will reap much greater rewards if you begin with an optimized airspace design.

The most efficient design is a rectangular shape. The site owner must work closely with the engineer to make sure that the design and permit allow for the maximum volume of airspace per acre of lined footprint. A rule of thumb is a minimum of 100,000 cubic yards of airspace for each lined acre.

Design features can be incorporated that will greatly expand site capacity. A mechanically stabilized earth berm can be designed and constructed around the landfill footprint to allow significant increases in depth and capacity. Waste depth across the facility can be increased by 50 feet or more with this type of construction. This technique is extremely valuable for facilities with no lateral room for expansion.

Landfill owners also can maximize their airspace management by making sure they follow some basic daily operational techniques. If you already have the proper equipment on hand, these techniques typically require more discipline than dollars. Furthermore, there are some technologies that not only extend the life of your landfill, but also can open up another source of revenue.

Focus on the Fundamentals

If you talk to a coach after an embarrassing loss, he is likely to say something like, “We are going to regroup and focus on the fundamentals.” In football, that means activities like blocking and tackling. In basketball, it refers to passing, dribbling and rebounding. Successful execution of these activities forms the foundation that will help a team be successful. There are also fundamentals in managing airspace. New technologies won’t do to extend a landfill’s life if the operator neglects the foundational practices. These practices include maximizing compaction efforts and controlling the materials coming into a facility.

Effective compaction will reduce waste volume to the smallest practicable size and minimize the airspace consumed. Maximizing compaction requires having the appropriately sized compactor, effective wheels and cleats on the compactor, and a consistent maintenance program to ensure that the equipment is up to the task.

Generally, the heavier the compactor, the better the compaction. Compactors weighing up to 120,000 pounds or so are used in medium- to high-volume landfill operations (meaning they take in more than 750 tons of waste per day). The unit should be designed for use with solid waste. Make sure that the compactor weight is transmitted effectively to the wheels. The cleats on the wheels should penetrate and increase the density of the waste. Some cleats will chop or even fluff the upper layer of material, depending on the composition of the waste. Consult with the manufacturer to select wheel and cleat combinations that best suit your particular mix of materials.

Regular maintenance is required to ensure effective compactor performance. A maintenance checklist should be prepared that covers all of the compactor's critical systems. Wheels and cleats should be monitored and replaced at the wear level recommended by the manufacturer, as excessive wear will impede a unit's function and prevent an operator from achieving the necessary compaction. All cleats should be replaced at the same time to ensure that uniform waste compaction is taking place.

A landfill operator must have a target density and methods established to see if that density is being reached. In-place density should range from a minimum of 1,200 pounds per cubic yard (lbs/yd3) to as much as 1,800 lbs/yd3, depending on the character of the waste stream entering a facility.

We recommend a target density of 1,400 lbs/yd3 for municipal solid waste and 1,200 lbs/yd3 for construction and demolition (C&D) materials. This density is determined by dividing the weight of the waste received since the last site survey by the volume of airspace consumed since the last survey. If a site received 7,500 tons of waste since its last survey, and the survey shows that 10,000 yd3 of airspace have been used in that time, then the density would be calculated as follows: (7,500 tons * 2,000 lbs/ton)/10,000 yd3 = 1,500 lbs/yd3.

In order to ensure that established targets are being met, these surveys should be conducted at least annually and maybe quarterly, depending on the size of the site. Additional surveys should be done when a major change occurs in the operation, such as the purchase of a new compactor, installation of new cleats on an existing unit, or a change in the number of passes or the pattern used while compacting the working face.

Equipment is important, but the operating procedures that a landfill operator uses also can make a real impact on available airspace. Waste coming into the landfill should be placed in no more than 2-foot vertical lifts in order for the compactor to have the greatest effect. The compactor should make between three and five passes over each area of placed waste. The equipment operator should move over one wheel width to the left or right and then make three to five passes over the next section. On a larger working face, an operator can lose his place, leaving some areas on the face uncompacted. A consistent travel pattern for the compactor must be established to ensure that the entire working face receives the appropriate amount of compaction.

Minimizing the area of the working face and tipping deck can help extend a facility's life by reducing the amount of material required to cover the face at the end of each day. It also allows a more concentrated path for the compactor so that more passes can be made and compaction of the entire working face ensured.

Material Control

Whatever goes into a landfill is taking up valuable space. Waste is what you want to occupy that space, but operations typically require the use of soil as a daily cover. The working face must be covered at the end of each day. This is most typically done with 6 inches of topsoil. But the use of alternate daily covers (ADCs) can eliminate the use of soil for this purpose and free airspace for additional waste placement.

There are many types of ADCs available on the market. They include natural or artificial materials that can be sprayed or broadcast onto the working face at the end of the day. The material will break down when the next layer of waste is placed. A tarp can also be spread across the working face at the close of business each day and removed the following morning to allow waste placement to begin again. The lower your daily intake volume, the greater the impact an ADC will have on your available airspace.

Local governments can extend their landfills' lives by diverting recyclables. This will require implementing a recycling operation and diverting these materials to an appropriate vendor. A material recovery facility (MRF) also can be developed to reclaim a small percentage of recyclables from the waste stream before those materials enter a landfill.

C&D debris can be difficult to compact and can create problems in achieving the targeted density. These materials also can be diverted to processing facilities where they can be prepared for use as aggregate, mulch or a variety of other beneficial uses. This makes additional landfill space available for materials that may be more easily compressed.

Building on the Foundation

Once the fundamentals are well in hand, new technologies can further enhance compaction. The application of global positioning system (GPS) technology to landfill operations can provide much better control of all material handling operations. A GPS system can give real-time information on a compactor's horizontal and vertical positions. Systems are available that have color console displays to enable the compactor operator to clearly see where they are and understand the actions that need to be taken. These units can be set to help operators keep the vertical lifts to 2 feet and make sure that the applied daily cover does not exceed 6 inches. They can give a compactor operator a visual indication that the maximum density that the equipment can produce has been attained. These features help minimize the soil in the landfill and guide you to the best compaction that you can achieve.

The cost of the equipment necessary to make this work can be quite high and will vary greatly depending on how many pieces of equipment a landfill operator wants to monitor as well as the system and software he selects. Several hundred thousand dollars can easily be spent on this type of system. But if a facility has 500,000 cubic yards of airspace remaining and this system improves compaction by 10 percent with a tipping fee rate of $40 per ton, the owner could generate an additional $2 million dollars of revenue. If a site has sufficient remaining airspace, this kind of system can provide a great return on investment and help extend facility life.

Leachate recirculation is a practice that has been around since the 1970s and offers significant benefits related to extending landfill life. Leachate from the landfill is pumped to a storage location and then broadcast on the working face of the operation. This leachate also can be introduced into a landfill through a series of perforated pipes or trenches that are placed through the waste mass. The moisture added to the waste can greatly enhance the compaction operation. Waste densities of more than 2,000 lbs/yd3 can be attained when moisture is added to the waste prior to compaction. This moisture also accelerates the decomposition and stabilization of the waste mass. Additional airspace is obtained as the waste mass is consolidated as a result of these processes. Final in-place densities can be up to 2,600 lbs/yd3, making significantly more airspace available for waste placement.

One result of these processes is the accelerated generation of landfill gas (LFG). The high concentration of methane in this gas makes it a significant energy source. The gas can be used to run engines that generate electricity. This electricity can be used to help meet on-site power requirements or it can be sold to power companies and provide a revenue stream for your operation. Landfill gas-to-energy (LFGTE) systems require capital investment as well as operational management. The accelerated LFG production will limit the time frame available to recoup the investment in this system. A thorough evaluation of the revenue generating potential of this type of facility should be conducted before pursuing this type of installation.

Leachate recirculation systems also require capital expenditures to design, permit, construct and maintain. In addition, problems with slope stability and side wall seeps can occur. The system needs to be managed properly in order to prevent these types of issues. Carefully weigh the pros and cons of these systems in light of conditions at your facility before pursuing.

Creating a bioreactor landfill involves the recirculation of leachate and the addition of air to accelerate the decomposition of organic materials. This is a more aggressive approach than just leachate recirculation, but carries with it the same type of investment, benefits and problems to address. Stormwater, wastewater or wastewater treatment plant sludge often are needed to supplement leachate and enhance microbiological activity and maintain the proper moisture content to optimize the bioreactor. A detailed analysis of a site and its waste stream should be the first step in pursuing this technology.

Landfill operators can do a variety of things to extend a landfill's life. Some tactics are old-school methods that require discipline and consistent effort. Others require capital expenditures, but they could prove worthwhile depending upon the size and anticipated life of a facility.

Airspace is a valuable asset. Use it wisely.

Jerry L. McGraner, P.E., is a regional manager with Richmond, Va.-based Joyce Engineering. Tom Flannagan is a senior technical consultant with the firm.