Getting the Most Out of Your Biosolids

Effective treatment of biosolids helps control wastewater treatment costs.

By Marc Roehl

Wastewater treatment facilities are generally installed for one purpose—to clean up dirty water so that clean water can be discharged back into the environment. Nearly all municipal treatment plants rely on biological processes for wastewater treatment whereby bacteria and other microorganisms, frequently called "bugs," do this job of cleaning up the water. In these treatment processes, new bugs are constantly growing and old bugs must be continually removed to keep the process healthy and working properly. Once these bugs are removed from the treatment process, they become a byproduct of treatment that the industry calls "biosolids." Dealing with these biosolids can be costly and in some cases, amounts to more than 50 percent of the cost of operating the wastewater treatment facility.

So while treatment of biosolids is not the primary objective of most wastewater plants, doing it effectively and efficiently can be important to controlling costs. Many factors influence the cost of treating and disposing of biosolids; however, there are a few that are common to most treatment facilities:

- How effective is the facility at minimizing biosolids?
- Beneficial reuse of biogas (for anaerobic digester facilities).
- Dewatering: the dry solids content of the solids at the time of hauling and disposal (You typically pay by the wet ton, so reducing water content is important.)
- Quality of data used for monitoring and control of the process.

For communities looking to upgrade or overhaul their treatment process, it is important to determine how and where investments can be made to address these factors.

An anaerobic digester with a Dystor® dual-membrane gas holder cover allows gas production to be balanced with consumption.

Solids Minimization

The amount of biosolids that are produced is controlled in large part by the type of processes used at the plant. The two most common types of processes for treating biosolids are aerobic and anaerobic digestion. The goal of these processes is to stabilize the solids to reduce pathogens and to convert some of the biosolids to a gas (either carbon dioxide or methane) to reduce the mass of solids prior to disposal.

Aerobic digestion tends to be more energy-intensive, but less operator-intensive than anaerobic digestion. As a result, aerobic digestion tends to be more common in smaller treatment facilities where the total power costs are still relatively small and the need for operator attention is minimized. Anaerobic digestion does not require energy for aeration, but it does require heating of the sludge stream. Sludge heating is a large energy sink, but in general, it can be satisfied by burning biogas (methane), which is produced by the anaerobic digestion process itself. When this energy demand is met by burning biogas, the only real external power required is for pumping and mixing. However, with the production of flammable gas in an enclosed tank (that cannot be easily visually examined) and the need for sludge heating, the anaerobic digestion process tends to be viewed as more complex and challenging to operate. As a result, anaerobic digestion tends to make more sense for larger facilities that have more staff to properly operate and maintain the process.

Both aerobic and anaerobic digestion have been successfully used for decades. Rising costs for solids disposal and energy have spurred the development of new technologies for supplementing and improving these basic processes in the past five to ten years, especially in the area of solids minimization.

One class of these technologies is aimed at enhancing anaerobic digester performance by improving the digestability of the biosolids. The result is improved volatile solids reduction and increased biogas production. There are a number of technologies now on the market that aim to do this by a variety of means. One such technology is the Crown® solids disintegration system. With this system, it is possible to improve volatile solids reduction, and the related biogas production, by up to 25 percent. In many cases, sludge dewaterability is also improved. The system accomplishes this by mechanically conditioning the solids to shear floc, rupture cells, and release enzymes that aid in the digestion process. The result is the potential to greatly enhance the performance of the anaerobic digestion process and reduce the costs for solids disposal. Furthermore, with the production of more biogas, it is also possible to derive more energy by converting the biogas to heat and power.

Other newer technologies are aiming at minimizing the solids produced by plants that have traditionally used aerobic digestion. For example, the Cannibal® solids reduction process can be incorporated into a plant flowsheet to reduce the production of biosolids by 50 to 80 percent. This process relies on reconfiguring the activated sludge process to effectively change the way that the bugs used for treatment grow and decay within the process. The result is a much lower rate of biosolids production with little additional energy input.

Reviewing these and other newer technologies for improving solids minimization can be an important step in finding ways to reduce your overall costs for biosolids treatment and disposal. While there is a cost for incorporating these technologies, a simple economic analysis will show the long-term benefit. The outcome of such an analysis will largely depend on the local conditions, but in many cases these technologies can provide an attractive return on investment.

Beneficial Use of Biogas

For facilities that use anaerobic digestion, biogas is a useful and valuable byproduct that goes unused in many facilities across North America. Biogas production is a result of anaerobic digestion whereby the solids are converted to a combination of methane and carbon dioxide gas. For municipal plants, this biogas typically has a heating value of 600 BTU per cu ft of gas produced. If this gas is converted to electricity, a municipal plant can expect to produce in the neighborhood of two watts of electricity per person served by the wastewater treatment plant. For a city of 50,000 people, that is equivalent to 100 kW or about $70,000 per year worth of electricity (assuming $0.08/kWh).

While this gas is already used at many plants, a large number of plants today simply flare this gas off to the atmosphere, making no use of it. However, technologies have existed for decades to use this biogas for digester heating (in place of burning natural gas or fuel oil) and also for producing electricity. The basic tools consist of collecting and storing the gas, treating it to remove contaminants such as hydrogen sulfide and siloxanes, and then converting it to energy through the use of an internal combustion engine, microturbine, or fuel cell. At a minimum, it almost always makes sense to burn this gas in a heater/heat exchanger that is designed for heating digester solids.

Dewatering

In most cases across North America, the cost of biosolids disposal is set based on a unit cost per wet ton of solids. As a result, the amount of water present in the biosolids at the time of disposal can have an enormous impact on the total cost of disposal. For example, if liquid solids are disposed of at a solids concentration of three percent dry solids, roughly 97 percent of the disposal cost is

Siemens' new convective Sludge Belt Dryer offers such system advantages as efficient operation in minimal space, low emissions, low dust, a granular final product, and a low thermal requirement with possible heat recovery from low temperature waste energy sources.

The Crown® solids disintegration system is a U.S. patented cell lysing process that eliminates digester foaming, increases gas production by up to 30 percent, and reduces solids for disposal by 20 percent.

for hauling and disposing of water. Dewatering these solids to 15 percent solids will reduce the disposal costs by as much as 80 percent. The percent dryness of the solids will be controlled by the type of technology used to dewater or dry the solids.

The simplest methods are thickening the solids, either by gravity or in a mechanical thickener. These technologies can typically achieve anywhere from three percent up to eight percent dry solids. Common dewatering technologies include belt filter presses and centrifuges—these can typically produce anywhere from 14 percent up to close to 30 percent dry solids, depending on the type of system used and the nature of the solids produced at a given plant. Greater dryness can be achieved by thermal dryers that can typically achieve in the range of 60 percent to 90 percent dry solids, depending upon the type of dryer used. There are also some new technologies being developed to improve the efficiency of dewatering and drying systems. In any case, evaluating economic means for minimizing the water content of the sludge before disposal is a worthwhile exercise to determine the best option for a given plant.

Monitoring and Control

Improved process monitoring and control is an area that has gotten significant attention in the past ten to 15 years for operation of treatment plants. In general this work has been more focused on the liquid treatment processes, although there is also great opportunity to improve the efficiency and performance of biosolids treatment. In fact, many plants do not monitor their biosolids treatment processes as closely as other parts of the plant. Installing instrumentation and developing a disciplined monitoring and control program can help to improve process efficiency. It is not unreasonable to expect such a program to improve the process performance by ten to 20 percent at many facilities. This will translate into corresponding savings in sludge disposal and power costs and is also likely to minimize O&M costs by creating a more proactive approach to system operation and maintenance.

Putting It All Together

When the whole biosolids treatment system is reviewed and all of the critical areas are considered, it is possible to make changes and improvements that result in significant savings. The result is a system where you will be getting the most out of the equipment installed and employing the latest technologies and operational approaches to minimize solids treatment and disposal costs. Table 1 shows what can be achieved at a typical plant—in this case a ten-mgd facility using anaerobic digestion that historically was not beneficially using its biogas.

As shown in Table 1, this plant could expect to see some significant savings, close to $200,000 per year, through the use of biogas for digester heating and on-site power generation. Also, incorporating a new technology such as the Crown system to enhance digester performance could provide an additional annual benefit of around $190,000 per year. Of course, the capital and O&M costs would need to be factored in to determine the true merit of these potential improvements. While this is just one possible example, a variety of other opportunities exist to modify and improve the biosolids process to significantly reduce the costs associated with solids treatment and disposal.

With the technologies and solutions that are readily available today, conducting an evaluation of the options for biosolids treatment and disposal can be a worthwhile exercise. There are many areas where improvements can frequently be made that will significantly reduce the long-term costs of treating and disposing of biosolids. Implementation of many of those solutions will also help to create a more sustainable treatment facility that uses resources more effectively and more efficiently. GE

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Table 1-Sample Savings Analysis (Ten-mgd Plant)

Current Annual Disposal Cost	*$475,000.00*
Annual savings from heating sludge with biogas	$30,000.00
Combined electricity and heating value from beneficially using all of the biogas	$175,000.00
Enhanced Anaerobic Digester (i.e., Crown System)	
Improve VS Reduction by 20 percent	$55,000.00
Increase biogas by 20 percent (and convert to heat/power)	$45,000.00
Improved dewatered cake (16 percent to 20 percent)	$90,000.00
Total Potential Annual Savings	$400,000.00

Example assumes a solids disposal cost of $35/wet ton, power cost of $0.08/kWh, existing disposal cake of 16 percent, and typical digester performance prior to installing a Crown system.