GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

No action adv OH

Date: May 15, 1978

Project Title: Study of Wastewater Treatment Plant Problems

Project No: A-2142

Project Director: Dr. T. F. Craft

Sponsor: City of Augusta

Agreement Period: From 4/28/78 Until 5/27/78

Type Agreement: Standard Industrial Research Agreement, dated 4/28/78

Amount: $7,297

Reports Required: Final Report.

Sponsor Contact Person (s):

Technical Matters	Contractual Matters (thru OCA)
Charles D. Phillips City of Augusta Augusta, GA 30903	

Defense Priority Rating: N/A

Assigned to: ASL/EEAD (School/Laboratory)

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- Project Code (GTRI)
- Other

CA-3 (3/76)

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

no action
adv

Date: 7/27/78

Project Title: Study of Wastewater Treatment Plant Problems

Project No: A-2142

Project Director: Dr. T. F. Craft

Sponsor: City of Augusta

TERMINATED

Effective Termination Date: 7/31/78

Clearance of Accounting Charges: 7/31/78

Grant/Contract Closeout Actions Remaining:

X Final Invoice ~~and Closing Documents~~

_ Final Fiscal Report

_ Final Report of Inventions

_ Govt. Property Inventory & Related Certificate

_ Classified Material Certificate

_ Other _____

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Other _____

CA-4 (3/76)

AUGUSTA WASTEWATER TREATMENT OPERATIONS

A Report to:

The Mayor and City Council
City of Augusta, Georgia

by

T. F. Craft, Principal Investigator
W. G. Dodson
H. E. Holcomb
T. M. Wood

July 7, 1978

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Atlanta, Georgia 30332

GTEES

1978

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Georgia Institute of Technology
Engineering Experiment Station
Applied Sciences Laboratory
Atlanta, Georgia 30332

July 7, 1978

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FOREWORD

This document is a report of the work performed in fullfillment of a contract dated April 28, 1978 between Georgia Tech Research Institute and the City of Augusta. The project was directed by Dr. T. F. Craft, Senior Research Scientist, Applied Sciences Laboratory, Engineering Experiment Station, Georgia Tech, who specializes in the wastewater and water treatment area. Mr. W. G. Dodson, Senior Research Scientist, Economic Development Laboratory, is a specialist in municipal organization and management and investigated these aspects of the Augusta arrangements. Mr. H. E. Holcomb, Superintendent, Water Department, City of Cartersville, acted as a consultant to this project, primarily in the area of operations. The design review was carried out by Keck and Wood, Inc., consulting engineers, under the personal direction of Mr. Thomas M. Wood, P.E., Executive Vice President.

I. INTRODUCTION

The City of Augusta operates a water pollution control plant for the treatment of liquid domestic and industrial effluents prior to their release to the environment. The plant in its present form was completed in 1973, but has never functioned in a completely satisfactory manner for any extended period of time. Operations have been characterized by poor quality of effluent and frequent by-passing of the plant, allowing improperly and/or untreated wastewater to flow directly into Butler Creek and thence into the Savannah River.

Such water quality matters are within the jurisdiction of the Environmental Protection Division (EPD) of the Georgia Department of Natural Resources and they have been aware of the situation all along. From time to time they have written to the Mayor and other officials concerning the problems and the need for corrective actions. It is apparently the feeling of the EPD that little (if any) improvement has resulted from these communications or from visits to the site for in-person discussions.

The situation reached crisis proportions during a recent period of operational difficulty precipitated by mechanical problems. Subsequent actions were severely critized by EPD, although later review revealed equipment limitations and other circumstances that restricted the operational alternatives available. This matter was also forceably brought to the attention of the public by the strong, foul odors that persisted around the plant area for many days.

Sensing the suddenly increased urgency of the matter, the Mayor and City Council requested an investigation and review of the entire situation by the Engineering Experiment Station, Georgia Institute of

Technology to determine, if possible, the cause of the problems, and to suggest remedies. There was no consensus among city authorities as to whether the difficulty originated with defects in plant design, faulty construction, poor operation, inefficient organization of the management and lines of responsibility, a combination of these factors, or some other entirely distinct and unsuspected factors.

A wide-ranging investigation has now been carried out. This included a very detailed examination of the plans, O and M manual, reports, correspondence, and other pertinent documents. Several on-site visits were made so that the equipment and plant facilities could be examined first hand, and various individuals could be interviewed. This report sets forth the findings, conclusions, and recommendations that have resulted from this investigation.

II. FINDINGS AND DISCUSSION

The operation of a large wastewater treatment plant is a complex matter, involving many people and a large amount of equipment, and it appeared a priori that the Augusta difficulties would not be attributable to a single cause. It was also recognized that small matters, while in themselves perhaps not very significant, could possibly have much greater influence than was apparent. Interrelationships and their effects were therefore kept very much in mind. For the convenience of the reader this report is divided into various subjects, but the close relationships among them is quite clear.

Plant Design

The following documents were provided for use in review of design for the subject plant:

1. 1969 Primary Facility Plans (68 sheets), Dated August 1966.
2. 1972 Secondary Facility Plans (15 sheets), Dated November 1971.
3. 1972 Plan Revisions, Dated May 1972, October 1972, February 1973.
4. 1971 Secondary Facility Design Data Sheets.
5. 1977 201 Wastewater Facilities Plan (3 Volumes of 6).
6. 1976 Technical Assistance Project Report, EPA

Construction specifications, contract documents, and as-built drawings were unavailable for use in this review. However, reports and observations lead to the general conclusion that existing facilities are in substantial conformity with requirements of plans reviewed.

Persons interviewed concerning design matters during site inspections included the following:

Mr. David Moore, Supervisor of Water Pollution Control
Mr. Vernon Adams, WPC Plant Superintencent
Mr. Henry Dyches, WPC Plant Maintenance Superintendent

The review of design indicates that general approaches, considerations and application of procedures are represented to have been those in normal use at the time and are set forth in Exhibit I. Design flows and loadings were predicated upon an anticipated reduction of inflow and infiltration which is yet to be accomplished and on projected hydraulic and organic loadings already exceeded. A review of comparative unit process design parameters used and those recommended in references indicates a general application of minimums, in some cases even less than minimum as illustrated in accompanying Exhibit II.

The most significant unit processes in which it appears that marginal design parameters were applied include the following:

Aeration Basins - Detention Time

Vacuum Filtration - Dewatering Rate

Furthermore, there is some question of the degree to which the oxidation ditch variation used approaches a complete mix activated sludge system for which design parameters were used. For some reason the NPDES Permit issued by EPD appears to restrict average and minimum plant flows to 22.5 MGD and 28.1 MGD respectively.

There appear to be deviations from 1971 Design Data and final plan preparation with respect to aeration and aerobic digestor facilities in the following instances.

1. Total oxygenation capability was reduced in both facilities.
2. Use of submerged, motorized aeration basin effluent valves for aerator water level control in lieu of motorized effluent weir.
3. Aeration basin side water depth increased with compensating reduction in length of oxidation ditch.

Exhibit I

Plant Design Data - Basic

	Data Per 201	Data Per 1971	Record 1970	Per EPA 1976
Design Year	1995	1995		
Population	203,000	203,000[1]		
Industrial Pop. Equiv.	20,000	20,000[2]		
Total Pop. Equiv.	223,000	223,000		
Flow (Average)	30 MGD	30 MGD	9.35 MGD	23-28 MGD
Flow (Max. @ 1.4xAv.)	42 MGD	42 MGD		
BODs (@ 0.167#.PE)	37,500	37,200[3]	10,000	39,431 (Av.)
Dry Solids (lbs.)	29,090[4]		18,840	

[1] By Augusta Planning Commission for service area.

[2] By ZEL Report 2-5-71.

[3] By WQCB - 0.167 lbs/Cap.

[4] Anaerobic 18,840#, Aerobic 10,250#.

Exhibit II

Unit Process Design - Comparative Data

Unit Process	Parameter	Per 201 Data	Per 1971 Data	Reference Recommended	Reference Source
Primary Settling	Overflow Rate GPD/SF	915	--	800-1200	2
	Detention Time Hours	1.8	--	2-2.5	4
	Weir Loading GPD/LF	16,163	--	15,000	1
Aeration[1]	BODs Loading lbs/1000 CF	45	45	40	1
(for complete mix)	Detention Time Hours	3.46	3.12	3-5	4
Final Clarfiers	Overflow Rate GPD/SF	750	750	800(Max.)	1
	Detention Time Hours	3	3	2	1
	Weir Loading GPD/LF	30,900	30,900	30,000	4
Anaerobic Digestor	Detention Time[2] Days	30	--	30-60	3
	Solids Loading lbs. vss/CF/day	.028	--	0.04-0.1	3
	Volume CF/Cap.	3.3 Gross 2.0 Net	--	2-3	3
	Underflow % Solids	10	--	4-6	3
Aerobic Digestor	Detention Time Days	21	27	10-15	3
	Volume CF/Cap.	1.3	1.17	3-4	3
	Oxygenation Cap. $lbs.O_2/lbs.vss$	1.42	1.42	2[3]	4
Vacuum Filter	Loading lbs/SF/hr.	7		4-7 (Dig.Primary) 3.5-5 (Mixed Dig.) 2 (Activated Sludge)	3

Reference Source Key

[1]Ten States Standards

[2]EPA Technology Transfer - Suspended Solids Removal

[3]EPA Technology Transfer - Sludge Treatment and Disposal

[4]Metcalf & Eddy - Wastewater Engineering, Collection, Treatment, Disposal

NOTES:

[1]For "Complete Mix", Oxidation ditch used purported to "approach" complete mix.

[2]Temperature dependent.

[3]Includes oxygen required to oxidize ammonia produced during carbonaceous oxidation.

Features which apparently result in more significant operation and maintenance difficulties include the following:

1. A single unit mechanical bar screen on plant influent without process unit bypass makes equipment maintenance and repair difficult to impossible without complete plant bypass.
2. The reported hydraulic gradient developed from Chlorine Contact Chamber - Parshall Flume backwater at high flow rates restricts normal plant flow to a practical maximum of 26-30 MGD. At higher flow rates the backwater curve is such that the Final Clarifier effluent trough tends to flood.
3. The reported inability to remove "sugar sand" when aeration system of the grit removal facility is operated results in extra wear and loadings on primary facilities.
4. The reported need to eliminate aeration in grit removal facility results in an excess of organic matter in the grit removed.
5. Apparent heavy oil and grease wastewater components appear to tax the scum and grease removal system.
6. Apparent cavitation problems at activated sludge return pumps result in extraordinary bearing and shaft maintenance.
7. Reported vacuum filter performance has never reached expectations. The best reported sludge dewatering results to date has been about 50% of total daily solids produced (15,000# of 30,000#). This deficiency results in a continual retention and build-up of excess solids within the system.
8. Submerged valve installations result in extraordinary maintenance and repair problems.

More recent developments in the "state-of-the-art" indicate that certain conclusions have been reached which seem pertinent to conditions at this plant.

1. Gravity sludge thickening of aerobically digested sludge has not proven to be very satisfactory.
2. Vacuum filtration of aerobically digested sludge has not proven to be very efficient. Mixing of aerobic and anaerobic sludges just prior to vacuum filtration has been reported to improve results. More realistic expectations from mixed sludges seems to lie in the range of 2-4 lbs/SF/hr.

Other observations seem worthy of mention, including the following.

1. Cavitation of the multiple pot enclosed propeller-type activated sludge return pumps may be related to suction turbulence and/or varying suction and discharge head conditions.
2. Improved reliability of control and instrumentation systems was reported since the systems were placed under maintenance contract.

There are plant deficiencies enumerated in the 201 Wastewater Facilities Plan which relate to more recently established facilities reliability considerations set forth by the Environmental Protection Agency.

It is reported by plant personnel that equipment breakdown is a continuing problem. This may be due to the initial selection of components that are barely adequate for their intended operation, although the problem is no doubt compounded by insufficient maintenance. The availability of minimal overall capacity allows little flexibility in the operation of the plant. There is no reserve capability to utilize in times of shock loading or emergycy conditions. Clearly, all components of the plant must be functioning to provide satisfactory treatment, and when some part is inoperative, the load cannot be carried. In general, one assumes that a newly constructed municipal plant will begin operation at a level of loading well below design capacity. This allows the staff to become familiar with the details and eccentricities of the particular plant, so that gradually increasing loads can be handled on a routine basis. This was not the case at the Augusta plant. The initial loadings were high, and expected reductions were not made. It actuality, the loadings have increased.

In addition to the more significant factors, there are a number of items that make for less than optimum operation. For instance, it

was pointed out that certain valves were located and/or installed so that their operation and maintenance is more difficult than it might have been. Such small items do not appear serious enough to warrant change but relatively minor adjustments and adaptations can be helpful.

Management Organization

The ultimate responsibility for all municipal affairs lies with the Mayor and City Council. The Water Works Committee of City Council has responsibility for matters pertaining to water and wastewater. Technical aspects of water and wastewater are under the authority of Mr. James Messerly, City Engineer and Commissioner of Public Works. Answering to Mr. Messerly is the General Superintendent of Water Works Operations, Mr. Fred Gary. Reporting to Mr. Gary is Mr. David Moore, Supervisor of Water Pollution Control.

Mr. Gary is apparently exceptionally well qualified in the water area due to his technical knowledge and long experience. However, his considerable expertise does not extend very far into the field of wastewater treatment, and he is unable to be of much assistance with technical problems at the operational level. Mr. Gary receives budget requests from Mr. Moore and passes them along with his own requests concerning the water area. Messrs. Moore and Messerly already work directly on major wastewater projects and problems, and it appears desireable to relieve Mr. Gary of the wastewater burden and have Mr. Moore report directly to Mr. Messerly.

Activities at the plant site are under the general supervision of Mr. David Moore, Supervisor of Water Pollution Control, with Mr. Vernon Adams, Plant Superintendent, in immediate control of operations. Two years ago Mr. Moore was placed in this important but exceptionally difficult position. He was familiar with the plant through having written the O amd M manual, but had no hands-on experience with wastewater treatment plant operations. Inexperience was a trememdous handicap as he was expected to direct the activities of the Plant Superintendent, an older

man of wide experience. Mr. Moore has certainly made great strides in the period he has been at the plant, and has become knowledgeable about wastewater treatment in general and this plant in particular through long hours and much effort.

It is believed that having Mr. Moore in direct daily charge of operations would be advantageous. Given time and full backing from upper mangement levels, he could institute changes, issue directives, and see personally that things are done without having to work through another layer of responsibility. If he can bring about the needed changes in the plant and its operation, in the long term he should be able to turn daily affairs over to a new operations supervisor, and devote his efforts to the broader aspects of water pollution control for the City of Augusta. At some point his title should probably become Superintendent of Water Pollution Control, to signify the recognition by City Council of the importance of wastewater matters in the scheme of municipal affairs.

External Appearance

On approach to the Augusta Waste Water Treatment Plant, one becomes aware of a foul odor, one that is not typical of well-functioning wastewater treatment plants. The odor did not appear to vary during the period of our visits to the plant, and it is not possible to say if this is a generally continuing characteristic of the plant. The buildings are of pleasant industrial design, and the layout of the outside equipment and appurtenances is quite acceptable in appearance. Closer examination, however, showed that the shrubbery around the front was in need of trimming, weeds were in evidence around the shrubbery (also in joints in concrete walls, walks, and drives all around the yard), and the grass needed

cutting. Many of the painted metal structures are beginning to show rust. Some below-grade piping has been modified, but remains in an open hole in the ground, and needs to be bricked into a substantial pit. One outside door of the building housing the vacuum filters is bent, and the glass which was in the upper part of the door is missing. It was reported that this door has been in this condition since January 1978. There was a considerable amount of sludge on the driveway in the area where trucks receive dewatered sludge from an overhead conveyer. Around the bar screen area at the head of the plant it was noted that there were strings and rags hanging from various projections, and a large metal access door on the bar screen structure was hanging by a single hinge. Overall, one gets a feeling of decay and neglect about the plant site.

It is to be noted, however, that none of these appearance items necessarily have any bearing on the actual mechanical operations of the plant, but they strongly suggest that something is wrong. It is also very poor public relations, as few casual observers would believe the plant could possibly be doing a good job if it does not present an outwardly neat and clean appearance. Perhaps even more important, however, it is the effect that an improved outward appearance should have on the morale of plant personnel.

Care of the yard need not be an excessively time consuming task, particularly if distributed among the operators. At least a part of the job could be assigned to the evening shift, as daylight is available for many hours of this shift during the warm seasons when most outside work is needed. The investment of a few man-hours per day in painting operations should soon bring a brightened look to the whole place.

Operations

The interior of the plant is an extension of the exterior in appearance. The office area is at least moderately maintained, but the working areas need immediate and continuing attention. The chemical mixing room in the filter building was filthy, and the chemical storage area left much to be desired. The floor and walls of the filter room were splashed with sludge that had dried. The chlorine feed building had a bird's nest under the roof of the open area and there was litter on the floor. Clearly, there has been a laxness in the operation of the plant that has led to difficulties. It is fully recognized that the job requirements for wastewater treatment plant operation are not 60 minutes out of every hour. However, some significant effort is needed on a continuing basis, and plant personnel should not be in the lunch room for a sizeable portion of each hour. Maintenance, for instance, seems to have suffered excessively and perhaps unnecessarily. While there are individuals whose specific assignment is maintenance, they cannot be expected to handle all the daily details. It should be the responsibility of the operators to keep equipment clean, free from accumulation of dirt or other material, lubricate items that need continual oil or grease replenishment, and to inspect all moving parts for signs of possible failure. The maintenance specialists have their hands full with repair of broken items, and the performance of the more complex and time consuming maintenance routines that may be needed on a weekly, monthly, or more extended schedule. The maintenance department has had difficulties on its own—much of it due to lack of an adequate inventory of spare parts. It is known that suppliers often quote extended delivery periods,

but it is felt by some that city purchasing procedures are not very rapid. Whatever the cause, it is reported that there is provision in the new budget to remedy at least a portion of the deficiency. It is further noted, however, that in cases of emergency, items have been bought by the purchasing department when required, even though budgeted funds were not available. Contingency funds have been used in such cases.

An additional problem is the lack of proper storage space for spare parts. Miscellaneous areas around the plant could be utilized until such time as a proper building can be constructed. Some temporary relief could be obtained if the steel shelving in the present maintenance store room was extended to the ceiling and a ladder installed. Small and light weight items could easily be kept on the higher shelves.

An appreciable amount of the repair work particularly on large pieces of equipment, requires the services of outside contractors. This could be reduced if even limited machine shop facilities were available. It is probably not worth while to plan an extensive facility which would involve more money, space, and trained personnel. If a lathe could be obtained at low cost, however, it should be a valuable asset. Such items are occasionally available through Federal Surplus, and can be obtained by municipalities at very low cost. The possibility of getting work done at the central City of Augusta machine shop should also be considered. A significant saving in both time and money could result. One specific need at the treatment plant is for a portable arc welder that could be used throughout the plant. At present, a contractor is called when such work is required.

Maintenance activities could also be facilitated by the acquisition of a hoisting device for removing the return activated sludge pumps

and for lifting other heavy pieces of equipment. The installation of catwalks and ladders on some of the elevated structures would provide better access.

The anaerobic digestors are not significantly producing methane gas, and it is believed that this situation has existed for 3 or 4 years. At present one of the three digestors has been drained as far as possible, but still contains sand and other settlings to an estimated depty of 8 to 10 feet. The second digestor is used as a holding tank, and the third is operational, after a fashion.

Problems with the anaerobic digestors are costly in that improperly digested sludge is more difficult to dewater, and no useful gas is generated. Under these circumstances it has been necessary to purchase natural gas at a cost (last year) of $49,000. If the digestors were operating as designed, only gas for heating the buildings would have to be purchased.

The exact cause of digestor dysfunction is not known, but there is no doubt an accumulation of sand in all the digestors which greatly reduces the useable volume. A widely-held opinion regards toxic components of industrial wastes as the culprit. If this is indeed the case, the inflow of toxic and/or inhibitory materials will have to be stopped before any improvement can be expected. A study of the situation should be made to determine if waste now entering the plant is amenable to proper digestion and if there is any practical way in which the digestors can be brought into full, normal operation without the trouble and expense of cleaning. At present, there is no assurance that emptying and cleaning the digestors will enable them to begin operating in the desired manner.

Regulations for the disposal of wastewater are set forth in City of Augusta Ordinance No. 4446 as amended by Ordinance No. 4583. It clearly establishes what may and may not be discharged to the sewers, and it is apparent that the ordinance is not being enforced. Available analytical reports on industrial wastes as detailed in Exhibit III show that the provisions of the ordinance are seldom being met. High levels of metals, phenols, cyanide, grease and solids along with wide fluctuations in pH make biological treatment very difficult if not impossible. There can be serious interference with settling in primary and secondary clarifiers, with the effectiveness of aeration, and with sludge digestion. At present, contributors are charged only for BOD and suspended solids that exceed the established maximums, and no penalties are being invoked for violation of other limits.

It is understood that some industrial customers are exempt from provisions of the ordinance, but if their wastes are found to be deleterious to operation of the treatment plant, their exemption should be revoked. Closer contact with industrial customers may educate them to the needs and problems of the treatment facility and result in better cooperation on pretreatment and accidental spill control. A program of periodical analysis of industrial effluents is needed. An independent laboratory would be required, as the plant laboratory is not equipped for some of the more sophisticated analyses that are needed. It is also to be noted that the surcharge for extra strength waste seems low. The charge should reflect not only operation and maintenance costs, but capital costs as well.

It is understood that consideration is being given to the installation of sludge drying beds. While drying beds would provide a place to safely

Exhibit III

Characteristics of Industrial Waste
Asterisks indicate values outside allowable range
or above maximum allowable.

Contributor / Parameter	Range or Maximum Allowable (1)	Augusta Coca Cola	Augusta Chemical	Augusta Plating	Borden	Buckeye	Castleberry's	Enterprise Division Grainteville Co.	E-Z Co.	Kendall Co.	King Mill	Lily Tulip	Mid South Container	Monsanto	Murray Biscuit	National Linen	Ponderosa	Proctor & Gamble	Rental Uniform	Sibley Mill	Southern Wood Piedmont	Transco
pH	6.0-9.0	11.5*	8.8	6.7	4.8*	6.4	4.9*	6.4	5.7*	10.0*	11.2*	6.8	3.9*	9.3	4.5*	10.2*	7.1	7.5	10.8*	6.2	4.6*	7.2
BOD	200	357*	992*	17	571*	90	580*	476*	441*	424*	326*	120	526*		1448*	421*	803*	550*	431*	385*	1109*	
TSS	200	55	79	101	202*	25	378*	451*	214*	141	86	270*	5540*		2797*	498*	1604*	180	1153*	115	2280*	
Grease, Oil	100				117*	165*	535*	154*	190*	119*		109*		240*	132*	297*		208*	654*	170*	556*	140*
Cadmium	5.0			0.08				0.02	.008		.027	0.08									.03	
Chromium	3.0		0	26*				0.2	.075		.08	0.1								0.2	.068	
Copper	3.0		0	0				0.25	0.4		.25	.12									0.03	
Cyanide	0.0		0	7.5*				0.07	0			0.112*										
Nickel	0.1																					
Silver	5.0																					
Tin	5.0																					
Zinc	3.0		0					0.6	0.05			0.21										
Phenol	0.5							0.13	0.05	2.1		0.7		3.5*				0.2		0.3	0.6*	
Flow - thousand gal/per day		131		80		8	217	517	184	212	2192	185	148	15	471	---	3350	225	809	722	92	2753

[1] All values expressed in mg/l except pH.

discharge part of one digestor, it does not appear to offer a long-term solution to the problem. As the situation now stands, it is not known exactly how the partially filled digestor can be emptied, although a fire hose may break up the solid (or semi-solid) residue to the extent that it can be pumped either with the installed pumps or with an auxiliary unit. Flowing material could then be disposed of by several means, including lime stabilization and placement on drying beds to be removed when sufficiently dried.

The sludge dewatering capacity of the plant is insufficient, under present conditions, and probably would be, even if the vacuum filters were operating at maximum efficiency. Some of the lessened efficiency is due to the type and condition of the sludge, and some to possible operational factors such as the type and concentration of filter aid being used. A well-digested sludge dewaters more readily, particularly when treated with an effective filter aid in optimum quantities. The use of a test device should be helpful in determining optimum filter aid and dosage. It therefore appears that solving the problem of the anaerobic digestors would improve the filtration situation. Other means of increasing dewatering capacity would be to add additional dewatering equipment such as a belt press, centrifuges, drying beds, or more vacuum filters. Capital costs would be high for any of these selections, and energy costs for centrifuges are quite high. Drying beds normally are cleaned by hand, or light mechanical equipment. The lack of willing laborers and/or lack of protection from the elements has led to abandonment of existing beds in a number of instances.

There is, however, another possible solution to the problem of inadequate dewatering capacity. Land application in some instances

has been found to be a very satisfactory, cost effective means of disposing of stabilized sludge. This process eliminates the need for dewatering and involves transfer of stabilized (digested) sludge directly to a tank truck for transport to a location where it is spread on the surface, or injected at appropriate crop depth into the soil. Some sludges have considerable fertilizing value and may be sold or given to farmers located within easy trucking distance. The cost of soil injection equipment, tank trucks, and the installation of any needed tanker loading facilities would probably be considerably less than the cost of any of the above-mentioned alternatives.

In the aeration basins and aerobic digestor, the rotor drives are installed in sumps, which have been provided with shields to prevent their filling with process liquid. These sumps have drains installed to prevent accumulation of water. In several locations these drains were stopped up, and continuing problems with such stoppages is reported. There are mechanical problems with the gear boxes, and frequent inspection is needed. This is not likely to be provided if the operator has to wade through ankle-deep water to get to the equipment. It appears that there should be sufficient expertise on the staff to get these drains cleaned and to keep them open.

The major cause of the foul odors associated with the plant appears to be a deficiency of oxygen in the secondary section. The imposed load of organic matter is greater than can be accommodated, particularly with some of the aeration equipment out of operation. An increase in oxygenation capability should essentially solve the problem. Any available compressors or blowers might be used with a makeshift pipe and hose arrangement on a temporary basis to provide additional oxygen until such time as permanent arrangements can be made.

Personnel

The Maintenance Superintendent, Mr. Henry Dyches, is seemingly well thought of by all who know him. He is technically very competent but cannot possibly do the needed job without better help. His chief assistant is capable, but others on his staff share the general low morale of the plant personnel and exhibit no enthusiasm and little interest in gaining increased competence. The value of an effective maintenance program, including preventive maintenance is apparently not appreciated based on relative salary levels. It is believed that the position of Maintenance Superintendent should be brought into the range of the chemist and Operations Superintendent.

The chemist is very inexperienced and obviously needs much guidance. He does not appear to really understand the concepts of plant control by the laboratory and has poor general knowledge about water pollution control or the Waste Ordinance of the City of Augusta. Little time is invested in training laboratory assistants. The laboratory is in need of a strong leader.

The number of employees is sufficient, but the quality of personnel is really unknown due to the rapid turnover. The present staff appears to have potential and could probably do a very satisfactory job if they could be retained long enough to be trained and certified.

Interviews with individuals and with groups of employees revealed that they are not informed about plant policies, fringe benefits, or safety regulations. The general feeling is that the plant is a place to work until something else comes up. There were several complaints about the odor and the long distance from town. They have a very poor

image of themselves and feel that they are working in a place the city fathers think is a losing proposition and would abandon if it were at all possible. It is regarded by some as the last, lowest, final step for city employees who have not been acceptable in other departments. Salaries are very low, and even foremen or others who have made some advancement are still below the minimum paid by nearby industrial concerns. The rapid turnover of personnel is a strong indicator of the low morale that permeates the staff.

Discipline has been a problem in some instances in the past, with employees refusing to perform assigned tasks. All employees who do not follow the reasonable instructions of their supervisors should be subject to prompt suspension or dismissal.

Some specific problems that surfaced include the retirement system which does not allow older employees to participate. The uncertainty of pay day and the amount to be received is an annoyance mentioned by some personnel. This seems to arise from the manner in which the bookkeeping is done and the shift assignments of the employees. There is definitely a need for each individual to know what he/she is to receive and the day on which it will be received. It is not known whether this is a significant matter or not; the payroll people were not aware of any problem. It may be that a full explanation of the pay policies and procedures would relieve the situation.

It appears that the plant is in need of strong, consistent supervision. Each individual should be told exactly what is expected, and his/her achievements and activities should be monitored. Policy matters should be clearly explained to everyone, and the penalty for failure to follow established rules and procedures should be made known. Any

who find themselves unable to cooperate with the spirit as well as the letter of the regulations should be dismissed, as their presence can only spread dissent among the balance of the staff. But if there are penalties, there should also be rewards for those who excell. It appears that the salary scale is below what many smaller municipalities offer, and should be revised upward. It was noted that typically 5 or 6 employees may be eligible for food stamps, which further accentuates the need for increases. Additionally, there should be some tangible reward for achieving each level of certification. The present system of sending employees to the Georgia Water and Waste Water Institute for short courses is commendable, and should be continued, perhaps on a somewhat increased scale.

The Georgia Water and Pollution Control Association is composed of those interested or active in the water/wastewater industry, and employee membership should be encouraged. Maximum benefits of membership accrue to those who attend the annual state-wide conference or some of the smaller district meetings that are held several times per year in a number of locations. The latter are often most useful for those in operations, as it allows good personal contact in a group of perhaps 20 to 50 with others similarly situated from nearby towns. The typical format is that of an evening meal followed by a short technical presentation on a pertinent subject. A $10.00 expense allowance would probably cover the meal and nominal travel involved, and it should be a very worthwhile investment to allow some employees to attend each of these meetings. For those at the mamagement/surpervisory level, attendance at the state-wide annual meeting is likely to prove more valuable. A

diversity of topics is covered in the technical sessions, and the contact with others in the industry may provide a new perspective on one's own situation.

Several things can be done at negligible cost and effort that may help improve morale. A regular program to spread information on plant policies, fringe benefits, current problems, achievements (or lack thereof), and other matters of general interest should be instituted. It would be desirable to have a representative of the city personnel department visit the plant and explain such matters as fringe benefits, insurance details, and relevant city policies. An occasional visit to the plant by the mayor and various council members might convey the idea that water pollution control is a subject of interest and concern to the leaders of the city.

Recommendations

1. Assign priority of interest to coping with this problem, be impressed with the importance of the plant within the socio-economic-political arena and improve the image of those associated with it.

2. 1. Get facilities into full operational status
   a) Repair or replace inoperative units
   b) Provide spare parts inventory including
      (1) complete aerator assembly in separate units
      (2) return activated sludge pump rotating elements and bearings
      (3) convey or belting, rollers, guides and bearings
      (4) WW pump rotating elements and bearings
      (5) vacuum filter auxiliaries
   c) Start anaerobic digestors with cleaning if required, disposing of contents in most acceptable manner

   2. Establish and carry out preventive maintenance program
      a) Inspection
      b) Lubrication
      c) Cleanup
      d) Painting

   3. Reduce plant loadings to reestablish balanced treatment processes
      a) Minimize plant flow initially
      b) Gradually bring plant flow to maximum capacity while meeting NPDES permit requirements on effluent

   4. Reduce plant loadings to minimum on permanent basis
      a) Infiltration and inflow elimination
      b) Sewer use ordinance enforcement

   5. Expend facilities as finally determined to be necessary
      a) Solids handling and disposal
      b) Aeration capability

3. Revise line of authority so that the Supervisor of Water Pollution Control answers directly to the City Engineer.

4. Place the Supervisor of Water Pollution Control in direct daily charge of plant operations.

5. Combat odor problem by increasing oxygenation capacity of the secondary section of the plant.

6. Consider land application of sludge as an alternate to present vacuum filtration/landfill operation.

7. Elevate morale of personnel through an increase in salary, rewards for achievmeent, and other actions to convince the employees that they and their jobs are important to the community.

8. Establish levels of competence for the chemist and allow time for their achievement. Reevaluate the laboratory situation at frequent intervals.

9. Reevaluate the entire situation in a few months, and if needed, at intervals thereafter.