Biosolids Treatment and Disposal Alternative for Altamonte Springs

Michelle Hanson, Brenda Keenan, Mimi Perez-Falcon, and S. Marie Romah

The authors are members of the University of Central Florida team that won the statewide 2003 Student Design Competition sponsored by the Florida Water Environment Association, then won the National Student Design Competition sponsored by the Water Environment Federation. The article describes the students' award-winning design project.

The city of Altamonte Springs Regional Water Reclamation Facility (RWRF), located in Seminole County, began operating in 1977. The 12.5-MGD treatment facility produces a high-quality treated effluent for reuse by the city and local residents through its water reuse program, "A Prototype Realistic Innovative Community of Today" (Project APRICOT).

The solids produced during the treatment process are thickened using a gravity thickener, aerobically digested, and dewatered using a belt filter press. The biosolids produced from this process are not meeting Florida regulations, Chapter 62-640, for land application, so Altamonte Springs contracts an outside provider for transportation, treatment, and disposal of the biosolids at a cost of approximately $500,000 per year.

Alternative methods should be considered for the treatment and disposal of biosolids produced by the RWRF. The approach to the problem was twofold: (1) An alternative biosolids treatment method must be implemented to meet current and impending regulations, and (2) disposal options must be explored to alleviate the financial burden of contracting with outside vendors.

Design Loadings

In the design of a solids-handling facility, the main factors affecting the required capacity are wastewater flow rate and the amount of solids produced. In order to determine the RWRF's projected flow rate, statistical analyses and historical data were used to predict a 7.5-MGD influent flow for the end of the 20-year design period in 2023. To account for the fluctuations in seasonal flows, the biosolids treatment process should be designed for the increased flow of 8.5-MGD at the end of the design period.

The mass balance of the RWRF used six months of discharge monitoring reports to predict average and peak flows for each of the solids streams. Currently, 21 tons of dewatered biosolids per day at 18 percent solids by weight are generated on average by the RWRF and require further treatment. At design capacity, 27 tons per day will be generated at 18 percent solids by weight.

Disposal Options

Several different treatment alternatives exist, but disposal options are limited so they were considered first. The two main disposal options for biosolids are landfilling and land application.

The landfilling of biosolids after treatment of municipal wastewater is common among plants with limited disposal options. Of the nearby landfills, the Orange County landfill accepts only biosolids from Orange County facilities, while the Seminole County landfill currently accepts biosolids from only a limited number of facilities.

Many landfill operators are hesitant to accept biosolids because the landfill surface can become slippery and damage operating equipment. The landfilled solids can also contribute to odor problems, affect slope stability, and affect the quantity and quality of leachate and gas generated. Additionally, the transportation and tipping fees associated with landfilling often exceed the cost of further treatment for land application standards.

Biosolids treated to Class A or B standards can be land applied. Citrus fields, cow pastures, croplands, and golf courses are effective ways to dispose of biosolids and also increase the nitrogen content of the soil. Further treatment to Class AA standards permits distribution to the public for use in home landscaping and lawn maintenance.

Land application was selected because of its greater freedom for final disposal.

Selection Criteria

As different options were researched for the treatment and disposal of the RWRF biosolids, selection criteria were developed to evaluate the alternatives. These criteria were made specific to the RWRF in order to select the optimal alternative for the facility. In descending order of importance, the criteria included:

1. *Land Availability*—Location of the plant in a populated area made land availability a large concern and was the focus of the selection. Selecting an efficient process is futile if the system can not fit into the facility site plan.
2. *Treatment to Class A or Better*—With the possibility of regulations becoming more stringent in the future, treatment to a Class A or better would eliminate the need to renovate the plant due to regulation changes. Treatment to Class AA would provide a greater degree of freedom in disposal options.
3. *Process Efficiency and Reliability*—The process must treat the biosolids to the degree that is expected in a reasonable amount of time and must consistently meet the design treatment needs.
4. *Odor Production*—Since the majority of complaints about a treatment facility typically stem from odor issues, odors emitted from the selected process will pose a concern because of the plant's proximity to homes and businesses.
5. *Cost*—The low-cost alternative would be most desirable, but grants, loans, and credit assistantships are available from federal, state, and local sources, offsetting the financial burden.
6. *Marketability*—The ease with which the biosolids can be disposed of and the effort needed to distribute the finished product were also considered.
7. *Ease of Operation*—The simplicity with which the plant operator can control the process is important for smooth and effective operation, but ease of operation can be improved through adequate training and the availability of newer technologies, such as computer programs, making it the lowest-weighted selection criterion.

Treatment Alternatives

Various alternatives were examined for applicability to the RWRF using the developed selection criteria. The alternatives researched were lime stabilization, composting, anaerobic digestion, autothermal thermophilic aerobic digestion (ATAD), and heat drying.

Lime stabilization is used in varying-capacity wastewater treatment facilities to treat biosolids to Class A or B standards. The process can be started and stopped with ease to accommodate fluctuating biosolids flow rates and requires little operator attention. Some of the drawbacks of lime stabilization are odors generated by the ammonia stripping, the reactivation of biological activity

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due to the decline of pH, and the substantial increase in biosolids volume.

Composting is a cost-effective, environmentally safe way to biologically stabilize wastewater biosolids. Composting can be combined with other processes and produces a high-quality, potentially marketable product. For static or windrow processes, initial costs are relatively low. Disadvantages are that composting requires 18 to 30 percent dewatered solids by weight, the need for a bulking agent or amendment, aeration costs, and significant land-area requirements; it also has the potential for odor problems. Depending on the specific process, there can be high operational costs for power, labor, or chemicals.

Anaerobic digestion is the most common form of biosolids treatment. It produces higher solids content in the digested solids (compared to the current aerobic digestion), reducing the volume of end product. This process also produces methane gas that can be used to supply part of the energy needed to operate the digester, reducing energy costs. Disadvantages of anaerobic digestion include high organic concentration in the supernatant, high capital costs, and possible odor problems. The temperature and pH requirements associated with this form of digestion can be challenging to control, causing operational difficulties.

ATAD is a process to further reduce pathogens that produces Class A material. The process produces sufficient heat to maintain the required thermophilic temperature levels within the insulated reactor. ATAD produces objectionable odors, poor dewatering characteristics, and high temperatures that inhibit nitrification.

Heat drying of biosolids is a method to reduce pathogens and water content in wastewater biosolids. The heat in the process kills pathogens, producing Class A biosolids that are suitable for marketing as a soil amendment, conditioner, or fertilizer. The high solids content of the dehydrated residual dramatically reduces the volume for disposal, and the space requirements of the process are lower than other researched processes. Some of the drawbacks associated with heat drying are the high capital and operational costs.

Decision Matrix

To make an informed decision regarding the best choice of solids handling, the seven researched alternatives were compared. Using the selection criteria, a scoring system was developed to analyze each of the different available treatment processes objectively. A scale of one to five was chosen to rank the solids handling alternatives; a score of one indicates the process poorly meets the criteria, and a score of five indicates the process adequately meets the criteria. The sum of the points from each of the selection criteria produced the final rating of each treatment method, as shown in **Table 1**.

Table 1: Decision Matrix

	Criteria							
Process	**Land Space**	**Class A**	**Efficiency & Reliability**	**Odors**	**Cost**	**Marketability**	**Ease of Operation**	**TOTAL**
Multiplier	*5.0*	*4.5*	*4.0*	*3.5*	*3.0*	*1.5*	*1.0*	*!*
Lime Stabilize	3.0	2.0	3.0	3.0	3.5	1.0	3.5	62.0
Windrow Compost	1.0	4.0	1.0	1.0	5.0	2.0	2.0	50.5
Static Pile Compost	1.0	4.0	1.0	2.0	4.0	2.0	3.0	52.0
In-vessel Compost	2.0	4.0	2.0	3.0	3.0	2.0	4.0	62.5
Anaerobic Digestion	4.0	2.0	3.5	2.5	3.0	1.0	3.0	65.3
ATAD	**4.0**	**5.0**	**4.0**	**3.0**	**3.0**	**1.0**	**5.0**	**84.5**
Heat Drying	**2.5**	**5.0**	**5.0**	**4.5**	**1.5**	**5.0**	**4.0**	**86.8**

According to the selection matrix, heat drying and ATAD are the two best solutions for solids handling at the RWRF.

ATAD and Heat Dryer Comparison

After selecting heat drying and ATAD as the best alternatives, cost estimates for ATAD and heat dryer systems were requested from manufacturers. At an interest rate of 5 percent compounded annually and financing over 20 years, the estimated annual costs of each alternative were determined.

The ATAD system's costs include a four-tank ATAD system, a rotary drum thickener, engineering and legal fees, permits, and operational costs. For the heat-drying systems, costs include the dryer, the building to house the system, installation, a storage silo, a biofilter, engineering and legal fees, permits, and operational costs.

At a design solids production of 27 wet tons of biosolids dried daily and utility cost of \$0.08/kWh and \$0.80/therm, an approximate annual operating cost for each dryer system was calculated. From the comparison provided in **Table 2**, both heat drying and ATAD were determined to be economically advantageous over the current method.

Both ATAD and the heat-drying systems have the potential to produce a Class AA material. The major distinction between Class A and Class AA is in metal concentrations. Information provided by the city of Altamonte Springs stated that the metal concentrations in the influent are low, so the Class AA metals concentration requirement should be satisfied if treated by either of these processes, producing a highly marketable product.

The dried biosolids can be easily marketed to an outside company or packaged and sold privately. On the other hand, the liquid produced by ATAD is not in a form acceptable for sale. It can not be packaged and its storage would require the construction of liquid storage tanks, a considerable expense that was not accounted for in the original cost estimate. Contacting some of the local citrus growers revealed that they accept liquid biosolids but require a disposal fee.

According to the Florida Department of Environmental Protection's 2002 Summary of Class AA Residuals, demand for pelletized biosolids in the state of Florida is significantly greater than demand for other forms of treated

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biosolids. Due to this greater demand, heat drying provides the opportunity to recover some of the costs of solids handling by selling the treated biosolids. Furthermore, if the dryers are slightly oversized, Altamonte Springs can offer its biosolids treatment services to neighboring wastewater treatment facilities.

Another major consideration was transportation to the final disposal site. Synagro, an agricultural company with an office in Tampa, would be interested in purchasing the dehydrated biosolids and would assume responsibility for hauling the treated biosolids, leaving no disposal costs for the RWRF. The volume of solids produced by the heat dryer is significantly less on a wet basis than ATAD, which substantially reduces the volume requiring transportation and disposal.

For these reasons, it is recommended that the RWRF implement a heat-drying system to take advantage of producing a high-quality product.

Manufacturer Selection

Differences among dryer manufacturers, such as years of experience and the established distribution area were considered. Both Manufacturer B and Manufacturer C have been distributing heat dryers for over 15 years and distribute their dryer systems worldwide. Manufacturer A's first heat-drying system was installed in 1996; the system has since been distributed mainly in the southeastern United States.

Another consideration was the quality of the final product with respect to the city's desire to aggressively pursue selling its dried biosolids. Manufacturer B's dryer produces a high-quality, pellet-like product that can be used as a soil conditioner or amendment. Conversely, both Manufacturer A's dryer and Manufacturer C's dryer produce a dustier, less-profitable material. Since the final products produced from these two manufacturers are similar in nature, Dryer A was eliminated because it had a higher amortized cost.

If the RWRF implemented Dryer B, it would produce a pellet-like product that, when marketed, could recover some of the expenses of the heat-drying process. For example, Synagro purchases high-quality biosolids at $25 to $40 per dry ton, based on quality. At an average cost of $32/dry ton at the design solids production, the RWRF could recover over $63,000 per year.

Furthermore, Dryer B has a 50-wet-tons-per-day capacity, allowing the RWRF to treat up to an additional 23 wet tons per day from other facilities. In conjunction with charging for their services, the facility gains additional product that can also be sold. At $32/dry ton, an additional 23 wet tons per day of biosolids could potentially generate an extra $53,800 per year in sales on top of the potential profit for offering its services. This scenario could prove to be very lucrative if Altamonte Springs sold (1) its own product, (2) its services to other wastewater treatment facilities, and (3) the product yielded from those other facilities.

Table 2: Final Annual Costs Comparison

Manufacturer	Final Annual Cost
Current Method	$500,000
Manufacturer A: ATAD	$308,100
Manufacturer A: Heat Dryer	$411,500
Manufacturer B: Heat Dryer	$443,100
Manufacturer C: Heat Dryer	$392,900

If Altamonte Springs is not interested in pursuing the sale of its solids treatment services and final product, Dryer C offers a more favorable option, requiring lower capital and annual costs. Although Dryer C does not produce as desirable a product, the treated biosolids still have many disposal options. Furthermore, with a 48-wet-tons-per-day capacity, Dyer C still provides sufficient capacity to treat up to 21 wet tons per day of additional biosolids from other facilities.

Building Location

Implementing a heat dryer at the treatment facility will require building a structure to contain the dryer. The dehydration chamber will require a minimum space of 30 feet by 25 feet. The RWRF is located in a developed area, making the option of purchasing surrounding land for this structure infeasible. The dryer should be located near the belt presses, so that conveyance of the solids will not pose a problem.

The issue of transporting the solids from the presses to the heat dryer led to the examination of the areas directly surrounding the belt filter press building. The area immediately north of and adjacent to the building is currently a parking lot. Dewatered solids from the presses would be conveyed directly into the dryer. The proximity of these processes to each other contributes to the efficiency of the biosolids treatment process.

Building Design

The size of the existing belt press and filter building is 113 feet by 89 feet. A driveway runs the entire length of the building on its east side. This driveway is currently used by trucks that collect the dewatered solids from the presses, so it must remain intact.

The northern boundary of the available area is the access road that runs east to west in front of the parking lot. Road access must not be affected, since this road is used to access other areas of the facility.

Constructing the new heat-dryer building in the current parking lot, as an extension of or connection to the existing building, will reduce the material cost and result in a completely enclosed biosolids handling facility. The parking lot can then be relocated to the grassy area north of the proposed dryer building.

A review of the construction plans of the facility revealed that there are several pipelines that run under the parking-lot area. The depth of these pipes is unknown to the design team, but their existence must be considered because they will be impacted by the construction of the new building. Also, the presses have almost reached their 20-year lifespan, making their replacement necessary in the near future. Upon replacement, the layout of the presses can be redesigned to locate the hopper near the inlet area of the dryer.

Conclusions

There are many benefits to selecting either Dryer B or Dryer C to treat the RWRF biosolids. The design team feels that the environmental benefits and economic potential of an indirect heat-drying system justify the initial expenditure, which is still less costly than the current financial arrangement.

Upgrading the treatment to satisfy Class AA requirements will ensure that the facility meets or exceeds federal regulations in the near future. Furthermore, the dried form of the biosolids is an in-demand soil conditioner that can be sold to local companies at a profit. Recycling the biosolids is an innovative technique congruent with Altamonte Springs' reputation of being environmentally conscious, as exemplified by Project APRICOT.

EDITOR'S NOTE: This article was published to showcase the University of Central Florida's team effort that won the national student design competition. Since team members had access to limited information in order to compare system manufacturers, these manufacturers and their system models were given generic names (Manufacturer A, B, etc.) for the purpose of publication. Readers who wish to obtain the manufacturers and models of the two systems recommended by the team may contact Mimi Perez-Falcon at mperezfalcon @hotmail.com.