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Take Command of Your Landfill With Smart Equipment

Posted By Tauren Dyson On April 15, 2015 Waste Technology

Gone are the days when surveyors were forced to jam stakes into the dirt to grade landfills. Today, engineers have the option of using GPS or machine control to finish landfill construction projects in much less time than years past.

"Landfill construction has very tight tolerances. It has the same benefit as any GPS machine control," according to Randy Noland, Carlson Software's vice president of business development and marketing. "You want to move exactly per design, as productively and accurately as possible. If you over grade, it costs money; if you under grade, it costs money. . . . In building landfills, you've got a very regulated design for the slopes of the landfill. You've also got expensive materials because you're lining the landfill with clay and with other materials, and those are even more expensive."

Having to rebuild a slope because of poor grading could mean millions of dollars in lost materials and manpower. Noland adds if a slope is built too steep, that means it might have too much air space. If it's built too flat, it might not have enough air space.

For many first-time GPS users who plan to build landfills, setting up the device onsite may seem daunting. To grade a slope accurately, for example to a 3:1 or 2:1 ratio, the user must set up the GPS properly. Any deviation from the specifications can require a costly rebuild.

Since many errors occur due to poor GPS usage, here's a quick rundown of how to set up the GPS system:

- Set up control points throughout the site in order to calibrate the area: some engineers recommend 4, others go with 6 or 8 to be safe.
- Anchor the GPS base station somewhere stable, between 6 to 8 feet in the air. This device enables the system to reach a desired level of accuracy. Also calibrate it to the site. Find a permanent location for the base station to avoid having to move it later.
- Set up the radio or cellular network, including repeaters that transmit data to machines onsite.
- Convert or build the landfill design into a 3D design file landfill design that the machines onsite will use to as guides for construction.
- Install the GPS into the bulldozer, compactor, ATV to be used during construction, and calibrate them with the base station onsite. (Note: Some recommend not placing the GPS sensor directly on the blade during day-to-day landfill operations due to a high probability to the system.)
- Transfer the design files from the system to the machine.
- Lastly, as a measure of practicality, anyone operating the machines should receive training on how to properly use the system.

A GPS wireless setup at one location joins a network of other GPS devices at different locations. The owner of those systems can sit in a home office and receive and deliver real-time data from each system. This aspect of GPS use is important in order to reduce needless work. Operators can check landfill construction at any point to ensure the builders are staying true to design. In the actual design phase, the user can load a design into the system that gives specifications for a slope, or perhaps another landfill component.

"The things that used to take two days now take two hours. Using that machine as a tool to help the operator grade the plan is probably the biggest use of it [GPS], with compaction being second," says Bruce Flora, owner of Flora Surveying Associates. "If I am building a wetland, I can put a model into the machine, and the machine can guide and cut through the wetland for me. So, you can do it quicker, faster."

Flora also adds the manner in which things within the landfill, such as the haul road, storage pad, stormwater drains, leachate and stormwater retention ponds, and constructed wetlands are built, remain the same as before. Even though the machine can cut out the design, builders still need to survey the scene before beginning construction. Now the difference is GPS provides more accurate

grading and cuts down on the time surveyors once wasted putting stakes in the ground to build those items.

Ted Hawley, senior engineer at HDR, says GPS allows for more accuracy on landfill construction sites, and recommends mounting the GPS receiver to the end of a bulldozer blade. In the cab, the operator has a 3D image of the entire site. This minimizes human error, which ultimately leads to a quicker completion.

He also focused on the efficiency of GPS machine control versus the traditional staking method of grading. "So with traditional methods of grade control, there's an awful lot of syncing by a construction surveyor, and then the sequence that follows the grade stakes. With GPS machine control, all of that information can be essentially input into the computer on the machine itself and the operator controls the machine but the GPS unit, essentially controls the blade, but the machine can cut or build essentially directly to grade without having hundred and hundreds or thousands of grade stakes to follow."

Hawley recalls a recent project in which GPS use helped to drastically reduce the cost of building a landfill. "It was a $10 million contract: the contractor possibly saved $50,000 to $100,000 by using GPS machine control properly. They may have saved more. They were able to minimize the amount of surveying they needed to do. They didn't have any repairs that they needed to make in their liner system. Typically, without GPS machine control, on a 15-acre project, there will be 20 or 30 holes in the liner system."

John Thomas, the marketing and strategy manager with the construction and solutions group at Caterpillar, disagrees with Hawley about where to place the GPS receptor on a vehicle. He thinks GPS owners should avoid installing systems on blades for day-to-day operations.

"These systems provide the highest accuracy to meet the permitted design within the accuracy specifications for the project. But these blade-mounted systems are typically not used on the active face of the landfill during day-to-day operations of waste or daily cover placement," says Thomas. "Blade-mounted systems are at a higher risk of damage on the active face due the GPS receiver/antennae and harnessing locations. Waste from the active face can damage these high dollar components, through direct contact, or from getting tangled in the connecting cables/harnesses."

But even with accurate technology like GPS, human error often creeps

into the design. Unskilled users can improperly program the device, which could lead to unwanted results.

Hawley thinks GPS works well for grading accuracy. But he warns against too much reliance on GPS machine control to survey a site, and urges users to train on how to properly operate the system. "A lot of landfill construction is working on top of the geosynthetic liner system, and we just can't allow holes to be torn in that liner," he says. "We need an operator to understand the GPS, to use it as a tool to assist them, as opposed to taking the hands-off approach and letting the machine do its thing."

Because the geosynthetic liner contains so many expensive layers of material, tearing it would not only be costly to repair, but any leachate or toxic material that may leak into the soil could be expensive to clean up. GPS minimizes those mistakes.

GPS also helps to maximize airspace. By not using all available airspace, a landfill owner could potentially lose millions of dollars. Overuse of the space could cost money if the landfill owner has to regrade the slope.

Len Necaise is the district manager at Advanced Disposal. The company began using the Carlson 3D machine control system in 2011. He notes the use of GPS had an immediate impact. "This GPS, right off the bat, improved our density. I think before we started using the Carlson System, we were about 1,200 or 1,300, and the last flyover we had, this past October, we were at 1,680 per cubic yard."

Dave Jordan has worked as the national sale manager of the machine control division at Carlson Software. Like Necaise, he's seen density growth among landfills of the various customers who use Carlson Systems. "One reason density growth has improved, is that GPS helps build better engineered slopes," he says.

He recalls one instance in which creating better leachate control helped save time and money for a client. "I was with a landfill company in the Chicago area. It used to rain, and the next day they would be pulling their machines out [of the landfill]. After they got their GPS that we installed, we created a slope, got the leachate to run off of the deck of the landfill, and they don't pull machines anymore, if water runs." After Jordan came in and helped engineer a better deck, it diverted the leachate away from the machines in the landfill.

According to a study that was done by water treatment company CDM

Smith, leachate treatment cost Hall County, GA nearly $80,000. Jordan insists proper deck construction with GPS can cut these high costs, and lead to better leachate management.

Noland, of Carlson Software, agrees, "It's a huge component in the GPS compaction systems to have GPS control the top of your deck. If your deck is not created correctly, the water will just sit up on top of the deck and just penetrate the landfill, which becomes leachate, then they just have to pump or treat it. If water runs off of that, you don't really have to treat that."

Carlson Software's website estimates leachate removal at 10 to 12 cents per gallon. "Because I have GPS guidance, I'm able to manage my slopes. So I got a landfill design slope, but I'm also building slopes with the waste stream," says Noland. "And if my slopes aren't accurate, if they're not compacted right, if the slopes aren't accurately built and I get a lot of rainfall or I don't compact very well, those slopes will fail. And when slopes in the waste stream fail, there are all sorts of residual negative effects."

By controlling the amount of leachate that enters the landfill cell, companies can also keep fuel costs down and cut down unnecessary hauling. "The machines are very expensive to run. We're talking 600-gallon fuel tanks, on average, and you don't want to be running them when you don't have to," says Sam Rohr of Geologic Computer Systems.

For surveyors who can't program a GPS setup, Geologic has programs and systems that are retrofit to older machines.

Rohr states, "If you think about what they do now, without a GPS system: What they do is they'll have a surveyor come out and do a survey of the surface, and he'll put stakes in the ground and tell them how far they need to go until they get the final grade. Imagine if you were able to do that in real time. You're in the cab of your vehicle, and you can see where final grade is. 'I know, right here: I'm 10 feet below it.' And it's a money saver right there for what you're paying for survey costs and survey fees to make sure you're on grade and increasing your compaction, running your machine efficiently and your fuel saving."

According to Noland, "The biggest benefit of GPS in a landfill is optimal compaction, with better density. That's because you're selling airspace. That's what you're selling; you're selling storage buildings. And, the more stuff I can pack in those storage buildings, the more

efficient I am."

GPS systems also provide more accurate compaction numbers that help landfill operators avoid unnecessary passes, which ultimately conserves fuel. For example, he says an operator using Caterpillar 836G for compaction on a 5-foot lift, should pass over the trash four times, and then use the GPS system to monitor deflections. In the cab, the system's touchscreen displays a four-color coded system, starting with pink. The GPS equipped compactor can also measure the depth of a lift.

Noland says communicating data back to the main office is important to keep the landfill from wasting valuable space. "So, the data from a GPS on compactors and dozers pinging to a back office give you near real-time airspace utilization. You're actually watching as things are being compacted and making decisions in near-real-time to keep that corrected."

Most industry experts consider 2 feet to be the "optimized standard" for a lift thickness. Flora remembers the days before GPS, and how landfill operators only used their eyes to estimate inaccurate lift compaction rates. "I have seen mistakes that have cost $500,000, $600,000, $700,000," he says. "I've seen things go as high as $1.29 million. We had no idea if they were compacting it properly. Were they burning fuel and wasting time? Were they not doing enough? It was all done by eye."

Having a compactor continuously and needlessly roll over a lift can eat up a lot of money in gas alone. Rohr reports, "We're averaging about a 14% improvement using GPS on landfills. So you say, ' How much airspace did you fill last year? And what is the dollar value of every cubic foot of airspace?' And, you say, 'How much is it worth to you if each one of those cubic feet is 14% more valuable?' The monthly dollar value on that is astronomical. You're talking, in most cases, hundreds and thousands and millions of dollars."

Jordan is on the same page. "They're all looking for density. They want better density because they pay, say, maybe $10 million for airspace. They pay ungodly amounts of money for airspace. The more they can compact, the more garbage in it, the more money they make. So with this system, we've seen increases in the small range of 3 to 4%, all the way to 34% of an increase by having this system on their machines."

It's important for vehicle operators in the landfill to locate dangerous

substances. If not, results can be disastrous. “Every time that you put anything in the landfill, generally, especially when you’re talking about things like gas wells, you want to know their position,” says Rohr. “When you’re driving, and you’re dropping these GPS coordinates, you’re able to attach any additional information to this point that you just dropped from day one. Let’s say for example somebody brought in a pile of asbestos. I definitely want to know where that is because later on when I’m going to dig a well, I do not want to hit that. So, what our customers will do is they’ll take the compactor and drive to where to asbestos pile is, and we have a little label function, and it will add a little asbestos label to each point that it drops.”

GPS allows landfill owners to label and locate each landfill component in the same manner. “If you’re driving around and compacting with our software, you’re basically looking down at a top view down,” he adds. “As far as the construction aspect, as you’re driving your compactor or your bulldozer, you can actually see your position in relationship to final grade, you position in relationship to let’s say, it allows you to do internal construction projects like, build a lift or set a slope.”

Rohr agrees GPS is helpful in mapping out where to put things such as leachate drain lines or landfill gas laterals and verticals. However, he views GPS as a tool to tell you “where” to build something, not “how” to build it.

“If you have a three-dimensional map of all of the pipe and lines that run through your landfill, you can basically take that landfill map and you can look inside of it and see where everything goes,” he maintains. “So really, GPS isn’t going to help with construction of the physical line, it’s going to help you with construction of the network that it’s going in, to show you information about where you’ve already placed lines, where you’ve already placed [gas] well heads, and it’s going to show you information about where you need to place other [gas] well lines.”

Jordan adds, “What we do with the GPS, if there are gas wells on the landfill, we can put warnings and lock zones around that drawing, and if the operator is working at night and can’t see that gas lateral, it will warn him in the system if he’s 10 feet or 15 feet away before he hits it.”

Geoligoc’s Rohr also talks about the various GPS products companies can buy to locate various components of the landfill during construction. “There are special monitors for gas wells; there’s stuff for

doing construction and compaction like we do; there's some tracking trucks."

Jordan agrees GPS is helpful in pinpointing objects. "With our GPS system, as it rolls over the landfill, it time stamps everything. So if you needed to find out, at this date and time, where was this machine and where were you dumping trash, it can tell you that, because I'm storing that data in the GPS. In some cases, people have lost things, or bodies have been in the landfill, and people needed to find out on a certain day and time where that machine was. We can pull the log files to help them locate the area their trash was placed in."