

2 – PHASE ANAEROBIC DIGESTION TO
ACHIEVE CLASS A BIOSOLIDS
GLENDALE WATER RECLAMATION FACILITY
LAKELAND, FLORIDA

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ABSTRACT

In anticipation of reaching full treatment plant operating capacity and changes in the biosolids disposal regulations, the City of Lakeland, Florida decided to pursue improvements and expansion of the existing solids processing at the Glendale WRF. A design memorandum was prepared for the City presenting various processing options. Several meetings held with City representatives, representatives from Chastain-Skillman, Inc., and some of the process vendors. The selected process (2PAD with Egg-Shaped Digester) was then designed into the existing facility and is under construction. The purpose of this paper is to present some of the options considered during the selection process, to show how these options were integrated into the final design, and also to show how a proprietary process can be included in competitively bid projects.

KEYWORDS

Anaerobic digestion, 2-Phase Anaerobic digestion, Egg-Shaped Digester (ESD), Digestion processes

INTRODUCTION AND BACKGROUND

Chastain-Skillman, Inc. (CSI) has worked with the City of Lakeland (COL) at the Glendale WRF, the City’s oldest and largest wastewater treatment plant, for many years. The Glendale facility has two (2) existing anaerobic digesters of sufficient size to produce Class B biosolids with the liquid biosolids disposal at permitted land application sites. The treatment facility is not yet operating at its full hydraulic capacity of 13.7 mgd, but it will in the near future. The existing digestion system is not adequate for the solids loading as the plant approaches hydraulic capacity.

The Florida Department of Environmental Protection (FDEP) has been studying the continued land application of Class B biosolids as an approved disposal method. The FDEP has received many complaints and is expected to rewrite the disposal regulations to further restrict the application of Class B solids or perhaps eliminate the practice altogether. Given the potential uncertainty, the City of Lakeland elected to review and select a technology to produce Class A materials for disposal prior to restrictions being implemented by the state.

In preparation for continued updating of biosolids disposal requirements the CSI and COL engineering staffs attended workshops offered by the Florida Department of Environmental Protection (FDEP). These work shops, offered at various locations around the State, brought together engineers, regulators, biosolids processors and applicators, and those individuals with complaints regarding current disposal methods. Many of these same people also attended seminars presented by Florida Water Environment Association (FWEA), Water Environment Federation (WEF) and Environmental and Water Resources Institute (EWRI). All of the information gathered from these background meetings influenced the City's decision to pursue a higher level of treatment for biosolids disposal.

The Glendale WRF has been digesting blended primary and waste activated sludge (WAS). To help relieve periodic solids overloading a temporary facility is in operation to process the WAS using the Bioset process to produce a Class A sludge. With this system in operation, the primary sludge continues to be processed in the existing anaerobic digesters, while the WAS is dewatered and mixed with lime in the Bioset process to produce Class A sludge. In this manner, the loading to the existing digesters is reduced. The digested primary sludge continues to be land applied as Class B biosolids. Under the present agreement, Bioset is responsible for disposal of the Class A sludge produced. It is expected that the Bioset/primary sludge digestion process will continue operation until the design and construction is complete for the new solids handling project.

CSI received and reviewed the plant operating data for the one year period from November 1, 2002 through October 31, 2003. The sludge has been fed to the digesters from two sources. Primary Sludge is pumped directly to the digesters. Waste Activated Sludge (WAS) is thickened by gravity belt thickeners before being fed to the digesters. The data for the one year period is summarized in **Table 1**. Comparison of this data to other data from recent years indicates that it is typical for recent years although periods of higher flow and organic loading have been experienced.

Table 1
Lakeland Glendale WWTF
Sludge Data
From Operating Data, November 1, 2002 through October 31, 2003

	Annual Total	Daily Average	Average Concentration
Plant Influent Flow	3481.28 mg	9.54 mgd	
Infl BOD Loading	10,609,346 lbs	29,067 lb/day	365 mg/L
Infl TSS Loading	7,542,247 lbs	20,664 lb/day	260 mg/L
Primary Sludge Flow	17,489,000 gallons	47,918 gpd	
Thickened WAS Flow	11,996,000 gallons	32,866 gpd	
Total Sludge Flow to Digesters	29,485,000 gallons	80,784 gpd	
Primary Sludge Total Solids	4,337,334 lbs	11,883 lb/day	3.0%
Thickened WAS Total Solids	5,111,162 lbs	14,003 lb/day	5.1%
Total Solids to Digester	9,448,496 lbs	25,886 lb/day	3.8%
Primary Sludge Volatile Solids	3,697,714 lbs	10,131 lb/day	85.3%
Thickened WAS Volatile Solids	4,291,723 lbs	11,758 lb/day	84.0%
Total Volatile Solids to Digester	7,989,437 lbs	21,889 lb/day	84.6%
Gas Production	42,096,900 cu ft	115,334 cu ft/day	
Volatile Solids Reduction		50.3%	
Calculated Loading information (based on a total digester capacity of 1,337,000 gallons)*			
Hydraulic Retention Time		16.55 days	
Volatile Solids Loading		0.12 lb VSS/cu ft/day*	

* Based on liquid level in digesters at midpoint of range and neglecting cone volume

As shown in **Table 1**, the current average wastewater flow to the Glendale WRF is 9.54 mgd. It is anticipated that the flows to the Glendale WRF will increase over the next several years to the design capacity of 13.7 mgd. Although flows caused by growth in the existing service area could exceed the 13.7 mgd capacity, current plans are to reroute flows beyond the current plant capacity to the Northside WWTP. Therefore, no expansion beyond the current 13.7 mgd capacity is anticipated.

An increase in the plant flow from the current 9.54 mgd to 13.7 mgd represents an increase of 44%. Assuming the sludge production increases in the same proportion, the digester feed would increase to 116,000 gpd. For design purposes, to allow for variations in influent quality and sludge generation rates, 116,000 gpd was rounded to 120,000 which represents a 49 percent increase over the current digester feed rate. Key parameters increased by the same 49 percent are presented in **Table 2**.

Table 2
Lakeland Glendale WWTF
Projected Key Parameters at Design Flow Rate

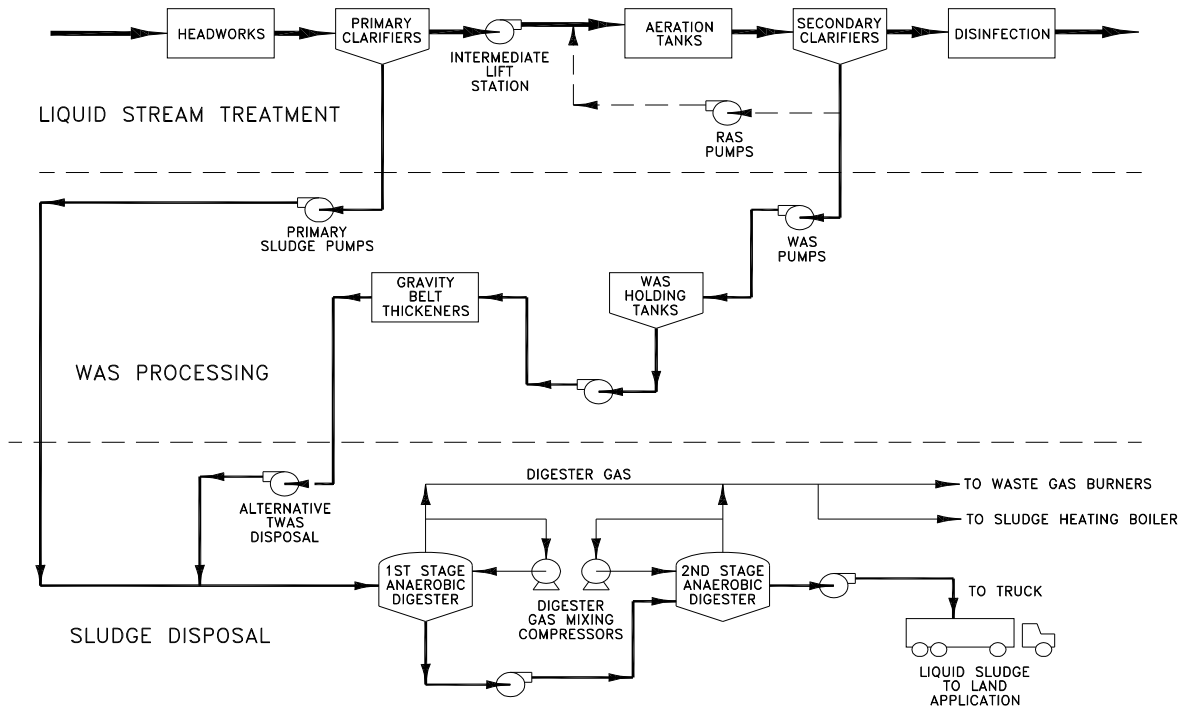
Parameter	Units	Values	
		Current (1)	Projected (2)
Plant Flow	mgd	9.54	13.7
Infl BOD	lb/day	29,067	43,179
Infl TSS	lb/day	20,664	30,696
Infl BOD	mg/L	365	378
Infl TSS	mg/L	260	269
Primary Sludge Flow	gpd	47915	71,200
Thickened WAS Flow	gpd	32866	48,800
Flow to Digester	gpd	80,781	120,000
Primary Sludge Solids	lb/day	11,883	17,652
Thickened WAS Sludge Solids	lb/day	14,003	20,802
Total Solids to Digester	lb/day	25,886	38,500
Average Digester Feed Solids Concentration	%	3.84%	3.8%
Volatile Solids to Digester	lb/day	21,889	32,500
Volatile Solids Concentration	%	84.56%	84.42%
VS Reduction	%	50.29%	50.29% (minimum)
Detention time (in existing digesters)	days	16.55	11.14
Gas Production	cf/day	115,334	172,000

(1) Based on averages for 12-month period from November 2002 through October 2003

(2) Based on increase of 49% from current values.

The projected values in **Table 2** were utilized as the design parameters for the selection process. The existing process flow diagram is shown below in **Figure 1**.

Figure 1 – Current Sludge Processing Diagram



SELECTION PROCESS

The City retained CSI to design modifications to the biosolids system to provide sufficient capacity to handle all of the biosolids produced at the design flow rate and to produce Class A biosolids to provide greater flexibility in disposal options. Ideally the treatment technology would “guarantee” production of Class A biosolids. The City desired a vendor who would be willing to provide a bond (or some other financial security) to assure that the City’s system would meet the Class A requirements as defined by the EPA’s 40 CFR Part 503 regulations and would be approved without exhaustive site specific testing. The City wanted to utilize known treatment processes and preferably continue with the anaerobic digestion process. It was also desirable to keep the existing treatment process in operation during the digestion system modifications. Because of the reported ease of operation and excellent performance associated with it, the City preferred the egg shaped digester (ESD) for any new digestion tankage required. Five options for producing Class A solids were evaluated: 1) Two-phase anaerobic digestion (thermophilic/mesophilic) using a Conditional National Process to Further Reduce Pathogens, 2) Two-phase anaerobic digestions (thermophilic/mesophilic) using egg-shaped digester with sequenced feed system to obtain site-specific approval, 3) Aerobic thermophilic pretreatment using a process approved as Equivalent to a Process to Further Reduce Pathogens, 4) Pasteurization process meeting temperature and time requirements to produce Class A biosolids, and 5) Combination of first two alternatives using an egg-shaped digester for the first phase of the two-phase anaerobic digestion system and using a Conditional National Process to Further Reduce Pathogens.

Five options for the Glendale WRF are discussed below. In addition to continuing the current operation (sixth option), other options for producing Class A sludge are discussed. All of these options involve process additions and the continued use of the existing anaerobic digesters in some form. The first two treatment options involve the addition of a small thermophilic acid-phase digester in front of the existing digesters and the use of the existing digesters as gas-phase digesters in series. Although these options modify the existing process, they continue with the use of anaerobic digestion which is already familiar to the Glendale WRF operators. The additional digester provides increased digestion capacity to accommodate the projected future volume of sludge to be treated. The third treatment option involves the addition of a high temperature aerobic digestion step ahead of the existing digesters. The fourth treatment option involves raising the temperature of the sludge for the specified time to meet the time-temperature requirements to produce a Class A sludge. The last two options do not significantly increase the digester capacity, and, therefore, do not address the projected overloading of the existing digesters. Options three and four are not good candidates for long-term solids disposal because of the expected solids increase.

No Change From Existing – Including Bioset

With the start-up of the Bioset process, the loading on the existing digesters was greatly reduced. This will eliminate the potential for organic overloading, but the COL will still be producing and hauling a large amount of Class B biosolids with the potential liabilities and possible further restrictions on disposal in the future. The cost of producing and disposing of the Bioset solids is significantly more than the current cost to digest and dispose of Class B biosolids.

Two-Phase Anaerobic Digestion (2PAD™)

The 2PAD system is a two-phase anaerobic digestion system. The first stage (acid phase) operates in the thermophilic range at about 55°C, while the second stage (gas phase) operates at about 37°C in the mesophilic range. The hydraulic residence times are approximately 2 days and 10 days, respectively in each stage.

Data has been submitted to the EPA and the process has been granted Conditional National PFRP Equivalency. Additional testing at a full scale plant is required to obtain full National PFRP Equivalency, but once it is obtained, the system will be accepted as equivalent to the listed processes that produce Class A Sludge. Under the conditional approval, the Pathogen Equivalency Committee (PEC) recommends equivalency at a specific site as long as the process is operated in accordance with the “Operation Guidelines” prepared by the vendor, and the specified monitoring of enteric viruses and viable helminth ova is conducted. This requires additional monitoring until compliance with Class A requirements is proven or full National PFRP Equivalency is granted.

Two-Phase Anaerobic Digestion Using Egg-Shaped Digester

This process for Two-Stage digestion includes the addition of an egg-shaped digester (ESD) to provide for acid phase digestion in the thermophilic range and use of the existing anaerobic digesters for gas phase digestion operating in the mesophilic range. This process has been used successfully in other locations, but it is not a listed process or equivalent process to produce Class A sludge. Therefore, an extended sampling and testing program would be required to obtain a site specific approval recommendation from the PEC for the Class A treatment designation.

The scope of equipment supply for this option includes the ESD vessel with an overall height of 61 feet with the major diameter being 36 feet; a 12-foot diameter feed tank which doubles as the center column for access stairs and platform; and a jet mixing system for the existing digesters. Also included would be design, supply, and construction of the vessels with foundation and anchorage; all mechanical equipment associated with the ESD mixing, heating, pumping, ventilation, instrumentation, and electrical design and supply; and process startup and training. The vendor would also assist the owner and engineer in developing the information required for acceptance of the 2-stage process as an equivalent PFRP, but no guarantee indicating that the sludge would meet Class A requirements was proposed. Their assistance would include developing a test protocol for the facility and developing a description of the process for review by the USEPA in determining the Class A status.

The egg-shaped digester offers several operational advantages, including:

- the bottom cone shape prevents sludge accumulation and loss of digester capacity;
- the egg shape provides for more efficient mixing and, therefore, less power costs;
- the digester shape and jet mixing system provide for very effective scum and foam control;
- the sealed top design is gas tight and prevents escape of foam from the digester as may occur in a floating cover design;
- the egg-shaped digester has less surface per unit volume. This factor combined with an effective insulation system results in less heat loss and, therefore, less heat required for the egg-shaped digester; and
- the use of a split draft tube system that allows the digester to be operated over a wide range of levels without sacrificing mixing efficiency.

Aerobic Thermophilic Pretreatment (ATP™)

This system utilizes an aerobic first stage operating at 65°C with the discharge going to the existing anaerobic digesters. The scope of supply would include three 12-foot diameter by 36 feet high, fiberglass reactor vessels, a sludge heat recovery system, new boiler heating system, and all pumps, instrumentation, and other equipment to provide a complete first stage treatment process. The preliminary proposal was based on 96,000 gallons per day of sludge to be treated; therefore, scale-up is required for the desired 120,000 gallons per day capacity.

BioPasteur

The BioPasteur system is a means of sludge treatment that maintains the influent sludge at 70°C for one hour. This process meets the standards set by USEPA for a Class A process based on the temperature and time relationship. The process consists of three 6,150-gallon stainless steel pasteurization tanks, stainless steel heat exchangers, progressive cavity pumps, pigging station, pigging pump, and valves and controls to make a complete system. The solids are discharged from pasteurization tanks directly to the existing anaerobic digesters. Odor control is required for the vent gas from the pasteurization tanks.

Selected Process

The selected process includes a combination of the 2PAD and ESD options and will be discussed in more detail later.

PROCESS SELECTION

Table 3 provides a comparison of the various options. Another treatment option, which is a combination of the egg-shaped digester with the 2PAD system to produce Class A biosolids, is included. The costs shown in the table include the manufacturer's cost for the quoted items plus the cost of additional equipment and installation to complete the project; thus, putting the costs on a comparable basis. The cost of a new heating boiler is included in every option because the existing boiler needs to be replaced even if it would otherwise meet the heating needs of the new process.

Table 3
Lakeland Glendale WWTF
Comparison of Class A Options

System	IDI 2PAD	ESD (2 stage anaerobic, AGD)	ATP	BioPasteur	IDI 2PAD w/ ESD
Company	Infilco Degremont	CB&I	CB&I	Kruger	Infilco Degremont/CB&I
Process	Thermophilic acid phase, 2.34 days, 55 deg C; Mesophilic gas phase (existing), 12.95 days, 37 deg C; requires min 6 hrs between feedings	Egg shaped acid phase--min 1.5 days--1.9 days provided, 130-136 deg F; existing gas phase, 12 days	Aerobic thermophilic first stage, 19.6 hrs in 3 reactors, 150 deg F; existing digesters second stage	3 alternating tanks; 70 deg C for 1 hr	ESD Thermophilic acid phase, 2.1 days, 55 deg C; Mesophilic gas phase (existing), 12.95 days, 37 deg C; requires min 6 hrs between feedings
Class A Method	Conditional National PFRP Equivalency	Modeled after DuPage County Illinois; site specific certification	National PFRP Equivalency	Time/Temperature	Conditional National PFRP Equivalency
Design Flow (gpd)	120,000	120,000	96,980	120,000	120,000.00
Design Feed Solids	4-5%, min 3%, 70% volatile	4-5%, 70% volatile	4%, 70% volatile	1.5%	4-5%, min 3%, 70% volatile
Equipment Required	Cannon mixing system; digester heating system; gas safety and handling equipment; controls; sludge feed/transfer pumps; fixed cover for thermophilic digester	ESD vessel, jet mixing system, access tower/surge tank & bridge; existing digester jet mixing system; boiler and heat exchangers; transfer/feed pumps, accessories.	Reactors, heat exchangers, boiler, transfer pumps, vent air blower, accessories	Heat exchanger, pigging system, expansion tank, pasteurization tanks, hot water tank, sludge grinder and pumps, misc.	ESD vessel, jet mixing system, access tower/feed sequencing tank & bridge; existing digester Cannon mixing system; boiler and heat exchangers; transfer/feed pumps, accessories.
New Tankage	Feed Seq Tank: 20' dia x 18' swd; Thermo Digester: 44' dia x 23' swd	252,000 gal stl ESD: 36' dia x 61' high; 12' diameter surge tank/access tower	3 FRP Tanks: 26,400 gal; 12' dia x 36' high (increase for higher flow)	3 st stl tanks: 6,150 gal ea	252,000 gal stl ESD: 36' dia x 61' high; 12' diameter feed sequencing tank/access tower
Equipment Included in Vendor's Quote	Cannon gas mixing system; digester heating system; gas safety and handling equipment; controls; sludge feed/transfer pumps; fixed cover for thermophilic digester	ESD vessel, boiler, transfer pumps, accessories	Reactors, heat exchangers, boiler, transfer pumps, vent air blower, accessories	Heat exchanger, pigging system, expansion tank, pasteurization tanks, hot water tank, sludge grinder and pumps, misc.	ESD vessel, boiler, transfer pumps, accessories
New Tankage	Feed Seq Tank: 20' dia x 18' swd; Thermo Digester: 44' dia x 23' swd	1 252,000 stl ESD: 36' dia x 61' high	3 FRP Tanks: 26,400 gal; 12' dia x 36' high (increase for higher flow)	3 st stl tanks: 6,150 gal ea	1 252,000 stl ESD: 36' dia x 61' high
Process Experience	Pilot Unit at Indianapolis	(ESD) US since 1989, >22 plants	20-years in Europe; Lebanon, TN-6 mgd; Maquoketta, IA-1 mgd	12+ in Europe; 2 under construction in US	ESD's have been used in US since 1989, >22 plants; 2PAD system was piloted in Indianapolis
Advantage	Conditional PFRP Equivalency; adds digestion capacity; IDI will guarantee Class A biosolids; IDI will pay for additional testing required	Adds digestion capacity; smaller foot print	PFRP Equivalency	Meets Class A requirements by Time and Temperature	ESD; adds digestion capacity; smaller foot print; conditional PFRP equivalency; IDI will guarantee Class A; IDI will pay for additional testing required
Disadvantage	Cylindrical digester--larger foot print; not operating in US; additional testing needed to get site specific approval	Need site specific approval; production of Class A biosolids not guaranteed	Different biological process; reduced gas production in existing digesters; does not significantly add to digestion capacity; potential for heat exchanger fouling and odors at high sludge temperature	Does not add to digestion capacity; not operating in US; potential for heat exchanger fouling and odors at high sludge temperature	Additional testing needed to get site specific approval
Quote for Vendor Supplied Equipment	\$1,825,000	\$3,200,000	\$2,845,948 Proportioned for 120,000 gpd capacity	\$1,343,000	\$4,750,000
Opinion of Probable Construction Cost (Conceptual level)	\$4,000,000	\$4,750,000	\$4,400,000	\$3,900,000	\$4,750,000

The choices are easily narrowed down to the two-stage anaerobic digestion options. Although the BioPasteur and ATP processes can produce Class A biosolids, neither process adds significant digestion capacity to the system to handle the projected sludge generation rate when the plant flow reaches 13.7 mgd. To avoid overloading the existing digesters, additional digestion capacity or further thickening of the digester feed sludge would be required. By providing some volatile solids reduction in the aerobic digestion process, the ATP process would reduce overall gas production. These processes are also most unlike the current operation and would, therefore, place more of a burden on the operation and maintenance staff. These processes also operate at the highest temperature, creating potential problems with piping and heat exchanger fouling and increased odors.

In terms of process, the 2PAD system and the ESD system are very similar. Both use a thermophilic acid digester with a detention time of approximately two days followed by the existing digesters acting as gas phase mesophilic digesters.

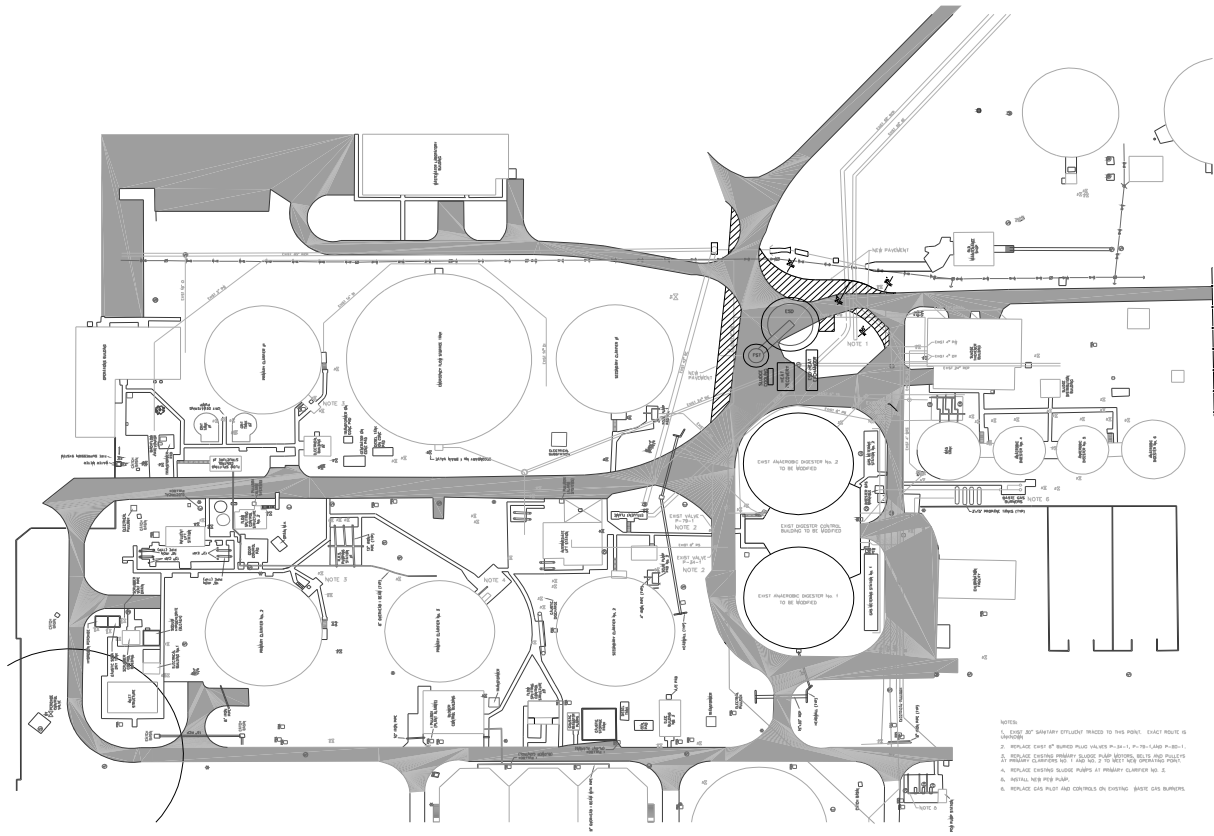
As the Opinion of Probable Construction Costs suggests, egg-shaped digesters are generally more expensive to construct than cylindrical concrete digesters. However, egg-shaped digesters offer several operational advantages including better mixing and heating, better solids removal and better control of the scum layer to maintain the active digester volume. Maintaining the active digester volume is a critical part of the 2PAD process and must be guaranteed by the tank vendor.

The 2PAD system has the advantage of being well on the way to national approval as a process to further reduce pathogens. At the Glendale WRF, the vendor is willing to pay for the testing required to establish a site specific approval as a PFRP. They will also guarantee that Class A requirements will be met and will provide a bond to back-up the guarantee.

At the budget level of cost analysis presented here, the ESD option appears to cost significantly more than the 2PAD system. However, some long-term advantages in using the egg-shaped digester such as those addressed above plus potentially lower mixing power costs, less operation and maintenance labor, and better space utilization have not been quantified. By combining the two options, the Glendale WRF can have the operational advantages of the ESD and the guarantee of meeting Class A requirements through the 2PAD process. The process offers the further advantages of being similar to the currently operating digestion process; it fully utilizes the existing digesters; and it requires the least additional space.

A preliminary site layout is shown in **Figure 2**. The new digester is shown to be constructed to the east of the existing anaerobic digesters. This layout allows the new tank to be located in the vicinity of the sludge thickening building and other biosolids related systems.

Figure 2 – Preliminary Site Layout



SELECTED SYSTEM

The selected system is a combination of an egg shaped digester design and a proprietary process that has been given a Conditional National Process to Further Reduce Pathogens (PFRP) equivalency by the Pathogen Equivalency Committee (PEC). The system will be implemented by constructing an egg-shaped digester with a detention time of approximately two days to serve as the thermophilic first stage and using the existing conventional digesters for the mesophilic stage. This was determined to meet all of the established criteria for the processing of biosolids including: ease of operation, effective mixing of the biosolids, sufficient residence time to meet processing requirements, a reasonable fit of the tankage in the site space available, and the process guarantee for the production of Class A biosolids. Part of the requirement for producing the Class A biosolids is the operation of the system in a batch mode to avoid the possibility of short circuiting of under-treated biosolids (at the thermophilic temperature). To accommodate batch operation a sludge feed sequencing tank (FST) is included to allow accumulation of the thickened, waste activated sludge and primary sludge between batch feed cycles. Ancillary equipment includes a new hot water boiler for heating the inlet sludge and maintaining the temperature in the ESD, heat exchangers for heating and cooling the sludge, associated pumps for recirculation and transfer, gas type mixers for mixing in the mesophilic tanks, gas compressors for the gas mixing system, digester gas cleaning equipment, excess gas flares, and controls for automatic operation of the system.

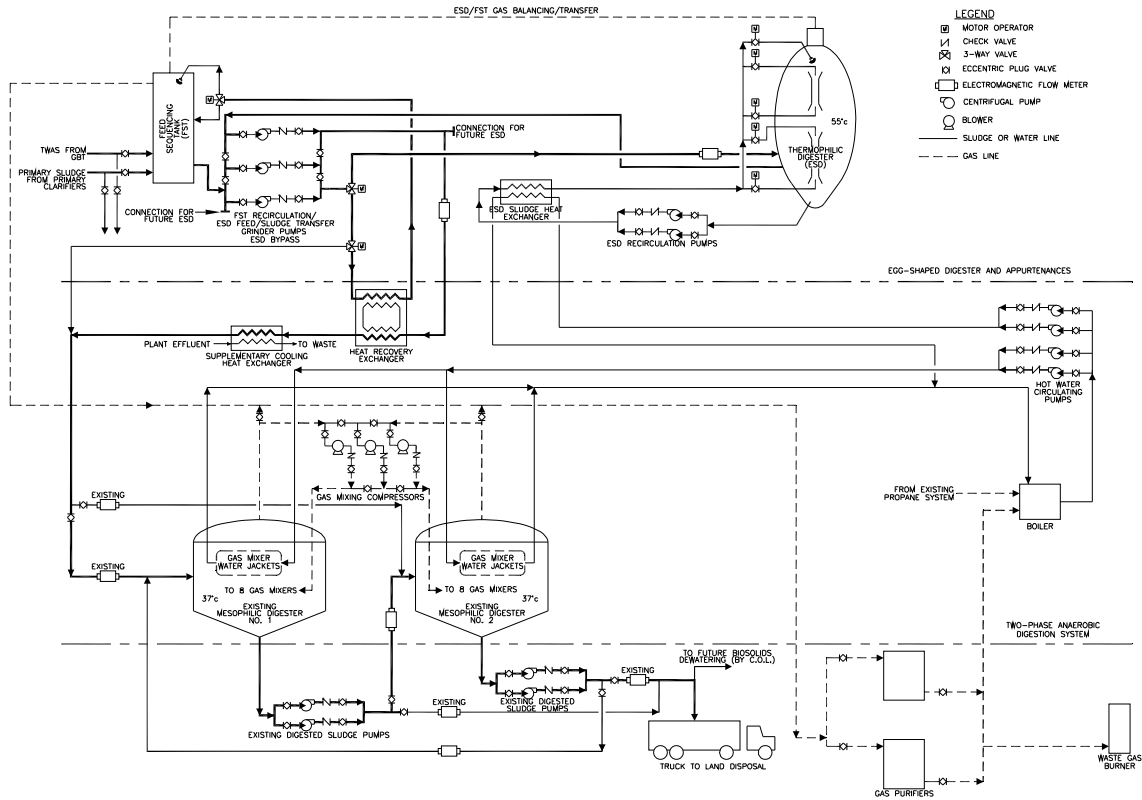
FINAL DESIGN

In addition to the normal coordination between the owner and engineer, the selected configuration necessitated extensive involvement by the Class A process vendor and the ESD vendor. Meetings were held with the vendors, engineer, and City to determine the areas of responsibility for each member of the team, including equipment supply and process control. Once the areas of supply were established, then it was necessary to develop a team approach so that design efforts could be directed to the engineer to assemble a biddable set of documents. The owner set the criteria for the bidding process, realizing that the vendor responsible for the ESD and the vendor providing the process guarantee needed assurance that their engineering efforts would be compensated. The City's purchasing guidelines requires competitive bidding for this value of work, but there also needed to be compensation for the extra design effort in behalf of the City. A value for the engineering performed by the ESD and 2PAD vendors was included in the bidding documents so that if an alternate supplier were used by the contractor, this fee would be used as compensation and included as part of the deductive alternate. [As a matter of fact, a deductive alternate was offered at bid time for a system similar to the 2PAD system. As of this writing, the contract has not been awarded so the alternate has not been reviewed for acceptability.] **Figure 3** shows the proposed new process flow diagram.

Following are the key features of the major system components:

- ESD Sizing – 268,400 gallons, 36' major diameter by approximately 65' overall height. This provides 2.1 days of sludge residence time at the ultimate sludge production rate of 120,000 gallons per day.
- FST Sizing – 49,900 gallons, 12' diameter by 65' overall height. This tank is sized to store the sludge as produced so that it can be pumped down routinely to batch feed the first stage of digestion.
- Mesophilic Tank Mixing – Each of the existing mesophilic digesters will be fitted with 8 - 24" diameter gas draft tube mixers. These mixers will produce sufficient mixing to assure a minimum of 90% active volume in each digester. The mesophilic tanks are to have a minimal 10 days solids retention time, as well as capacity for daily sludge storage.
- Heat Exchangers (Heating and Cooling) – Heat exchangers will be provided with the ESD to be used on recirculating sludge to maintain the digester temperature. A heat exchanger utilizing two water to sludge heat transfer passes to transfer heat from the thermophilic sludge leaving the ESD to the raw sludge in the FST. This serves to preheat the ESD feed sludge and to cool the sludge feed to the mesophilic digesters. During warm weather operation, it may be necessary to further cool the sludge being transferred to achieve mesophilic temperatures. Therefore, a separate sludge to water heat exchanger is being provided that uses plant effluent water for cooling purposes.

Figure 3 – Proposed Process Flow Diagram



- Other Equipment:

Gas Compressors – 240 scfm at 8.6 psig

Hot Water Boiler – 3,400,000 BTU/hour

Digester Gas Cleaning

Excess Gas Flares

- Control Room – The existing digester control room will be renovated and the new control system will be installed. The control system will include the motor control centers for some of the new equipment and programmable logic controls for automatic operation of the sludge digestion system including the ESD, pumps, boiler, mixing system, compressors, etc.

- Process Control – Sufficient controls will be provided to assure that the complete sludge digestion process can be automated. Little operator interface will be needed, except for final sludge load-out.

CONCLUSION

The selection of this particular process for producing Class A biosolids may not be appropriate for every treatment facility. However, for facilities with existing mesophilic digesters, the

addition of a single, smaller thermophilic unit may be an economical alternative to larger, more complex systems. The thermophilic/mesophilic combination can also optimize digester gas production when a source of energy for co-generation or biosolids drying is important. For the City of Lakeland, this selection of processes met all of their criteria.