Beneficial Use of Domestic Wastewater Residuals

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The Florida Department of Environmental Protection encourages and promotes the beneficial use of domestic wastewater residuals in Florida. Approximately 75% of the estimated 253,000 dry tons of residuals generated annually in Florida are believed to be beneficially used (66% land applied, 9% distributed and marketed). Additionally, over 95,000 dry tons of pelletized residuals product were imported in 1998. Florida's warm climate and large agricultural industry provide an ideal setting for the beneficial use of domestic wastewater residuals.

Regulations

Chapter 62-640 FAC regulates the beneficial use of domestic wastewater residuals in Florida. Originally adopted in 1990, the rule was revised effective March 30, 1998. DEP primarily revised the rule to improve consistency with the final version of Title 40 CFR Part 503, which became effective in 1993, and to provide clarification and refinements to the existing rule.

The revised Chapter 62-640 FAC incorporates Part 503's pathogen reduction options, most of the vector attraction reduction options, pollutant limits, cumulative loading limits, and monitoring frequencies. The annual pollutant loading rates of Table 4 in Section 503.13 were not incorporated and the option to sell or give away residuals based on this table is not offered by Chapter 62-640 FAC. Florida only allows the distribution and marketing of residuals that meet both Class A pathogen reduction requirements and pollutant limits equivalent to Table 3 of Section 503.13.

Although the revisions to Chapter 62-640 FAC incorporated many of the technical elements of Part 503, the implementation and administrative requirements of the state regulations remain unique to Florida. For example, when a facility applies for its wastewater facility permit or permit renewal, it must submit an Agricultural Use Plan for each site where it intends to land apply residuals. This plan details the site's physical characteristics, location, crops, nitrogen requirements, application rates, application areas, and describes how site management requirements and restrictions will be met.

The revised rule also contains a section providing requirements unique to residuals management facilities (RMFs). RMFs are facilities that accept and treat residuals from other wastewater facilities. The revisions were intended to address some of the characteristics of these facilities and their operations that previous regulations either did not address clearly or cover at all. A few of the items addressed are shipping manifests, operator staffing, and preliminary design report requirements.

Pathogen Reduction

Chapter 62-640 FAC incorporates the Class A and Class B pathogen reduction requirements from Part 503 by reference. DEP also added or revised existing rule language to be consistent with Part 503's site restrictions regarding public access and growing/harvesting restrictions. One exception is that DEP always restricts public access to a land application site for 12 months following the last application of Class B residuals, whereas the federal rule allows access after 30 days if the land has a low potential for public exposure. Chapter 62-640 FAC also establishes more stringent setback distances to water than the federal rule and also establishes setback distances to wells, buildings, and possible conduits to groundwater.

Classes of Residuals and Their Use

Chapter 62-640 FAC allows three classes of residuals to be beneficially used: AA, A, and B. Class A and Class B residuals have received either Class A or Class B pathogen reduction treatment respectively, but only meet ceiling pollutant limit concentrations equivalent to Table 1 of Section 503.13. Class AA residuals must be treated to Class A pathogen reduction requirements and also meet pollutant concentrations equivalent to Table 3 of Section 503.13.

In general, the concentrations of metals contained in Florida residuals are relatively low. Whenever a Florida facility provides Class A pathogen reduction, the resulting residuals product usually meets Class AA requirements. Except for only a few facilities, residuals intended for beneficial use in Florida are either Class AA or B.

Class AA residuals are the highest quality residuals and may be distributed and marketed in bulk or bag form similar to commercial fertilizers. Distributing and marketing a Class AA residuals product relieves the producing facility of many regulatory requirements such as site approval and management.

A wide variety of Class A pathogen reduction technologies are used for the production of Class AA residuals in Florida. Autothermal thermophilic aerobic digestion (ATAD), composting, "RDP" processes, various "N-Viro" technologies, and thermal pelletizing processes are all currently used in Florida. Overall, Florida appears to have a strong market for Class AA residuals. Of the 186,000 dry tons of Class AA residuals products distributed and marketed in Florida in 1998, over half were imported pelletized Class AA residuals.

Seventeen Florida facilities produced Class AA residuals in 1998. All of these facilities were located in the central and southern portions of the state. More facilities are choosing to meet the Class AA requirements each year. Since 1995, five facilities have started generating Class AA residuals.

Class B residuals are land applied throughout the state. It is estimated that almost two-thirds of the residuals generated in Florida are treated to Class B standards and then land applied. With plenty of agricultural land available nearby and Florida's warm climate that allows year-round application of residuals throughout the state, the production and beneficial use of Class B residuals seems to be the most common option chosen by Florida facilities. A recent inventory, with limited data, indicated that although Class B residuals in Florida are applied to many different crops, the majority appear to be applied to pasturelands.

Public Acceptance

Florida has not experienced any significant problems with the land application of residuals. Common complaints involve odors and truck traffic issues.

A few counties in Florida have adopted their own ordinances in addition to the state regulations. In Pasco County, for example, all residuals generated within the county must be sent to the county's regional management facility for treatment to Class AA requirements. Additionally, only Class AA residuals may be land applied in Pasco County. Another county's ordinance contains requirements that allow greater local control over land application operations. These requirements include registration of haulers and appliers, approval of truck routes, and daily hours of operation for transport and land application.

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Full-Scale Experience with Conditioning and Dewatering Thermophilic Aerobically Digested Biosolids

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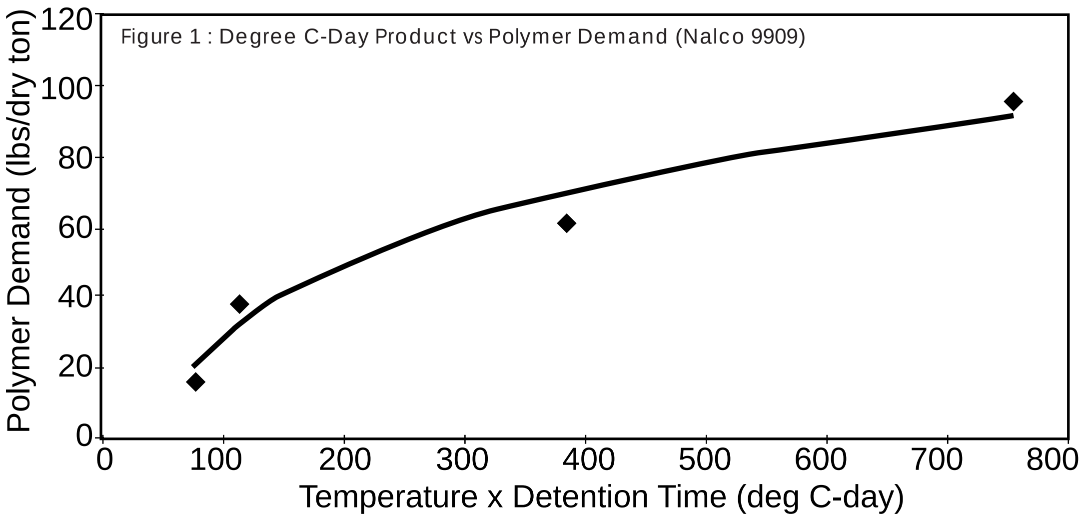
The EPA Part 503 Biosolids Rule has prompted the use of thermophilic digestion processes in achieving the vector attraction and pathogen reduction requirements. These processes are characterized by high operating temperatures (55 – 65°C) and relatively short detention times (6 – 12 days). One process that has been effectively used for sludge digestion at small to medium sized facilities (0.3 to 15 MGD) has been the autothermal thermophilic aerobic digestion (ATAD) process. The ATAD process has been used for over 20 years in Europe and now has 16 full-scale installations in the United States.



Prior to 1996, experience with the dewatering of thermophilic aerobically digested biosolids was limited. The majority of European facilities practiced liquid land application (Schwinning *et al*., 1997). Early reports from Vik and Kirk (1993) showed a substantial improvement in the dewatered cake solids, increasing from 16 to 27% solids content, after switching the digestion process from conventional mesophilic aerobic digestion to ATAD. Later reports indicated that thermophically digested biosolids were difficult and expensive to dewater. Burnett *et al*. (1997) reported that polymer costs for ATAD facilities were between $63 and $121/dry ton. Roediger and Vivona (1998) recommended the ATAD process for small facilities which would not require dewatering due to the nature of the produced biosolids.

However, recent advancements to the conditioning regime of thermophilic aerobically digested biosolids have lead to substantial improvements in dewatering efficiency, solids throughput, and dewatering costs. The conditioning improvement utilizes a metal salt in conjunction with a cationic polymer to promote better and more efficient flocculation. The metal salts include ferric chloride, ferrous chloride, and alum. This conditioning process has been used successfully in full-scale facilities to reduce the overall chemical (metal salt and polymer) cost to between $35 and $60/dry ton while increasing the solids throughput by 25% when compared to conventional conditioning methods.

Inside the ATAD Process

Stabilization is determined by the degree of reduction in volatile solids content of the digested sludge. The ATAD process utilizes an aerobic environment to promote the destruction of organic substances. Since aerobic degradation is an exothermic process, efficient capture of the released heat will result in high operating temperatures with correspondingly high rates of volatile solids degradation. In order to achieve stable autothermal operation, a minimum influent volatile solids feed concentration as well as an efficient aeration, mixing, foam control and heat retention strategy are necessary. Design fundamentals and operating experience of the ATAD process have been discussed elsewhere (US EPA, 1990; Schwinning *et al*., 1993; Schwinning *et al*., 1997).

A combination of temperature and detention time (degrees C x days or °C-day product) has been used to estimate volatile solids reduction and pathogen destruction. A 400°C-day product has been recommended to achieve 38% volatile solids destruction as required by the US EPA (1990), although pathogen destruction can be achieved at lower °C-day products. An increase in thermophilic detention time will also lower the specific oxygen uptake rate (SOUR) of the processed sludge. Therefore, it is generally accepted that a higher °C-day product will result in "safer" digestion performance and design with respect to pathogen destruction and stabilization.

However, there appears to be a strong correlation between the °C-day product of the digestion system and the polymer demand for acceptable dewatering. As shown in Figure 1, the higher the°C-day product in the ATAD reactors, the higher the polymer demand for acceptable conditioning.

This correlation suggested that when operating and designing ATAD systems, the safety factor utilized for pathogen destruction and stabilization should be optimized for plants which are dewatering. Facility optimization may include multiple trains or reactor cooling systems. However, the necessary additional equipment for process control may create unfavorable economics or unsteady sludge digestion operations. Therefore, the use of a cost-effective alternative conditioning process will enable the ATAD technology to continue to be an economically feasible Class A alternative.

Alternative Conditioning Regimes

In December 1997, laboratory trials were conducted to evaluate different conditioners and conditioning regimes to reduce the dewatering polymer demand for ATAD produced biosolids. Experiments were conducted by the plant personnel at College Station, Texas, as well as several polymer manufacturers. An exhaustive screening including combinations of polymer coagulant and flocculants and many polymer flocculants was conducted. However, these experiments did not result in a substantial reduction in dewatering costs. Bench scale trials were then conducted using a combination of ferric chloride and polymer flocculant. Almost immediately, it was observed that the addition of ferric chloride reduced additional polymer demand considerably. Table 1 summarizes the results with the addition of 0.10 lb Fe/lb dry solids. It was also noted that the centrate COD was reduced significantly with the addition of ferric chloride.

As presented in Table 1, there was a significant reduction in polymer demand with the addition of ferric chloride. This polymer reduction ranged from 66 to 97%, with a corresponding reduction in filtrate COD between 53 and 75% when compared with the initial bulk solution COD. Much of the bulk solution COD is represented by organic macromolecules (protein and polysaccharide), and it is thought that these mostly negatively charged organics constituted much of the polymer demand for the ATAD process. The addition of ferric chloride resulted in the coagulation of these organics and their subsequent removal from bulk solution resulting in a reduced additional polymer demand. Similar improvements in reduced polymer conditioning demand were observed when alum was used in place of ferric chloride as the initial conditioner.

Since the original experiments, this alternative conditioning scheme, consisting of an iron or aluminum conditioner in conjunction with a polymer flocculant, has been used successfully at three full-scale ATAD installations.

Table 1. Polymer Demand (Nalco 9909) and COD concentration for Acceptable Flocculation with and without Ferric Chloride Addition

Sample Location	Polymer Demand (no iron) (lbs/dry ton)	Polymer Demand (with iron) (lbs/dry ton)	Initial COD (mg/L)	Filtrate COD (with iron) (mg/L)
ATAD Reactor 1	16	—	7100	—-
ATAD Rector 2	39	—	8400	—-
ATAD Reactor 3	108	26	8600	4000
Holding Tank 1	96	6	3700	1100
Holding Tank 2	66	2	3500	850

Table 2 – Comparison of Full-Scale Systems

	College Station	***Ephrata***	***Princeton***
Current Influent Flow (MGD)	4.2	1.8	1.3
Activated Sludge Process	Plug Flow	Oxidation Ditch	Oxidation Ditch
HRT (hours)	8	24	18
SRT (days)	8 - 12	20 - 30	15 - 20
Number of ATAD Reactors in Operation	3	1	2
HRT (days)	6 - 8	10	18 - 20
Average Reactor Temp. (C)			
Reactor 1	35	56	56
Reactor 2	45	—	45
Reactor 3	58	—	—-
Post-Digestion Holding	Aerobic	Anaerobic	Anaerobic
HRT (days)	25	30	15
Dewatering Method	Centrifuge	Belt Filter Press	Belt Filter Press

Full-Scale Implementation

Currently, there are three full-scale ATAD installations in the United States which utilize the dual conditioning program prior to dewatering. These facilities are located in College Station, Texas, Ephrata, Pennsylvania, and Princeton, Indiana. The ATAD process for each of these facilities is designed for waste activated sludge only, although, as shown in Table 2 and 3, the operating conditions within the liquid treatment portion are significantly different. During the data collection period, the College Station facility was using alum, the Ephrata plant was using ferrous chloride, and the Princeton municipality was using ferric chloride.

Table 3 – Comparison of Conditioning Parameters

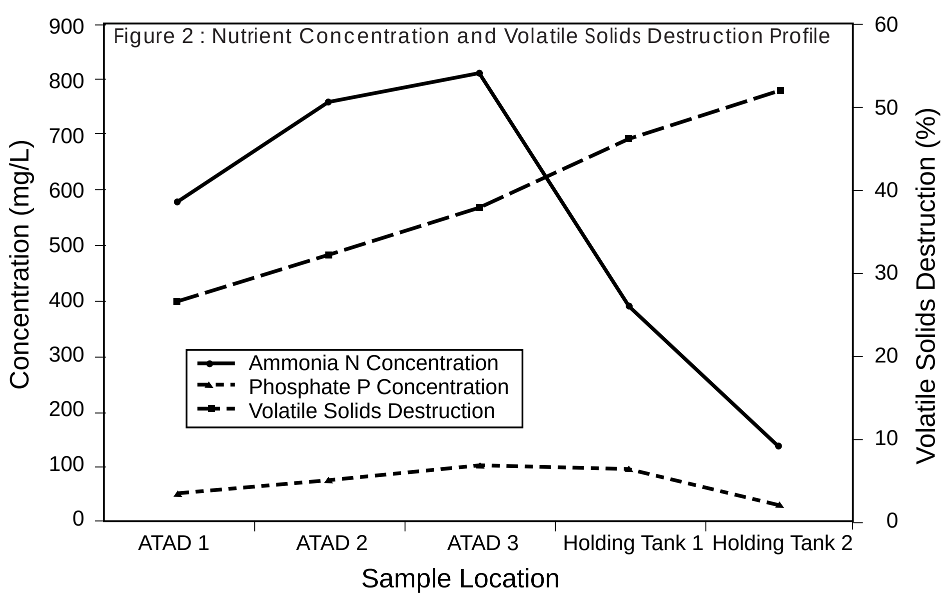
	College Station	***Ephrata***	***Princeton***
Sludge Feed Rate (gpm)	64	125	58
Feed Solids Conc. (%)	2.9	2.9	3
Feed Solids Rate (dry tons/hr)	0.46	0.84	0.44
Coagulant Feed (gpm)	0.113	0.36	0.15
Polymer Feed Rate (gpm)	5	4.1	0.42
Coagulant Feed (lbs Fe/lb solid)	0.04	0.02	0.06
Polymer Feed Rate (lbs/dry ton)	22	20	19
Coagulant Cost ($/dry ton)	9.75	5.80	12.70
Polymer Cost ($/dry ton)	49.50	39.60	31.00
Total Cost ($/dry ton)	59.25	45.40	43.70

College Station, Texas

The College Station ATAD system began operation in November 1995, and was designed to process 3.5 dry tons of WAS/day. The ATAD system replaced a conventional mesophilic aeration digestion process while the existing centrifuge was maintained for dewatering. Other equipment installed during the sludge processing upgrade including a rotary drum to provide the required feed sludge concentration to the ATAD system and an odor control unit consisting of a water scrubber and biofilter. The existing digesters were converted to post-ATAD holding tanks to cool the treated biosolids prior to dewatering.

Shortly after initiating operation, the plant began aerating its post-ATAD holding tanks to mitigate odor concerns. Shortly thereafter, a decrease in polymer conditioning demand was observed during dewatering. This was accompanied by a decrease in the ammonia and phosphorus concentrations and an increase in the vola-

Figure 2 : Nutrient Concentration and Volatile Solids Destruction Profile



tile solids destruction (Figure 2). There was also a reduction in the bulk solution COD concentration (Table 1).

The degradation of volatile compounds releases both ammonia and phosphorus into solution. Due to the high operating temperature of the ATAD process, nitrification will be inhibited. Therefore, as shown in Figure 2, the concentration of both these nutrients increases with an increase in digestion time. However, since the sludge is cooled in the aerated holding tank to approximately 35° C for 20 - 25 days, nitrification takes place resulting in ammonia oxidation. Further sampling indicated a nitrate production and pH depression in the holding tank confirming that a biological reaction, rather than air stripping, was taking place.

The cause of the bulk solution COD concentration profile measured during this investigation is uncertain. Some theories for the increase in COD during the digestion process may include the inability of bacteria to produce the enzymes necessary for degradation of these compounds, or the denaturation of the compounds themselves at high temperatures. The role of iron released during the thermophilic digestion process, and subsequently removed from solution during post-digestion aeration, is currently under investigation and may prove to be an important mechanism.

The College Station facility has some significant loading fluctuations depending on the school calendar of Texas A&M University. When the organic loading decreases during the summer months, the plant personnel operate only two reactors in order to optimize the overall operations of the sludge digestion and handling processes. The plant staff have been able to maintain a polymer cost between $40 and $60/dry ton after optimizing the conditioning system. Since the facility operates the centrifuge for lowest chemical consumption, the target dewatered cake concentration is approximately 14 – 16% and has been consistently maintained.

Ephrata, Pennsylvania

The Ephrata ATAD system began operation in January, 1998, and was designed to process 3.7 dry tons of WAS/day. A rotary drum is used to thicken the feed sludge between 4 to 5% solids content with a belt filter press being used to dewater the digested sludge. Similar to the College Station facility, the Ephrata plant uses an odor control system consisting of a water scrubber and biofilter. The post-ATAD holding tank, designed for 30 days storage, is equipped with submersible mixers.

When the facility first began to dewater the ATAD processed biosolids, the maximum feed rate that could be sustained with acceptable cake quality was approximately 60 gpm. After several months of experimenting with different polymers and mixing configurations, it was concluded that utilizing two polymer injection points would enable the feed rate to the belt filter press to increase to 100 gpm. One injection point was located on the suction side of the feed pump, while the other was located approximately 8 feet upstream of the belt filter press. With the use of ferrous chloride, the solids feed rate was increased to 125 gpm with no change in the dewatered cake characteristics. The facility routinely produces a dewatered cake solids content of between 18 and 20% at a total chemical conditioning cost between $40 and $50/dry ton.

During the evaluation period, samples of the centrate were tested for pH and soluble phosphorus. These results showed a pH between 7.1 and 7.4, and a soluble phosphorus concentration between 4 and 8 mg/L.

Summary

An improved conditioning process has been implemented in three full-scale ATAD installations to reduce dewatering costs and improve overall operations. The conditioning system utilizes a metal salt such as ferric chloride or alum in conjunction with a polymer flocculant. Compared to previously reported numbers, the conditioning cost for ATAD treated biosolids has been reduced by 67% with the cost averaging between $40 and $60/dry ton. This conditioning regime has been successful over a variety of conditions including differing sludge ages, thermophilic detention times, operating temperatures, and digested sludge holding conditions. Similarly, dewatering success has been demonstrated with both a centrifuge and belt filter press.

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Glossary of Common Terms Used in this publication

AWT	advanced water treatment
AWWT	advanced wastewater treatment
AWWA	American Water Works Association
BOD	5-day biochemical oxygen demand
BOD_x	BOD test based on other than 5 days
CBOD	5-day carbonaeous BOD
COD	chemical oxygen demand
CWA	Clean Water Act
DEP	Florida Dept. of Environmental Protection
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FAC	Florida Administrative Code
FSAWWA	Florida Section of AWWA
FWEA	Florida Water Environment Association
FWPCOA	Fla. Water & Pollution Control Operators Assoc.
GIS	Geographic Information System
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
hp	horsepower
MGD	million gallons per day
mg/L	milligrams per liter
MLSS	mixed liquer suspended solids
MLTSS	mixed liquer total suspended solids
NPDES	Nat. Pollutant Discharge Elimination System
NTU	nephelometric turbidity units
POTW	public-owned treatment works
ppm	parts per million
psi	pounds per square inch
RO	reverse osmosis
SCADA	supervisory control and data acquisition
SJRWMD	St. Johns River Water Mangement District
SFWMD	South Florida Water Management District
SRWMD	Suwannee River Water Management District
SWFWMD	Southwest Florida Water Management District
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
USGS	United States Geological Survey
WEF	Water Environment Federation
WRF	water reclamation facility
WTP	water treatment plant
WWTP	wastewater treatment plant

Infiltration and Inflow Reduction — A Program Overview

William Rothman and Ethan Heijn

North Miami Beach is in southeast Florida, where the soil is primarily medium-grain sand and limerock. The groundwater table generally ranges from 3 to 5 feet below land surface. These soil and groundwater conditions, along with heavy seasonal rainfall, make infiltration and inflow (I/I) reduction a priority for sanitary sewer systems. A significant portion of total flow, especially in aging systems constructed of vitrified clay pipe, may be attributable to I/I. A sound I/I reduction program will not only reduce the costs associated with the conveyance and treatment of wastewater flows, it will also provide additional sanitary sewer capacity for future development.

The city's sanitary sewer collection system consists of 10,000 service connections, 1,600 manholes, 75 miles of mostly vitrified clay pipe gravity sewer mains, and 28 lift stations. Wastewater discharged into the Miami-Dade County force main system and transported to the county's regional treatment plant. The county bills North Miami Beach based on the metered volume of flow received.

In early 1996, North Miami Beach began a system-wide I/I reduction program based on a preliminary assessment of the collection system. The assessment showed that of the 28 lift stations in the system, 15 were running at an annual daily average exceeding 10 hours per day.

Night flow studies, conducted between 1 and 5 a.m. when legitimate wastewater flows are at a minimum, indicated that 21 of the 28 collection basins had excessive infiltration. Of a 6-MGD average daily flow, approximately 50 percent was estimated to consist of I/I.

The next task involved a more detailed evaluation of specific problems and prioritization of repairs. The objective was to first identify and complete those repairs that would result in the greatest immediate I/I reduction.

City crews visited each lift station to verify initial findings and identify the conditions underlying reported problems. In the case of lift stations having excessive run times, it was found that six of the stations exhibited mechanical problems, such as worn pump impellers, partially blocked suction lines, and malfunctioning check and gate valves. After performing repairs, further analysis confirmed that the majority of measured night flows at those stations consisted of legitimate wastewater contributions, and the city was able to eliminate these areas from the I/I program. Similarly, the city was able to eliminate two additional stations that were found to be operating at an increased discharge head due to the impact of development in nearby areas on the manifolded force main system.

The city then proceeded with the inspection of all manholes and the installation of inserts in each manhole to eliminate inflow through the rings and covers. Following the insert installation, the city was able to document a significant reduction in inflow. Manhole inspection reports were then analyzed for telltale signs of infiltration, such as deposits of light-colored sand and heavy flows of clear water through the invert. Where such signs were detected, the city traced lines upstream through rear-yard easements and located a total of 20 collapsed main lines, some of which had developed into significant sinkholes. Upon replacement of the collapsed pipe sections, which ranged in depth from 8 to 16 feet below land surface and were completely submerged in ground water, the city achieved major reductions in the rate of infiltration.

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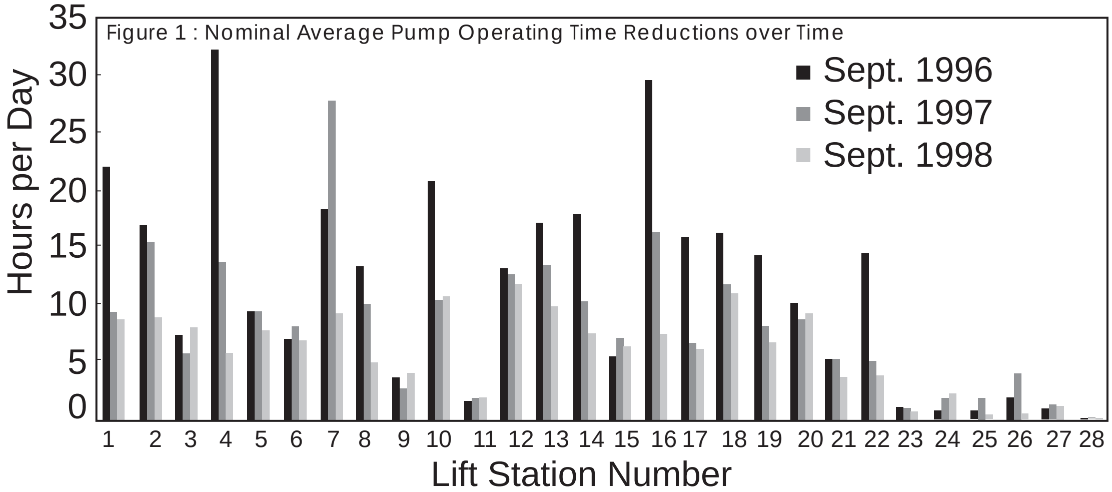
Public Services Director Kelvin Baker (left), Wastewater Division Manager William Rothman, and the Miller crew installing an eight-inch liner.

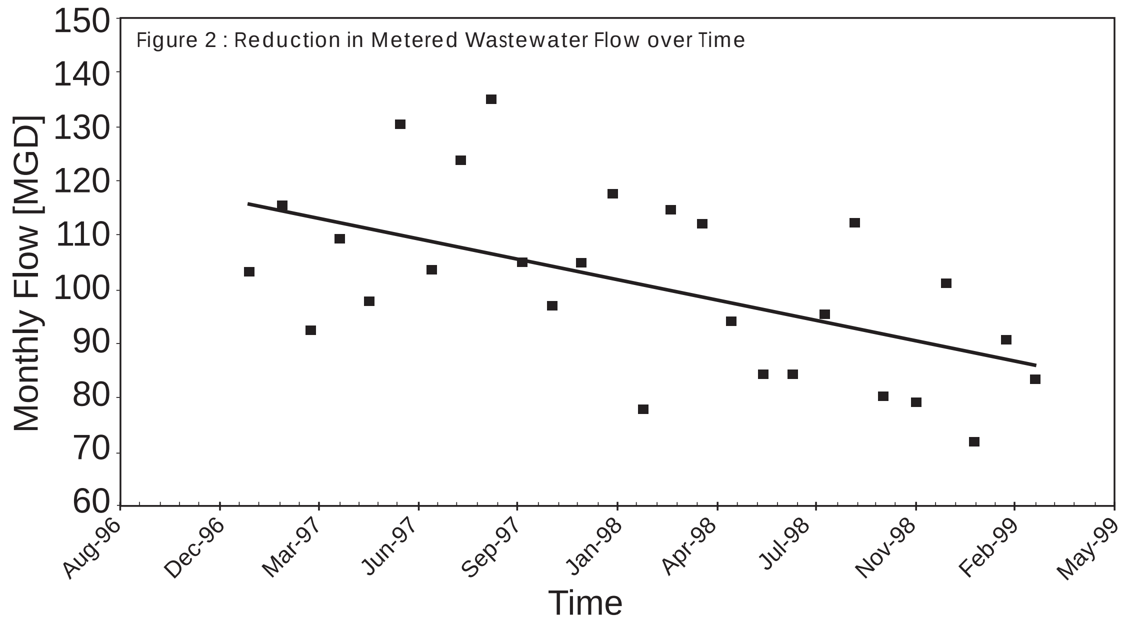
After implementing these measures and completing the high-priority repairs, the city began an intensive closed-circuit television inspection program to evaluate the internal condition of collection system piping. The objective of the program, initiated in 1997, is to videotape 20% of the system each year, and to complete inspection of the entire gravity system within five years. In the television inspection process, the line interior is first cleaned to dislodge grease and debris that might mask infiltration sources. Then a remote-controlled, self-propelled camera is inserted through the manhole into the pipeline, and a video tape recording is made of the entire line segment. City personnel review the video tape to identify root intrusion, cracks, separated joints, leaking service connections, and other sources of I/I. Following the tape review, decisions are made concerning repair methods and priorities.

Smoke testing is conducted in parallel with television inspection to identify sources of inflow such as roof leaders, area drains, abandoned building sewers, leaking service connections, and illegal connections. Smoke testing is preferably performed during dry weather and in low-wind conditions. Public notification and coordination with fire and police departments are performed in advance of the work. An air blower is used to force smoke into the pipes. Inflatable plugs are used to block the sewer sections that are not being tested to prevent smoke from escaping through manholes and adjacent sewer pipes. Observers document smoke coming out of the ground, catch basins, and other sources as the test progresses. While television inspection focuses on the gravity mains, smoke testing is predominantly useful with respect to service connections. The city reviews the smoke test results to identify repair tasks for city personnel and to identify other corrective actions for which property owners will be held responsible.

After videotapes and smoke test reports are reviewed, repairs are prioritized. Early in this process the city evaluated the different categories of system defects and reviewed the various technologies available to accomplish the necessary repairs. As noted, the city used excavation and pipe replacement in cases where the structural integrity of the pipe was badly deteriorated. Excavation and pipe replacement may also be appropriate when pipe is severely misaligned, when only short lengths of pipeline are badly damaged, or when additional pipeline capacity is needed. When piping is shallow, removal and replacement may be less costly than other methods of rehabilitation.

The city also reviewed the available trenchless technologies and decided on formed-in-place liner installation as the best means for rehabilitation of a high percentage of damaged gravity mains.





The Expanded-In-Place pipe lining method offers major benefits over traditional excavation and replacement for high-traffic areas, for deep lines that would require dewatering during excavation, for areas where other utility lines may present conflicts, and for rear-yard easements where gravity mains may run beneath customers' fences, gardens, sheds, and lawns. The city selected the EX Method, an Expanded-In-Place system from the Miller Pipeline Corporation, as that best suited for its system and conditions of installation. The EX Method provides a high-strength PVC pipe that is manufactured to meet all the requirements of SDR-27.5, which exceeds all the requirements of SDR-35 PVC. The material, once installed, meets or exceeds the standards of direct-burial sewer pipe, and it does not depend on the structural integrity of the host pipe. In contrast to methods such as grouting and spot repair, the PVC lining process effectively results in an entirely new gravity main with an estimated life of 50 years.

The Expanded-In-Place liner installation process consists of cleaning and televising the line, removing protruding service connections, and repairing or rerounding partially collapsed sections. Debris is removed from the pipe and grouting is performed as required. The pipe liner is then softened and winched through the existing manhole into the pipe to be reconstructed. Winching continues until the pipe reaches the next designated manhole, and then steam and pressure are applied to expand the liner tightly against the host pipe. Steam is then replaced by air at a constant pressure to allow the pipe liner to cool, after which the liner is trimmed at each pipe end and excess material is removed. The result is a continuous, jointless pipe from one manhole to the next, with only a minimal (approximately a quarter inch) decrease in pipe diameter. After cooling of the liner, the service connections are reopened using a robotic cutting device and a closed circuit television camera, then the services are grouted as needed. A tape is made of the lined pipe for final verification of proper completion. After the preparatory work of cleaning, sealing, and pre-inspection had been performed, the actual lining process could be completed in approximately four hours per pipeline segment, including the re-establishment of service connections. The Miller crew averaged two line segments (approximately 600 feet) per day, with little or no disruption to customers.

The I/I reductions achieved by these repairs contributed in part to the reductions seen in Figure 1, which contrasts lift station annual run times over a three-year period. Figure 2 displays metered wastewater flow over approximately the same time frame and directly indicates the I/I reduction achieved. At present the city is metering an average daily flow of approximately 3.1 MGD, a 48 percent reduction from the 6 MGD average daily flow measured at the start of the I/I reduction program. This reduction is translating into significant financial savings and an increase in available system capacity. ■

Beneficial Use *from Page 22*

To help promote the beneficial use of residuals in Florida, DEP has produced a twenty-seven minute video and a 58-page brochure. Each is intended to inform and educate the general public, agricultural and environmental interests, state and local government, and regulated utilities on the beneficial use of residuals in Florida. The video focuses on residuals as a valuable resource and shows how they are being treated and used in Florida. The brochure contains more technical information than the video and has been widely distributed to the department's district offices, other government organizations, and the regulated community.

Florida Facilities and Title 40 CFR Part 503

While the latest revisions to Chapter 62-640 FAC incorporated many facets of Title 40 CFR Part 503, the revisions did not incorporate all the provisions of the federal rule. Following state regulations does not ensure compliance with Part 503. The state and federal regulations are two distinct rules. Facilities should ensure that they are knowledgeable of their requirements under both rules. Judging from recent EPA enforcement cases, the most common deficiencies of Florida facilities involve record keeping and reporting, including the failure to submit annual reports.

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