

CASE STUDY - A Tale of Two industries
Pretreatment of Confectionary and Bakery Wastewaters

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ABSTRACT

Through a combination of waste minimization, by-product recovery, and wastewater pretreatment, waste management practices were improved at two bakery/confectionary facilities. This paper presents a description of these activities and relative performance data.

As a result of more stringent enforcement of the local sewer Authority's pretreatment program, one confectionary and one bakery facility implemented waste management programs. The first facility manufactured candy in a converted factory. Wastewater data was limited, resulting in a need for wastewater characterization. The characterization data illustrated the impacts of poor housekeeping practices on the total wasteload. Housekeeping modifications were implemented, reducing the wasteload and flow by over 50 percent. A biological pretreatment system was constructed consisting of influent screening and pumping, nutrient addition, biological oxidation, secondary clarification, and flow monitoring. The plant was designed for construction by plant personnel and had a design life of 5 years.

At the second facility, there were two main sources of oil and multiple sources of BOD and TSS. Inplant treatment systems were designed to recover coconut oil and lard. A biological treatment system, consisting of influent screening and pumping nutrient addition, biological oxidation,

secondary clarification, and waste sludge storage was designed and constructed.

INTRODUCTION

The Clean Water Act Amendments of 1987 place greater emphasis on water quality. As a result, municipalities will face more stringent discharge limits while competing for diminishing construction grant funds. Many publicly owned treatment works are at or near capacity. Pretreatment program enforcement offers an option for increasing capacity with limited capital outlay.

In 1986, the Macon-Bibb County Water and Sewer Authority (MBCWSA) faced similar circumstances. MBCWSA had not historically enforced its pretreatment program, and was at risk of losing Federal construction grant funds for third phase treatment plant expansion. To gain Federal funds for expansion, the MBCWSA was required to enforce its industrial pretreatment program. Area industries were required to provide pretreatment within a very stringent time frame. Two industries, Tom's Foods, Inc. and Keebler Company, were targeted to initiate pretreatment. Both had similar wastestream characteristics and treatment needs.

Tom's Foods, Inc. manufactures candy at its Macon facility. The facility generates a wastestream with a high BOD (primarily sugars) and low pH (a combination of naturally low pH well water and citric acid). Until 1986, the wastewater was discharged untreated to the Poplar Street WWTP. Sampling conducted by the MBCWSA in late 1985 and early 1986 indicated five permit violations for pH, three for BOD, and one for oil and grease (O&G).

The Keebler Company bakes crackers and cookies at their Macon facility. Approximately 75 percent of the facility's products are crackers, and the remainder are cookies. Until 1986, the wastewater was discharged untreated to the Rocky Creek WWTP. The Keebler facility had a history of O&G and pH permit violations. A variety of O&G controls had been installed over the years with only limited success.

Pretreatment systems were designed and constructed for each facility. However, two very different approaches were taken. One system was designed with a 5 to 10 year life, and construction was the owner's responsibility. The second system was designed with a 20 year life, and a contractor was hired for construction.

This paper presents:

1. The regulatory setting
2. Wastestream characterization data
3. Waste minimization and by-product recovery alternatives
4. End-of-pipe treatment alternatives
5. Construction aspects
6. System startup and operational aspects
7. Performance criteria

REGULATORY SETTING

MBCWSA owns and operates two WWTPs serving Macon and Bibb County. WWTP modifications to increase capacity were being completed in three phases; the second phase was underway. The Authority was notified by the Georgia Environmental Protection Division that third phase funding would not be available, and that pretreatment program enforcement was needed.

In April 1986, MBWCSA notified selected industries with significant wasteloads that pretreatment program compliance would be required by January 1, 1987. Service would be discontinued for non-complying industries. Tom's Foods Inc was included with the first group of industries notified in April. Keebler Company was notified with the second group of industries during the fall of 1986. The Authority established new pretreatment limits shown in Table 1.

Table 1
REVISED PRETREATMENT LIMITS

<u>Parameter</u>	<u>Concentration (mg/l)</u>	
	<u>Surcharge Limit</u>	<u>Maximum Limit</u>
BOD	250 ¹	1,000
TSS	250 ¹	1,000
O&G	--	100

¹Surcharge starts.

While there was some resistance to installing pretreatment systems, the targeted industries were primarily concerned with the 6 month compliance schedule. Public meetings were held with MBCWSA, but compliance schedule changes were not made.

WASTESTREAM CHARACTERIZATION DATA

Both Tom's and Keebler had installed parshall flumes to measure wastewater discharge to the sewer prior to receiving the notification letters. However, wastewater quality data was limited to monthly monitoring data (mostly grab samples) collected by the MBCWSA.

An intensive wastestream characterization effort was conducted at Tom's. Inplant samples were collected to evaluate waste minimization and/or at-source treatment alternatives. Combined samples were collected to evaluate end-of-pipe treatment alternatives.

Combined wastestream samples were collected at Keebler to evaluate end-of-pipe treatment. Inplant wastestream characteristics were assessed qualitatively, rather than quantitatively. Table 2 summarizes the wastestream characterization and current operating data for both plants.

Table 2
WASTESTREAM CHARACTERIZATION AND CURRENT OPERATING DATA

Parameter	Tom's Foods, Inc. ¹				Keebler Company ³			
	Design Basis ¹		Current Operating ²		Design Basis ³		Current Operating ⁴	
	(mg/l)	(lb/d)	(mg/l)	(lb/d)	(mg/l)	(lb/d)	(mg/l)	(lb/d)
Flow (gpd)	75,000		47,000		51,200		37,000	
pH	--		6.2		5.6		6.0	
TCOD	2,700	1,690	4,560	1,787	1,620	690	830	256
SCOD	1,800	1,125	1,690	662	--	--	290	89
TBOD	1,600	1,000	2,380	933	891	380	500	154
SBOD	1,200	750	970	380	--	--	175	54
TSS	600	375	2,950	1,156	756	322	--	--
O&G	170	110	66	26	285	122	--	--
TKN	5	3	13	5	--	--	2	0.6
PO ₄ -P	1	0.6	5.5	2	--	--	3	0.9

¹ May 1986 to July 1986

² June 1988

³ Historical pretreatment program monitoring data

⁴ August 1988

WASTE MINIMIZATION AND AT-SOURCE TREATMENT

Tom's Foods. Inc.

Based on historical data collected prior to the waste-stream characterization, poor housekeeping practices were found to be a major source of the wasteload. Waste materials were washed to the sewer rather than collected for dry disposal. Batch kettles were not scraped thoroughly before washdown. One specific production process generated a large volume of waste starch which was washed to the sewer during cleanup. A large volume of noncontact cooling water was also being discharged to the sewer.

A waste minimization program was initiated to reduce the wasteload and flow by improving housekeeping practices and redirecting noncontact cooling water from the sewer to a nearby receiving stream, respectively. Greater emphasis was placed on dry rather than wet cleaning. Wasteloads and flows were reduced by over 50 percent as a result of these efforts. Table 2 presents the waste loads after better housekeeping practices were implemented.

Keebler Company

Housekeeping practices at the Keebler facility were not a major waste source. However, two areas in the plant, the oleo/lard storage area and the coconut oil spray machines, generated large quantities of oil.

At-source treatment systems were designed and installed to recover the waste oil prior to combining with wastestreams from the other processing areas. Each oil recovery system consisted of a wastewater collection tank, a recovered oil storage tank, a belt skimmer, and associated transfer pumps. Figure 1 presents a process flow diagram of the oil recovery systems.

END-OF-PIPE TREATMENT

Waste minimization and at-source treatment reduced wasteloads but would not consistently meet MBCWSAs pretreatment requirements. Several end-of-pipe process alternatives were evaluated, and conventional activated sludge treatment was selected for both facilities. Unit processes included screening, influent pumping, biological treatment, secondary clarification, nutrient addition, sludge storage (Keebler only), and effluent monitoring. Figures 2 and 3 present the process flow diagrams for Tom's Foods, Inc. and Keebler Company, respectively. Alternative design approaches were

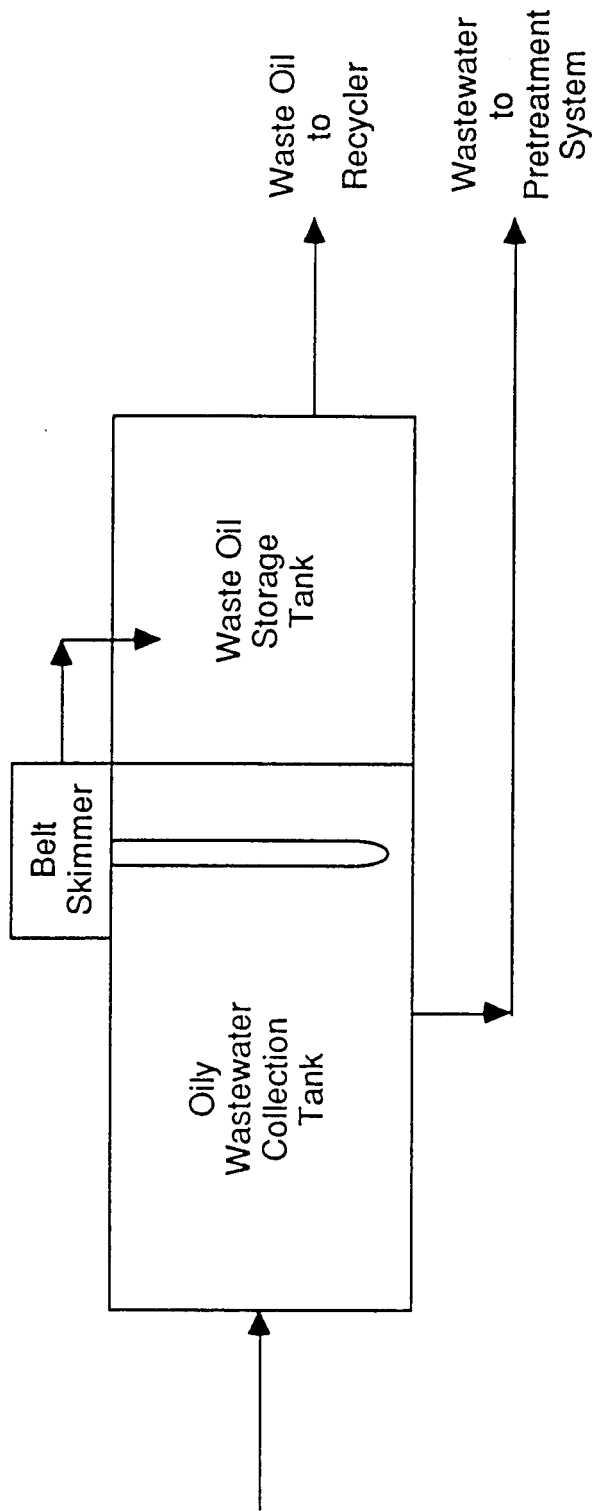


Figure 1. Keebler Company Oil Recovery Process Flow Diagram

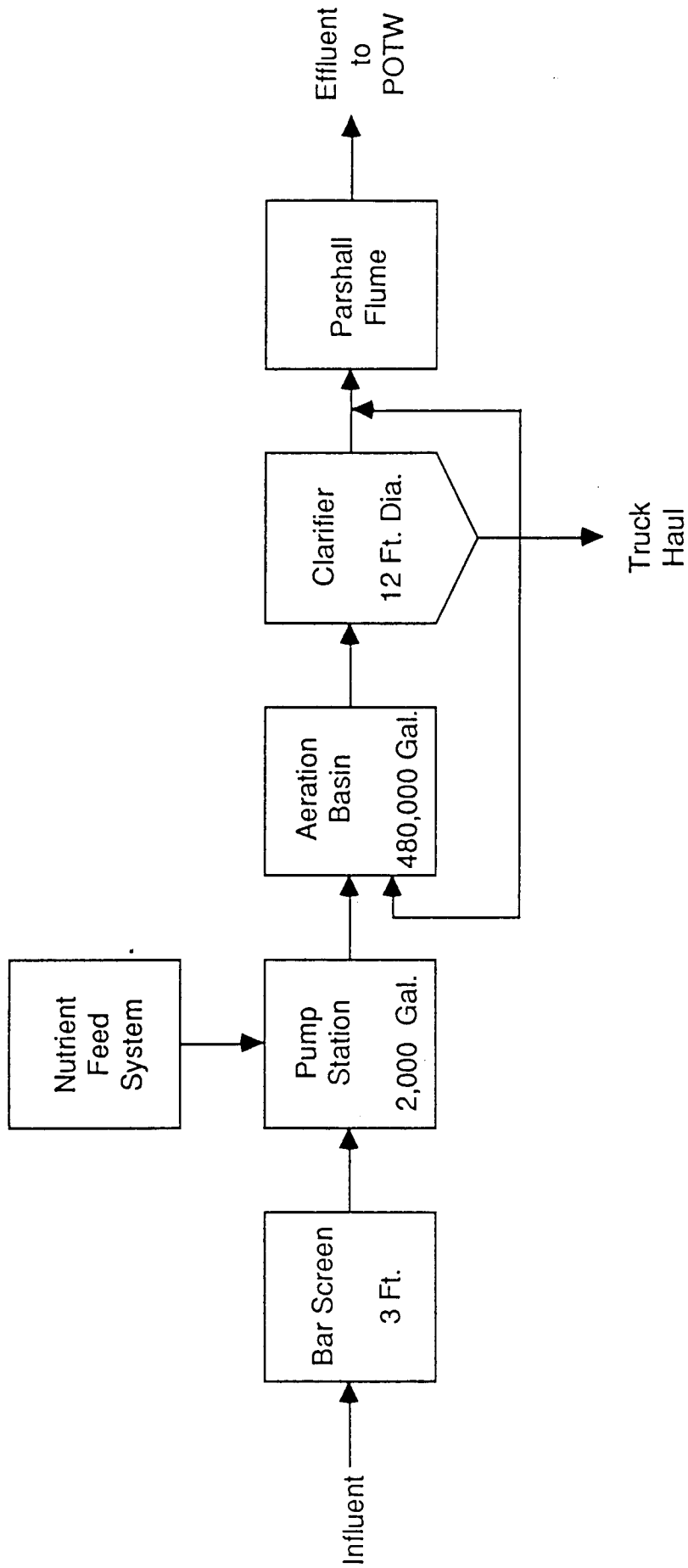


Figure 2. Tom's Foods, Inc. Wastewater Pretreatment System
Process Flow Diagram

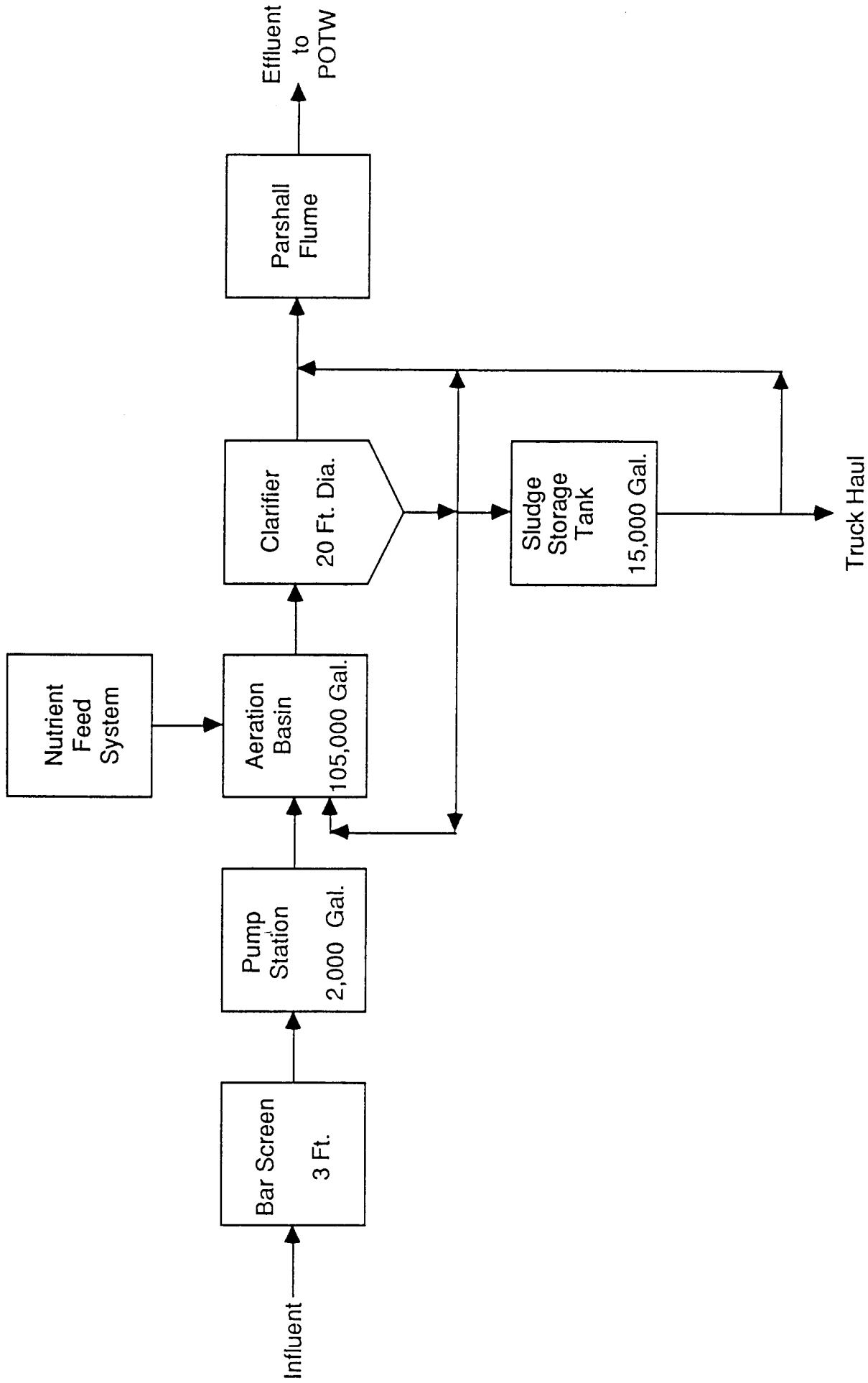


Figure 3. Keebler Company Wastewater Pretreatment System Process Flow Diagram

implemented since the long term and short term needs of both facilities were different.

Tom's Foods, Inc.

Tom's production plant was very old. Consideration was being given to gradually relocating Macon's candy production to Tom's Columbus facility. The relocation process, if implemented, could take several years (e.g., 2 to 10 years). In the interim, Tom's wanted to minimize their investment in wastewater treatment facilities. Biological treatment in an aerated basin was selected. The goal was to select equipment that could be relocated with the production processes. The aeration basin consisted of a temporary tank with steel rings and a synthetic liner. A high speed aerator was selected for aeration. Nutrient storage tanks and feed pumps were small and could also be moved and reused.

Installation drawings, rather than biddable documents, were prepared. A precast manhole and bar screen were used for the influent screen and pump station. The system was designed in an "erector set" fashion to allow construction by Tom's staff.

Space was provided for adding a clarifier in the future, if required. After six months of operation, the clarifier was added because effluent solids could not be consistently controlled. The clarifier was constructed of steel and suitable for truck hauling in one piece.

Keebler Company

The Keebler facility was relatively new, having been built in the 1950s. Bakery sales were strong, and there were plans for increasing production capacity. Keebler wanted a permanent system (i.e., 20 year design life) that would meet MBCWSA pretreatment requirements without exceeding the surcharge limit.

The Keebler pretreatment system was designed for growth and expansion. Prepurchase specifications were prepared for the Keebler project to expedite delivery and reduce costs. All mechanical process equipment was installed in a concrete block building. Lab space was provided for system monitoring. A sludge storage tank was provided to allow truck hauling and/or POTW disposal of waste biological sludge.

Contract drawings and specifications, suitable for bidding, were prepared. The level of detail was higher since the Owner and Engineer would not have direct job responsibility for construction.

CONSTRUCTION

Tom's Foods, Inc.

Construction of Tom's pretreatment system took approximately 4 months. Equipment was prepurchased in September 1986. Construction began immediately and was completed in time for a January startup. No major construction problems were encountered. Equipment arrived on schedule. Bad weather did not slow construction. Tank erection took several weeks longer than anticipated but did not impact the project's critical path. During tank testing, the liner leaked and had to be repaired, but ample time was available.

Keebler Company

The Keebler pretreatment system was considerably more complex, and construction took longer. The design was completed in January 1987. Equipment was prepurchased beginning in February. Contractor bids were solicited, received, and evaluated during February and March. The contractor was on site and began construction in April.

The preconstruction meeting was held in March. Construction was estimated to take 5 months with completion in July. Startup was scheduled for August. The pretreatment system was completed in November, 3 months behind schedule. Startup was completed in December. Equipment delivery delays and construction problems were the primary cause of the schedule overrun.

The motor control center was ordered in February but did not arrive until November. The aeration basin and clarifier were both of concrete construction and, during testing, leaked excessively. Each tank had to be drained, patched, refilled, and tested several times prior to satisfactorily completing the tank testing requirements outlined in the specifications.

SYSTEM STARTUP AND OPERATION

Prior to diverting wastewater to each pretreatment system, a clean water checkout was conducted. Pump motors and instrumentation were tested and no major limitations were encountered.

Each aeration basin was seeded with biological solids from MBCWSA. Acclimation was achieved over several weeks. During this period, floating scum was present and solids carryover occurred.

After several months of operation, minor mechanical/operational adjustments had to be made. At Tom's, batch dumps of heavy solids clogged the influent pump. A fine screen was added at the influent pump station. A clarifier was added because effluent solids could not be controlled to below the surcharge limit. The nutrient feed pumps required frequent maintenance.

At Keebler, the nutrient feed pumps were also requiring frequent maintenance and were eventually replaced. Piping modifications were required at several locations to overcome plugging problems.

Operator training was a key area of focus, specifically regarding nutrient addition, sludge watering, and system monitoring. Both systems experienced filamentous bacteria when nutrients were not added. At Tom's, excessive solids wasting resulted in system failure. Reseeding was required to restart the process.

PERFORMANCE ASSESSMENT

Table 3 presents influent and effluent characteristics, and Table 4 presents operating data from both biological pretreatment systems.

Table 3
INFLUENT AND EFFLUENT CHARACTERISTICS

	Tom's Foods, Inc. (1)				Keebler Company (2)			
	Influent		Effluent		Influent		Effluent	
	(mg/l)	(lb/d)	(mg/l)	(lb/d)	(mg/l)	(lb/d)	(mg/l)	(lb/d)
Flow (gpd)	47,000		--		37,000		--	
pH (S.U.)	6.2		7.0		6.0		6.8	
COD	4,560	1,787	50	20	830	256	65	20
SCOD	1,690	662	29	11	290	89	40	12
BOD	2,380	933	9	4	500	154	39	12
SBOD	970	380	3	1	175	54	24	7
TKN	13	5	4 (3)	2	2	0.6	5 (3)	2
PO ₄ -P	5.5	2	8 (3)	3	3	0.9	3 (3)	1
TSS ⁴	2,950	1,156	30	12	--	--	11	3
O&G	66	26	4	2	--	--	--	--

(1) June 1988 data

(2) August 1988 data

(3) Includes nutrient addition

Table 4
WWTP OPERATING DATA

<u>Parameter</u>	<u>Tom's Foods, Inc.</u>	<u>Keebler Co.</u>
HRT (days)	10	2.8
MLSS (mg/l)	3,000	3,300
MLVSS (mg/l)	2,500	2,600
Dissolved Oxygen (mg/l)	3.4	2.2
OUR (mg O ₂ /l/hr)	6	--
OLR (lb BODa/lb MLVSS/d)	0.09	0.07
Yield (lb MLVSS/lb BODr)	0.13	0.32
Clarifier Overflow Rate (gpd/ft ²)	415	118
Clarifier Solids Loading Rate (lb/ft ² /d)	10	5

CONCLUSIONS AND RECOMMENDATIONS

Greater emphasis will be placed on pretreatment program compliance as municipalities face increased competition for construction grant funds and more stringent discharge limits as a result of the Clean Water Act Amendments of 1987.

Industries that do not currently pretreat need to be prepared for more stringent pretreatment enforcement by collecting inplant and end-of-pipe wastestream characterization data (e.g., flows and loads) and evaluating potentially feasible inplant and end-of-pipe wastewater treatment alternatives. Without this information, potentially costly long term decisions must be made with insufficient information.

Industries should establish a good working relationship with the municipalities. A common understanding of the industrial and municipal perspective needs to be developed. This will allow early input into decisions which may have significant impacts later on.

Traditional and non-traditional approaches should be considered. Improved housekeeping, and at-source treatment can significantly reduce wasteloads, increase production yields, and generate useful by-products (e.g., recovered oil, animal feed).

As shown in this case study, construction can be simplified and costs reduced depending on the design approach. The Owner can take responsibility for construction and manage the subcontractors or hire a Contractor to take full responsibility for the construction effort.

Operator training is critical for consistent performance. Operators should be given well-defined responsibilities for system operation, and training should be provided. If possible, an experienced operator should be hired.

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