Immokalee Water and Sewer District: Case Study of Effective Biosolids Management

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The Immokalee Water and Sewer District (IWSD) is currently paying a premium to have the biosolids from its wastewater treatment plant (WWTP) dewatered and hauled to a landfill. The annual cost to IWSD for contract dewatering, hauling, and landfill disposal has historically been upwards of $500,000. Although landfill disposal of biosolids is still common in Florida, it should not be viewed as a long-term solution. Landfill disposal is considered to be environmentally beneficial only when the landfill is equipped to recover and convert methane gas into electricity. Landfills are carefully engineered and monitored to ensure protection of groundwater and surface water and stability of the landfill mass. As such, landfills have a limited capacity to accept biosolids in proportion to the total tons of refuse received. Most importantly, landfill disposal does not take advantage of the nutrient value and soil-building properties of biosolids and takes up landfill space that can be better used for other materials.

The updated Florida Biosolids Regulation, Chapter 62-640, F.A.C., became effective on Aug. 29, 2010. After four years, the full impact of this regulation is now being felt, particularly where Class B biosolids are produced and disposal is required. These regulations limit the number of available disposal sites as each site is required to complete and submit a nutrient analysis plan to the state for approval. Typically, this nutrient management plan is completed at significant expense. In addition, the available sites for Class B biosolids land application may now be much farther from the WWTP, thereby increasing transportation costs. Many WWTP operators are starting to incur increased costs to haul and dispose of biosolids, which is directly attributed to the new state regulations. In some cases, the costs of properly managing and utilizing these solids have nearly doubled.

To address this concern, Class AA biosolids, in conjunction with designated fertilizer licenses from the Florida Department of Agriculture and Consumer Services (FDACS), are becoming the new Florida industry standard. A number of different factors should be considered when evaluating technologies that produce Class AA biosolids, including capital cost, operating cost, reliability, ease of operation, complexity and safety of operation, odors and side streams of the processes, required space, and the ease of disposal.

As part of a strategy to reduce operational costs and improve biosolids management, IWSD directed its engineering consultant, Greeley and Hansen, to prepare and issue two requests for proposals (RFPs) in the summer of 2012. The RFP-1 requested design-build-finance (DBF) teams to provide a detailed lease to plan, design, and finance the entire cost of a Class AA biosolids production facility. The RFP-2 incorporated a land-lease option to allow an outside vendor to design, build, finance, and operate the facility. Under each RFP, the total annual payment, plus the annual operation and maintenance (O&M) cost, could not exceed $470,000, which is the existing operating cost for Class B biosolids dewatering and disposal. The facility would include permanent dewatering equipment and Class AA biosolids processing equipment, and it also needed to fit in a small footprint to be centrally located on the WWTP site where existing dewatering beds were located. After consideration of the various proposals, IWSD selected Schwing Bioset's DBF proposal under RFP-1.

The lease-to-own agreement allows IWSD to purchase the facility at any time during the 10-year, lease-to-own agreement. Initially, the annual cost savings would be over $70,000 compared to the existing operations. At the end of the 10-year lease, the annual cost savings is expected to be almost $400,000 and the equipment will be owned by IWSD. After giving consideration to the amount of interest that would be charged, the board of directors of IWSD opted to pay for the system entirely from its own funds.

The IWSD took the opportunity to achieve a cost savings versus maintaining the current Class B operations. The result is a long-term Class AA biosolids production facility owned by IWSD that will meet the needs for many years into the future. The permanent dewatering facility will be directly connected to the Class AA process and will be housed under the same roof in a compact operation, which optimizes materials handling. The agreement allows IWSD to maintain ownership of the Class AA biosolids and utilize them on its sprayfield as is currently permitted through the Florida Department of Environmental Protection (FDEP). The IWSD currently leases the 300-acre sprayfield land to a cattle farmer and is required to fertilize the property annually. The use of the Class AA fertilizer produced at the new biosolids facility will eliminate the need and cost for commercial fertilizer, and at the same time, eliminate the hauling and disposal costs of material taken to the landfill. The new facility was put into operation in April 2014.

This article focuses on the IWSD case study to provide a cost-effective solution for biosolids handling, which is a challenge that other smaller utilities are now struggling with due to the increase in hauling and disposal costs resulting from the new disposal regulations.

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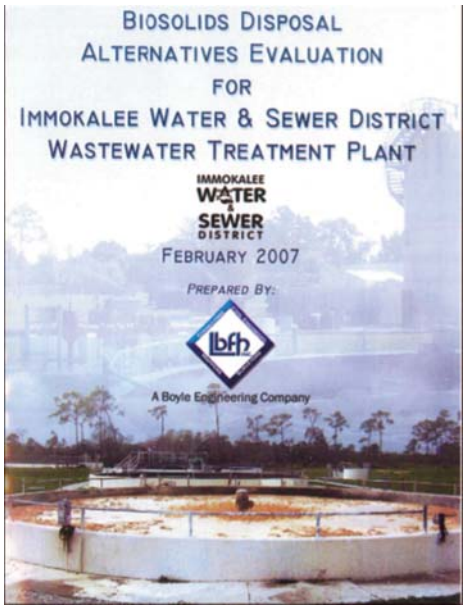
Immokalee Water and Sewer District Experience

The IWSD's WWTP currently produces Class B biosolids. The WWTP was originally designed with six sludge drying beds and had space for three more to be constructed at a later date. At the time the WWTP was designed, the common practice was land application of Class B biosolids on agricultural land. The IWSD had six permitted land application sites. In 2007, the United States Department of Agriculture (USDA) and FDEP were contemplating changes to the biosolids land application regulations, which would add phosphorus limits and thus restrict land application of Class B municipal biosolids on agricultural lands. The IWSD's consultant at that time wrote a report titled, "Biosolids Disposal Alternatives Evaluation for the Immokalee Water and Sewer Dis-



trict Wastewater Treatment Plant." This report compared several alternatives, but ultimately recommended the short-term solution of contract dewatering and hauling until the pending regulations came into effect to be sure that whatever was designed for the long-term solution would be in conformance with the regulations.

Therefore, in 2007, the IWSD entered into a contract with Synagro for dewatering the Class B biosolids and hauling the dewatered solids to a landfill for disposal. The IWSD "piggybacked" on a bid and contract from Martin County with Synagro. Originally, the contract price was $46 per 1,000 gal, resulting in an annual cost of $309,000; however, the contract allowed Synagro to use the cost-of-living adjustment (COLA) to adjust disposal charges each year during the term of the contract. For the contract, the biosolids have been disposed of at the Okeechobee Landfill, which is located 102 mi from the WWTP. The total annual cost for biosolids disposal has reached $470,000 due to increased sludge quantities and unit disposal cost. The IWSD realized that it needed to explore options to reduce this cost. Also, the current contract with Synagro expired on May 31, 2013, and the IWSD board voted to renew the contract for one year. The current price is $50.73 per 1,000 gal.

The IWSD board was split on whether to purchase the biosolids processing equipment or to simply act as the landlord and let another entity handle the operations. The board decided to issue two RFPs in July 2012. The RFP-1 was for design-build-finance of the biosolids facility at the existing WWTP site. Under this option, IWSD would own and operate the equipment. The RFP-1 Part 1 was for handling the sludge from the Immokalee WWTP only, and RFP-1 Part 2 was for converting the facility into a regional facility. The RFP-2 also had two parts: RFP-2 Part 1 was for a land lease for an entity to rent land from the IWSD for the sole purpose of constructing a regional Class A biosolids handling facility, and RFP-2 Part 2 was for contract dewatering and hauling, similar to the current arrangement with Synagro, while the regional facility was being designed, permitted, and constructed.

Greeley and Hansen assisted the IWSD in developing the following criteria for RFP-1:

1. 188,000 gal per week of 1.5 percent solids waste activated sludge (WAS) at Immokalee only.
2. Provide dewatering equipment to process 1.5 percent solids sludge to 18 percent solids.
3. Expandable to regional facility to handle an additional 27,000 tons of 18 percent solids sludge (from Collier County facilities).
4. Convert dewatered solids into a beneficial fertilizer/soil amendment product.
5. Utilize existing 200 amp, 460 volt, three-phase electric service.
6. Provide metal roof structure to house the equipment.
7. Equipment footprint to fit in one of the three cross-hatched areas available, shown in Figure 1.
8. Dried solids must meet Class A requirements (minimum).
9. Structural designs based on:
   a. 100 mi per hour (mph) sustained winds, 120 mph gusts,
   b. Exposure Class B,
   c. Occupancy Category II, and
   d. 20 pounds per sq ft (psf) roof live load.
10. Signed and sealed structural drawings.
11. Maximum of 16 hours/day operation.
12. Provide list of references and FDEP-permitted installations in Florida.
13. Provide list of personnel from the technology supplier, engineer, general contractor, and subcontractors working on this project, including documented similar experience and resumes.
14. Provide documentation of financial strength of the entity or entities providing project financing.
15. Provide general layout and general equipment arrangements for both Phase 1 and Phase 2.
16. Provide process flow diagram for Phase 1 and Phase 2.
17. Provide a narrative detailing the process for sludge treatment that specifically states the method of compliance with the FDEP 62-640.600 and 40 CFR 503 regulations. Include details for transporting sludge from the dewatering equipment to the sludge process equipment, plus details for accepting sludge from other facilities for Phase 2, as well as a narrative detailing the transition from Phase 1 to Phase 2. Also include the expected nitrogen/phosphorus/potassium (NPK) values of the final fertilizer/soil amendment product.
18. Provide detailed list of equipment being

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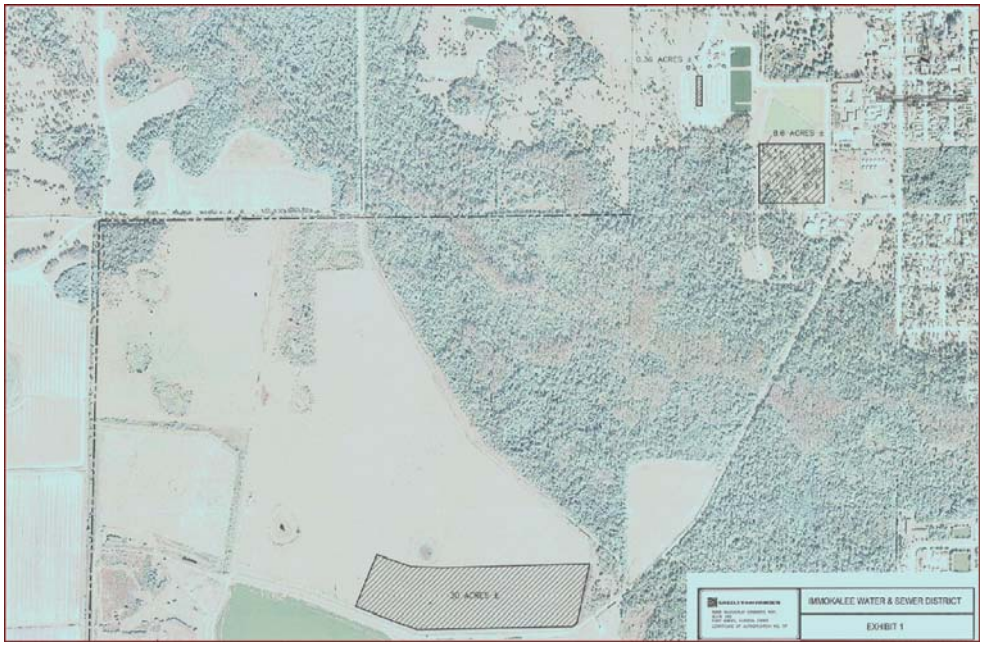

Figure 1. Available Cross-Hatched Areas

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provided for Phase 1 and Phase 2, including electrical phase, voltage, full load amps, and horsepower requirements (460V, three-phase is available).

19. Provide detailed capital cost breakdown, including engineering, installation, and equipment for Phase 1 and Phase 2.
20. Provide minimum of three current quotes for each chemical required from different sources.
21. Provide detailed annual O&M cost breakdown for Phase 1 and Phase 2 with calculations including chemical dosing ratios based on the average chemical cost from the sources obtained above, electrical cost of $0.08 per kilowatt-hour, diesel fuel cost of $4.25 per gallon, plus all assumptions made.
22. Provide statement regarding the treatment plant operator class required to operate the system.
23. Provide a detailed lease-to-own plan to finance the entire cost, specifically stating the monthly payments, fixed interest rate, and length of term. For Phase 1, the total annual payment plus the annual O&M costs shall not exceed $470,000.
24. Provide tentative project schedule indicating the number of days from Notice to Proceed until completion of construction for Phase 1 and Phase 2.
25. Provide information regarding training technical support and maintenance responsibilities during lease period.
26. Provide detailed information regarding the lengths and types of warranties being provided after the ownership transfer occurs when the equipment has been paid off.

Greeley and Hansen also assisted IWSD in developing the following criteria for RFP-2:

1. 188,000 gal per week of 1.5 percent solids WAS, Immokalee only.
2. Provide list of references and FDEP-permitted installations in Florida.
3. Provide list of all personnel from the technology supplier, engineer, general contractor, and subcontractor who will be working on the project, including documented similar experience and resumes.
4. Provide documentation of the financial strength of the entity or entities providing project financing.
5. Provide a general layout and general equipment arrangement.
6. Provide a process flow diagram.
7. Provide a narrative detailing the process for sludge treatment that specifically states the method of compliance with FDEP 62-640.600 and 40 CFR 503 regulations. Include details for transporting sludge from the dewatering equipment to the sludge process equipment, plus details for accepting sludge from other facilities. Also include the expected NPK values of the final fertilizer/soil amendment product.
8. Provide detailed list of equipment being provided.
9. Provide tentative project schedule indicating the number of days from Notice to Proceed until completion of construction with adequate time for permitting.

For both RFPs, proposers were directed to utilize the same costs for electricity, diesel fuel, etc. In addition, proposers was directed to provide three quotes for all chemicals that would be utilized in their processes, and to utilize the average of the three quotes for each chemical in developing the anticipated annual cost of operations.

Prior to issuing the RFPs, IWSD met with representatives of other local municipal utilities regarding the possibility of developing a regional facility and with Collier County officials regarding expanding their current conditional use (zoning) to cover the sprayfield area. Expanding the conditional use proved to be a difficult process. Also, the other utilities could not commit to participating in the regional facility. Accordingly, IWSD decided to move forward with the turnkey DBF option for the IWSD sludge volumes only and reject all submittals received for RFP-2.

In September 2012, IWSD evaluated submittals received for RFP-1. Schwing Bioset was selected due to the number of permitted installations it has in Florida, the experience of its design-build team, and its financial strength.

The Bioset Process

This process consists of blending the sludge cake with quicklime and sulfamic acid and allowing the reaction to occur under pressure to meet the requirements of the state's Chapter 503 rule. To accomplish this, it was necessary to control the flow of the biosolids through the reactor and dose them with quicklime and sulfamic acid so that the retention time and temperature rise achieved within the reactor match the required temperature set forth by equation 2 in Chapter 503.32.

Additionally, this dosage of quicklime raises the pH of the biosolids above 12, per Chapter 503.33. The final lime and sulfamic acid dosages for a specific application are designed such that U.S. Environmental Protection Agency (EPA) requirements are fulfilled for pathogen and vector attraction reduction, while also taking into consideration the local costs of chemicals. The goal is to strike the optimum balance between regulatory requirements and processing economies.

Key features of the bioset process include:

- Totally enclosed
  - o Contains dust
  - o Contains odors
- Ideally suited to operate as a regional facility:
  - o Accommodate fluctuations in percent solids of the incoming wet cake
  - o Accommodate rapid increases and decreases in throughput
  - o Accommodate biosolids from any wastewater process (aerobic, anaerobic, etc.) without any modifications to operations
- Fully automated
  - o Chemical feed rate adjusted based on reactor temperatures for Phase 1
- Long-term product stability
  - o Regional facilities and fertilizer marketing

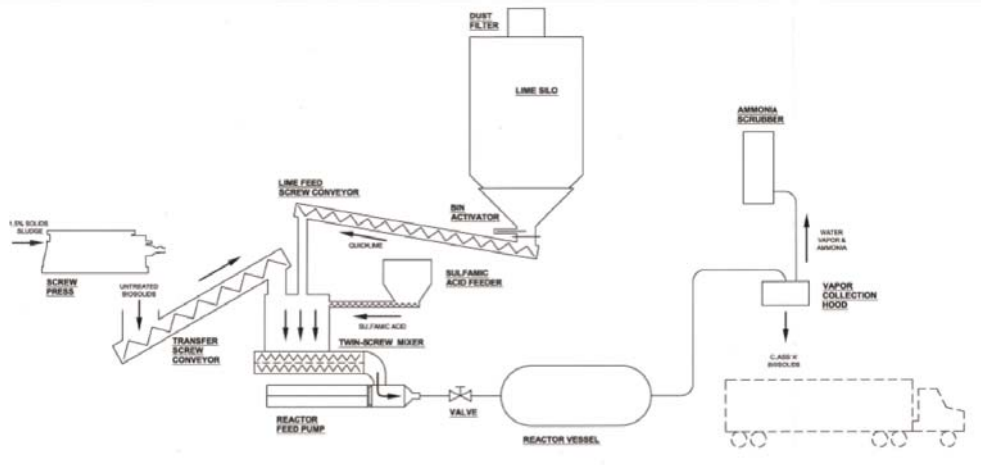

Figure 2. Bioset Process Flow Diagram

operations require product that is stable and can be stored for extended periods to span growing seasons and/or periods of unstable weather

- Easy to operate and maintain
  - o Simple processes that do not require multiple shifts of operators or complicated and/or potentially dangerous operating conditions are generally preferred technologies

Mixing Design

Poor lime/sludge mixing is a problem observed with other lime stabilization systems where portions of unreacted lime can be found in the discharged cake. The bioset system uses a twin auger mixer with counter-rotating, intermeshing augers. Mixing continues with turbulence induced in the piston pump control valve housing. The thoroughly blended product can be seen with a homogeneous consistency and coloration. The homogeneous product is evidence that all the biosolids are uniformly treated and unreacted lime is not wasted.

Dust Control

Historically, biosolids treatment processes that use lime have been plagued by dusty conditions that create unpleasant working conditions for plant staff; even some of the original bioset process installations had these same issues. As a result, a common reaction to a proposed lime stabilization system is a knee-jerk negative response; however, controlling fugitive lime dust was recognized as one of the most important issues for a successful installation. With this in mind, great care has been made to ensure that the handling of lime does not result in dusty conditions. The photos in Figure 3 show equipment that illustrates the connections into the mixing hopper. All of the connections are either hard-piped or sealed with a flexible boot to ensure that lime dust cannot escape, and a clean working environment is provided.

Odor Control

Another common complaint related to biosolids treatment technologies that utilize lime is the associated odors. Some competitors' systems and legacy bioset systems create overpowering amounts of unpleasant odors that have adverse impact on plant operations. As shown in Figure 3, this issue was addressed by completely enclosing the system where the mixing is taking place. The bioset reactor, a pressurized pipe, completely contains the odors until they are released at the reactor discharge. This single-point location results in a strategic location to capture the odors. Also included is a pinch valve at the reactor discharge to flatten the sludge flowing out of the reactor to create additional surface area to allow the ammonia and other compounds to be released, and subsequently captured, and scrubbed under the collection hood. The resulting end product has an odor similar to wet concrete as a result of the lime content, which is not offensive. Typically, the first comment prospective customers make when touring a bioset installation is how clean the system is and the obvious lack of odors (Figure 4).

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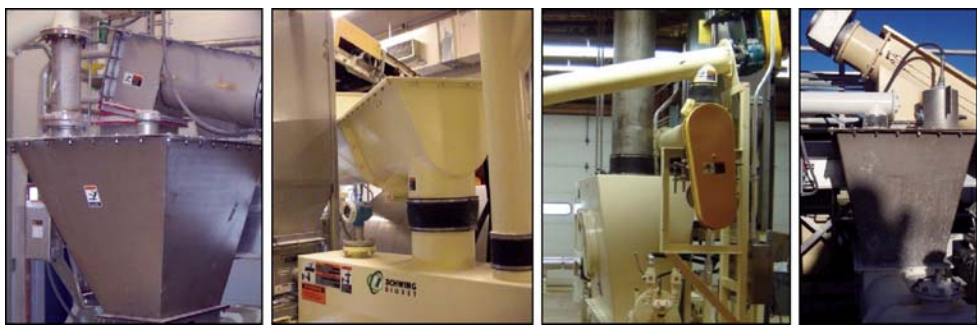

Figure 3. Equipment Showing Connections in Hopper

Figure 4. Clean and Odor-Free Operation of Bioset Facility

Figure 5.
Advanced High-Performance
Screw Press

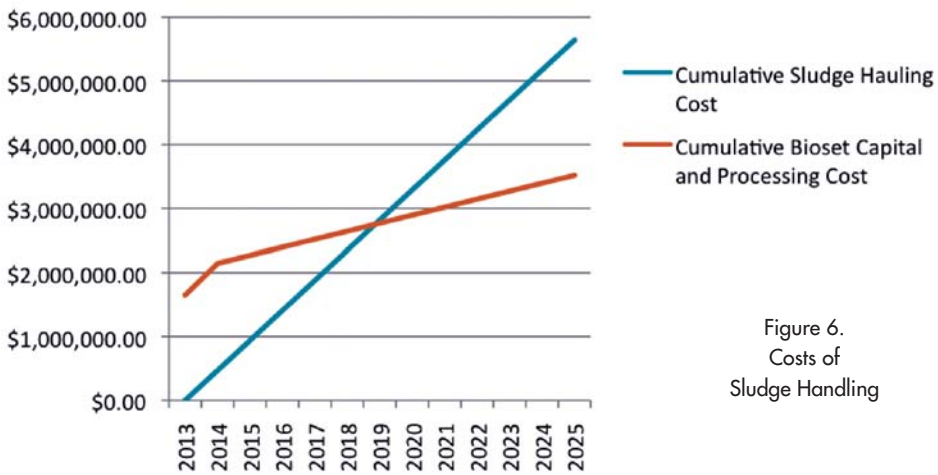

Figure 6.
Costs of
Sludge Handling

Brand Name: Organi'Kalee
3-1-0
Guaranteed Analysis:

Total Nitrogen (N)..... 3.00%

1.00% Water Soluble Nitrogen
2.00 % Water Insoluble Nitrogen**

Available Phosphate as (P_2O_5)..... 1.00%
Soluble Potash (K_2O)..... 0.00%
Calcium (Ca)..... 17.00%
Derived From: Biosolids and Calcium Hydroxide
FDACS Permit Number: F002089

** 2.00% Slowly Available Nitrogen from biosolids.

Additional Information: pH 11.5

This biosolids product meets the Class AA criteria of subsection 62-640.700(5)(b), F.A.C.

Guaranteed by:
Immokalee Water and Sewer District
140 White Way
Immokalee, FL 34142

IMMOKALEE WATER & SEWER DISTRICT

Recommendations on Proper Storage: Do not stockpile more than one dry ton of unapplied product for more than seven (7) days unless appropriate precautions are taken to prevent the following:
1. Runoff of product
2. Runoff of stormwater that has come in contact with product
3. Violation of odor prohibition of subsection 62-296.320(2), F.A.C.
4. Vector attraction

Recommendations on Usage: Apply this product at a rate that does not exceed your specific crop or plant nutrient needs.

Figure 7. Product Analysis

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Maintainability

A remarkable feature of the bioset process is how little maintenance is required, as there are very few moving components. Aside from the two feed augers that require normal drive and bearing maintenance, the only other item that requires regular maintenance is the piston pump. The system uses piston pump technology; these pumps were originally developed for pumping concrete and have over the past 25 years been adapted to other industries. The basic pump models offered are designed for pumping concrete, essentially a mix of rock and sand, at operating pressures up to 1,500 pounds per sq in (psi). By anyone's account, this is considered a severe duty application. When used in these applications, by comparison, the duty is much less severe, as biosolids will contain a small percentage of grit and the system will operate at less than 50 psi. As a result, the wear lives of the replaceable parts in the piston pump are capable of exceeding 5,000 hours of runtime.

Figure 8. Project Area Before Construction

Figure 9. Completed Facility (Small Footprint)

Screw Press Dewatering Process

While there are many methods of dewatering municipal biosolids in wastewater treatment plants, screw press technology has emerged as a low-energy alternative to the historical technologies. Until recently, screw press technology has been unable to deliver dewatering performance capable of competing with these legacy technologies, thereby limiting their market appeal. A new high-performance screw press offers improved throughput, capture, and consistent high-dry solid content for the full range of capacities, providing wastewater plant operators with the features, benefits, and low-energy consumption expected from a screw press, with the performance similar to high-speed centrifuges.

An advanced high-performance screw press (Figure 5) for high-solids cake offers a flexible dewatering solution for a wide range of facilities for digested and undigested biosolids. The precision machined screen and replaceable sealing lip produce high-solids capture rates with low power and wash water consumption. Wash cycles occur without interrupting the dewatering process, allowing greater uptime and dewatering capacity. This screw press offers simple start up and shutdown cycles, as well as having fully automatic and unattended operation.

Financial Considerations

Figure 6 shows the cumulative amounts the IWSD would have spent on sludge hauling (disposal) over the next few years compared to the capital and processing costs of running the bioset equipment (including chemical costs and electricity). The chart indicates a break-even point around the year 2019.

Fertilizer License

The IWSD further decided to obtain a bulk fertilizer license from FDACS. The IWSD had a staff competition to select the name for the product and the winning entry was Organi'Kalee. The IWSD's FDACS fertilizer license was issued on Feb. 7, 2014.

The IWSD utilized Thornton Laboratories to determine the guaranteed analysis of the fertilizer product (Figure 7) and will provide a copy of its label to purchasers of the product in accordance with FDACS rules.

Construction of the facility is now completed, and IWSD began processing Class AA biosolids in April 2014 (Figures 8 and 9). Since the facility went into operation in April 2014, IWSD began to realize a significant savings in its annual cost of biosolids disposal.