Benefits of a Progressive Centralized Biosolids Management System

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By progressively implementing a centralized management plan for biosolids, JEA has reduced the quantity of biosolids processed, lessened permit restrictions, reused existing infrastructure, and explored a new technology--all while producing a useful product and renewable energy source that will benefit the community and the environment.

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JEA, the largest community-owned utility in Florida and the eighth largest in the United States, operates and manages the water, sewer, and electric system for the city of Jacksonville and parts of adjacent counties. One of JEA's commitments is to improve the quality of life in the communities served by the utility. That commitment led to the decision to eliminate incineration as the method of wastewater sludge disposal and implement a plan for centralized biosolids management. This plan replaced the incinerators with a biogas thermal drying system that will reduce, if not eliminate landfill dependency. The resulting biosolids product can be used as a soil amendment to reduce agricultural dependence on manufactured fertilizers. Revenue received for the product can be used to offset the costs associated with biosolids disposal.

STRATEGIC PLANNING

Presently, biosolids consisting of both primary and waste-activated sludge (WAS) generated from wastewater plants owned and operated by JEA are incinerated at the Buckman Water Reclamation Facility (WRF).

Incineration to Drying

Incineration of municipal biosolids involves the evaporation of moisture and the combustion of the volatile solids portion of the biosolids. The remaining ash generally consists of the inert portion of the biosolids, including most of the metals. The high incineration temperature renders the ash virtually free of pathogens, results in the largest volume reduction of any of the methods employed to treat biosolids, requires a small footprint, and is capable of operating continuously regardless of weather conditions or transportation problems.

However, with incineration, beneficial nutrients and other organic materials in the biosolids are destroyed. The material is rendered useless as a fertilizer and typically must be disposed of in a landfill. Because the biosolids are burned, products of combustion such as particulates, metals, total hydrocarbons (THC), oxides of nitrogen (NOx) and gases that lead to the creation of acids are formed. Therefore, extensive air pollution control systems are required for incineration. Even with advanced air pollution control systems, the public often perceives incineration facilities as emitting hazardous air.

In February 1999, JEA, in conjunction with Black & Veatch Corporation, implemented a strategic planning initiative to review potential capacity shortfalls in the current incineration process. JEA processes biosolids in one of two multiple hearth incinerators, with the other unit serving as a standby. The first incinerator was installed in 1976 and has a capacity of approximately 62 dry tons per day (dtpd), while the second incinerator was installed in 1986 and has a capacity of approximately 42 dtpd. Pollution emission equipment for treating the incinerator flue gas consists of impingement tray scrubbers.

In 1998, solids production averaged 43.2 dtpd. Future 2015 average and maximum solids production were estimated to be 50.3 dtpd and 65 dtpd, respectively. The average solids production in 1998 was 43.2 dtpd, more than the capacity of the smaller incinerator (42 dtpd). Based on these figures, it was apparent that a strategy was needed to deal with short-term and long-term biosolids processing.

Through the strategic planning initiative, multiple technologies and biosolids management options were evaluated. The planning recommendation was to continue the central processing of all biosolids at the Buckman WWTP. Centralized processing not only enhances the product, but also utilizes existing infrastructure to reduce capital costs.

The recommended processing technology was a rotary drum thermal dryer, coupled with anaerobic digestion. This system is capable of producing a Class A biosolids product suitable for use as a soil amendment, potentially eliminating JEA's reliance on landfill disposal. JEA selected the Andritz DDS-70 model dryer, which can produce up to 68 dry tons per day Class A biosolid. The new biosolids system is expected to be completed in fall 2002.

BIOSOLIDS PROCESSING

Anaerobic Digestion

Anaerobic digestion will benefit the new system in several ways: by significantly reducing the quantity of biosolids processed, by producing a higher-quality product, and by reducing odors. The methane gas produced will be used as the energy source for the gas-fired sludge dryer and other sludge heating equipment. To avoid flaring excess digester gas and to maintain JEA's commitment to produce a percentage of its power from renewable resources, JEA chose to install an engine generator that will burn the excess digester gas and provide supplemental power for onsite use.

Digestion is predicted to reduce the design year 2015 average amount of biosolids that need to be dried by 42 percent, from 50 to 29 dtpd. Further, the thermal dryer effectively utilizes the ener-

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Thorough planning enabled JEA to utilize the existing three-story Biosolids Disposal Building at right to house the Andritz sludge dryer system, along with the thickening and dewatering equipment. JEA was also able to utilize the existing digester tank on the left and the raw sludge holding tank in the center.

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gy available by using the digester gas produced from the anaerobic process. It is estimated that during the design year 2015, digester gas production will be able to supply between 50 percent and 70 percent of the dryer's fuel requirement, depending on actual operating schedule and solids loading conditions.

Clean Power Initiative

JEA has established an ambitious clean power initiative to develop a significant clean power portfolio totaling at least 4 percent of JEA's total capacity by 2007 and 7.5 percent by 2015. By reaching these aggressive goals, JEA plans to become one of the leading clean power utilities in the United States.

The Sierra Club of Northeast Florida and the American Lung Association of Florida have partnered with JEA to help develop this program. Existing elements include:

*Solar Electric Power – JEA has installed 26 photovoltaic (PV) generation systems totaling 103 kW(peak), the largest collection of PV in the state.

*Biogas Power – JEA currently harvests biogas from its North Landfill and Girvin Road Landfill to generate 6 MW of renewable power and avoid wasteful flaring of the biogas.

Another element in JEA's clean power initiative is the use of digester gas to generate power. The methane (digester) gas produced in the anaerobic digestion process will be used as an energy source for the gas-fired dryer and other sludge heating equipment, including the hot water boilers.

The dryer is considered a four-to-five-day-per-week operation, but production of digester gas is a continuous operation, so there will be weekly excess. Rather than flaring this excess gas, as is typically done in the industry, JEA will use it to power an engine generator. Power from the engine generator will be placed on the plant's electrical grid to reduce the power consumed from the grid.

Another benefit derived from the engine-generator is waste heat recovery. Waste heat from the engine generator will be used to heat water for the digestion heating water system. Because of this heat recovery, less natural gas will be required by the boilers dedicated to this system. Heat recovered during operation of the engine generator is more than that produced by one of the digester heating system boilers, which will save money by eliminating the need for a redundant boiler.

Thermal Drying

The chosen thermal drying system heats the biosolids to reduce moisture to less than 10 percent, while leaving the volatile solids and inert components. Volume reduction is nearly 80 percent and the dried product is essentially pathogen free, complying with the requirements for a Class A biosolids product as defined by 40 CFR Part 503. Pathogens are destroyed with a dryer by achieving a material temperature of approximately 80 o C (175 o F). The low moisture content reduces vector attraction. Since the beneficial nutrients in the dried biosolids are not destroyed in the drying process, the dried product is suitable for beneficial use as a soil conditioner or fertilizer.

No combustion by-products are formed that result in air emissions because biosolids are not burned during the drying process itself. Air emissions are produced from the heating fuel and from the minimal amount of process gas (with volatile organics) removed from the system, but the levels are significantly lower than emissions produced during incineration. The resulting emissions and air permitting requirements are substantially simpler than those required for the existing incinerators.

A single train drying system was selected for both economic and space considerations. The new system is sized to enable JEA to go from a 24-hour, seven-days-per-week operation of dewatering and incineration to a weekly batch operation of dewatering/drying that lasts four to five days. The balance of the week allows for planned maintenance.

REGULATORY PERMITS

By permitting the new biosolids system as a centralized single source, rather than several dispersed sources, JEA was able to minimize permitting requirements. The current Buckman incineration facility is considered a major source of air emissions and has an EPA Title V Operating Permit. JEA demonstrated that the air emissions from the process and facility improvements are below Title V major source thresholds. As a result, JEA was issued a minor source air construction permit for the new facilities.

Air Permit

Improvements to the Buckman WRF, notably the thermal drying system and the retirement of the incinerators, required an air permit authorization prior to construction. Specifically, the modifications required a pre-construction Minor Source Air Construction Permit, as described in the following air permit licensing assessment.

Prior to the improvements at Buckman, the facility employed two sludge incinerators to dispose of processed wastewater sludge from several JEA facilities and other off-site customers. The facili-

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CENTRALIZED SYSTEM

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ty was considered a major source of emissions from an air permitting standpoint, primarily because of the two incinerators, and was operating under JEA of a Title V Major Source Operating Permit. In addition, the incinerators were regulated under 40 CFR 503 Subpart E, Standards for the Use or Disposal of Sewage Sludge. Replacing the incinerators with the sludge drying process eliminated the most significant emissions sources, lowering the impact on air quality and streamlining the air permitting process.

Under most circumstances, the addition of the sludge drying system and ancillary equipment, including the product storage silos and truck loading facilities, heating water boilers for the digesters, backup digester gas flare, and an engine generator, would have triggered a major air permit modification. However, a commitment by JEA to retire the sludge incinerators in conjunction with the biosolids project reduced the overall project net emissions to a level below the Title V major source threshold levels for both criteria and hazardous air pollutants (HAPs). Furthermore, the net emissions profile of the project also demonstrated that the project was not subject to Prevention of Significant Deterioration (PSD) pre-construction air permit review as a major source or modification. The result was a simplified minor source air permitting process that was administered at the local level through the city of Jacksonville's Regulatory Environmental Services Department (RESD, under delegated authority from the Florida Department of Environmental Protection), which minimized cost and potential construction schedule impacts.

This final pelletized product will be produced by JEA's new biogas thermal dryer system, reducing landfill costs and generating revenue. The system is scheduled to become operational in June 2002.

One of the benefits of the centralized biosolids management system is the streamlining of sampling and reporting requirements for day-to-day operations. Consolidating the biosolids handling eliminates duplicate reporting from multiple facilities.

Domestic Waste Permit

JEA worked with the Florida Department of Environmental Protection to determine the best permitting strategy for the Buckman WRF domestic waste permit. The incineration facility is currently permitted as part of the Buckman WRF permit. If the new biosolids processing facility were permitted as a modification to the existing Buckman WRF permit, it would allow the entire permit to be petitioned, not just the portion being modified. Also, if the new facility were permitted separately from Buckman WRF, the name of the facility could be changed. Although located on the same site, JEA operates the biosolids facility separate from the domestic waste plant. There are two sets of personnel on-site; one is the plant operation and maintenance crew and the other is the biosolids operation and maintenance crew.

JEA chose to permit the biosolids facility separate from the Buckman WRF, avoiding potential re-petitioning of the Buckman WRF's permit application; to rename the facility separate from Buckman WRF, thus allowing a separate identity; and keep the plant and biosolids facility permits separate.

UTILIZATION OF EXISTING FACILITIES

By maintaining a centralized system, JEA was able to utilize existing central infrastructure at the Buckman WRF and reduce the capital cost of the project.

Biosolids Disposal Building

(formerly the Incinerator Building)

The existing centralized incineration system utilizes a large, three-story building on the Buckman WRF site. The building is mostly vacant, as it was originally designed to house a much larger sludge system known as the Porteous process for thermal conditioning. The building was renamed the Biosolids Disposal Building with the elimination of the incinerators. The Andritz Dryer system

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is approximately three stories tall and requires protection from the elements. The system's typical arrangement was modified to allow the existing incinerator building to accommodate the new dryer and related peripheral equipment. The design and layout of the dryer facilities incorporated access points from the building's second and third floors to facilitate personnel access. One of the existing sludge conveyors in the building was reused for the new system.

Two of the three existing centrifuges were replaced, but the existing centrifuge frames, connected odor control ductwork, and hoists were reused. Since JEA personnel are familiar with centrifuge equipment, belt and screw conveyors, polymer systems, sludge pumps, and other sludge handling equipment, training and operations for the use and maintenance of these facilities will be simplified.

Three 3-meter gravity belt thickeners (GBT) will be housed on the third floor of the building. Since the GBT's are sources of odor, they must be enclosed. Due to the location chosen for the GBTs in the existing building, only one new wall is necessary to totally enclose them. Located below the GBTs are the GBT sludge receiving pump station and associated pumps. Although the building structure was utilized for this equipment, it was necessary to install a new door to allow equipment removal and access.

The existing centrifuge polymer tank will be reused to house the bulk GBT polymer. Also, the GBT mixing tanks and associated pumps will be contained in the existing incinerator building.

Existing Digester Control Building

Existing sludge transfer pumps and raw sludge recirculation pumps located in the existing digester control building will remain in service. Space in this building is available to place additional sludge transfer pumps and heat exchangers. By utilizing the existing digester control building which has three levels, the new digester control building size was minimized to one story. Had the existing facilities not been utilized, a basement level and/or substantially larger footprint would have been necessary for the new digester control building.

Existing Truck Loading Facility

Incinerator ash is currently stored in two bins located adjacent to the incinerator building in the truck loading area. This area was reused as the product storage and cake loading area for the biosolids facility. By utilizing this area, JEA was able to preserve the existing plant traffic patterns without requiring extensive roadway work or drainage improvements. JEA was also able to reduce capital costs by reusing one of the existing belt conveyors that carries sludge to this area.

Existing Sludge Tanks

The two existing 110-foot-diameter sludge holding tanks will be utilized to enhance the digestion process and optimize system flexibility. One of the tanks will continue to be used as a sludge storage tank, while the other will be used as a digested sludge holding tank. The cover of the holding tank will remain, while the digested sludge holding tank's cover will be replaced with a gas membrane cover to aid in the collection of digester gas.

Existing Pipelines

Two of JEA's regional WRFs currently pump their sludge to Buckman, while the others haul the sludge by truck. By continuing biosolids processing at Buckman WRF, these sludge lines will remain in service. Construction of a sludge truck unloading pump station was recently completed to receive and pump sludge from the remaining plants. This system is already providing JEA flexibility, since JEA has recently acquired surrounding utilities which are now able to haul their sludge to Buckman in addition to JEA's existing plants.

Odor Control System

The existing odor control ductwork, fans, scrubbers and biofilters were left completely intact. Since the existing odor control system had been oversized, no changes were necessary other than some minor duct extensions and modifications. Process gas from the dryer system will be routed through a Regenerative Thermal Oxidizer (RTO), rather than a biofilter, to ensure compliance with the air permit.

CONCLUSION

Currently a year and a half into construction, the system is expected to be fully operational in the fall of 2002. By replacing the existing incinerators with a thermal drying system and maintaining centralized processing, JEA will:

- Substantially reduce, if not eliminate, landfill dependency;
- Capitalize on large-scale treatment advantages;
- Utilize existing infrastructure;
- Significantly reduce air emissions;
- Produce a product with potential as a soil amendment to reduce agricultural dependence on manufactured fertilizers and offset the costs associated with biosolids disposal.

Maintaining centralized processing and pursuing a progressive technology has benefited JEA, the community, and the environment.