

North Carolina Cooperative Extension Service



Pollution Prevention Pays in Food Processing

Reducing Water Use and Wastewater in Food Processing Plants

How One Company Cut Costs

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Last Electronic Revision: March 1996 (JWM), 11/7/96 by Ronald Lee Still

Many food processing plants today are literally washing profits down the drain. This industry typically uses a large volume of water to process food products and clean plant equipment, yielding large amounts of wastewater that must be treated. Excessive water use and wastewater production adds financial and ecological burdens to the industry and to the environment. However, food processors can take actions that will dramatically reduce water use, wastewater production, and the high costs associated with these problems.

Using water for cleanup in food processing plants flushes loose meat, blood, soluble protein, inorganic particles, and other food waste to the sewer. Some of these raw materials could be recovered and sold to other industries, but instead are lost. Also, most of this waste adds a high level of biochemical oxygen demand (BOD₅) to the wastewater.

Wastewater treatment plants use BOD₅ levels to gauge the amount of waste that is present in water - the higher the BOD₅ level, the more treatment this wastewater will require. Sewer plants add surcharges for each pound of BOD₅ that exceeds a set limit. These charges can cost the company hundreds of thousands of dollars each year.

Food processing companies can benefit by learning about current methods and interventions that can assist in effectively managing their water resources. Without the appropriate knowledge and use of these wastewater management techniques, these companies will continue to lose money through water use charges, raw material losses, sewage surcharges, and possible fines from environmental agencies. With the public emphasis on environmental quality, the food industry has further incentive to reduce its water usage and its wastewater production.

This publication discusses how one food processing company became aware of its wastewater problems and reduced costly waste with assistance from the North Carolina Cooperative Extension Service and the North Carolina Pollution

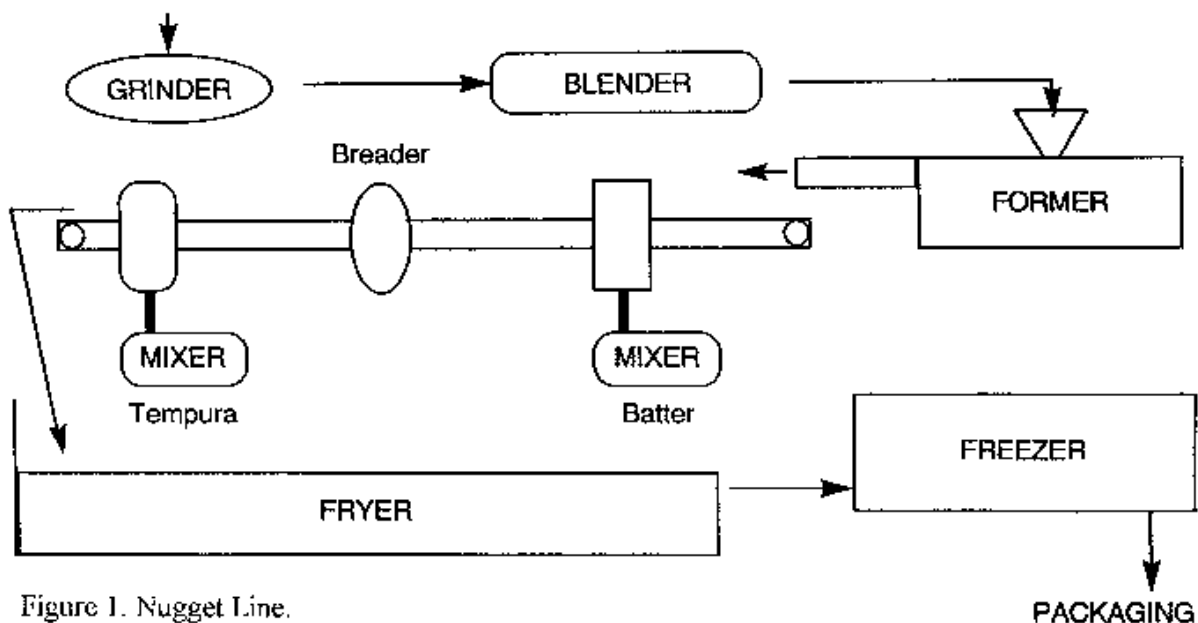
Prevention Program. By implementing a comprehensive water management and waste reduction program, the Equity Group has dramatically reduced its BOD₅ production by 77 percent and its water use by 30 percent (Table 1).

Measure	Before	Now	Goal
Water Use (gal/month)	4,250,000	3,000,000	2,000,000
Waste Loads-BOD ₅ (lb/day)	4,500	1,000	500
Landfill Disposal (tons/wk) (Scrap, inedible product)	30	0	0
Animal Food Collection (tons/wk)	0	50	80
Dry Cleanup Pollution Prevented (lb BOD ₅ /day)	0	2,200	2,500

Background

The Equity Group, a division of Keystone Foods, built a food processing plant in 1980. Each day, at the time its waste reduction program was developed, the facility produced around 2.5 million chicken nuggets for the southeastern McDonald's restaurants. These nuggets are formed from high-quality chicken breast and thigh meat. Chicken meat is ground, blended, formed, battered, breaded (Tempura), fried, frozen, and then packaged. This process is shown in Figure 1.

Figure 1. Nugget Line



The plant, which operates five to six days a week, used almost 200,000 gallons of water per day (Table 2). The company employs 275 people in two production shifts and one cleanup shift. When the problem of waste management was first approached, this company was discharging around 4,500 pounds of BOD₅ per day.

Table 2. Equity, Reidsville Facility

- Water use: Almost 200,000 gal/water per day
- BOD₅ Load: 4,500 lb/day
- Two production shifts; one cleanup shift
- 2,500,000 nuggets per day
- 275 employees

The problem

The Equity Group meat plant is required to meet stringent production and sanitation standards that result in high water usage in order to maintain high product quality. When the U.S. Department of Agriculture (USDA) implemented a requirement that the production lines be free of meat accumulation at all times, workers found they needed to hose the equipment three times per shift. Consequently, water use and waste production increased tenfold. Since Equity was not operating under a strict waste load reduction program, many pounds of organic material were flushed to the sewer and directed to the company's pretreatment plant. An average of 55 pounds of meat, 3 pounds of tempura, and 15 pounds of dry batter per line were being lost from each of the seven lines to the sewer on each shift.

At about this same time, the City of Reidsville ran into problems with its wastewater treatment plant when it was fined by the state for polluting Little Troublesome Creek. Investigations revealed that the city's system was incapable of processing all of the pretreated wastewater discharged by Equity's processing plant. The city then set a BOD₅ limit on this pretreated wastewater and imposed heavy surcharges for BOD₅ levels that exceeded the limit

Management forms a task force

Equity was notified of the city's sewage system problems and of the increased charges for treating waste-water containing high levels of BOD₅. The company took immediate action by appointing an in-house task force to explore ways to reduce the plant's waste and effectively manage its water use. The director of personnel for the company was designated to head Equity's task force. By selecting a manager familiar with human relations to lead the committee, Equity placed a strong emphasis on developing programs that would enhance employee attitudes toward waste reduction. To make changes in procedures, equipment use, and maintenance practices, the company would need its employees to fully understand and support new waste-reduction techniques.

The Equity task force contacted specialists at the Cooperative Extension Service who, in turn, called in an engineer from Pollution Prevention Program of the North Carolina Department of Environment and Natural Resources.

The Equity Group applied for and received a Challenge Grant from the NC Pollution Prevention Program (PPP) for use in developing its water and waste reduction programs. These grants are awarded to help businesses and communities develop waste reduction programs. The concept of PPP is to attack pollution at its source by reducing the amount of waste created rather than trying to correct the problem through wastewater treatment.

The problem is addressed with the PPP concept

Equity's task force met with Pollution Prevention Program representatives, Extension Service specialists, and Reidsville city officials to analyze the wastewater problems the company and the city faced and to explore possible solutions. To reduce Equity's problem, the task force and specialists took the following steps based on the PPP concept of waste prevention:

1. Provided education on water use and waste load;
2. Surveyed the plant for problem areas;
3. Evaluated plant processes;
4. Promoted the use of dry cleanup;
5. Provided for waste recovery and utilization;
6. Enhanced waste pretreatment.

These steps are discussed in the following sections.

1. Education is first and foremost

The most critical step was to educate the plant's managers and employees. Few of them realized the importance of waste and water control. No one understood how much water was used and how much waste was generated. Managers just did not realize the daily cost of a careless approach to waste management and water use.

Managers provided the incentive for employees to become informed and to take action in Equity's waste-water reduction program. When the managers showed a genuine concern and commitment for reducing water use and waste production, the employees were motivated to become involved as well. Providing education on the causes and effects of high water use and wastewater production also raised employees' social consciousness.

Today's public is greatly concerned about the environment. If a company does not show equal concern, it may find itself with a public relations problem. Fortunately, all of Equity's managers were concerned and prepared to address their problems openly. Remarking on reports identifying the areas of waste production and heavy water use, Jerry Gotro, Equity's vice president, said, "This is not a slap on the hand. No one is to be ashamed of what the report states. On the other hand, everyone will need to be 150 percent dedicated and involved in the ultimate solution." This type of attitude in the industry is ultimately conveyed to the public and promotes a positive outlook from the community.

2. Initial survey identifies dry cleanup as an opportunity

A plant survey determined where water use occurred and where wastes were generated in this food processing plant. The results showed that over half of the waste load resulted from wet cleanup practices. Waste in the form of batter, tempura, bits of chicken, juice, blood, fat, and nugget pieces was being flushed down the drains.

Specialists were called in to analyze the cleanup process and make recommendations. Drawing on the PPP concept of waste prevention, these specialists suggested techniques for dry cleanup (discussed in Section 4) that would reduce wastewater production. In dry cleanup, methods are used to capture all nonliquid waste and prevent it from entering the wastewater. Part of the Challenge Grant was used to develop a training program for the cleanup crew based on these recommendations.

3. Further evaluation of plant processes

Some of Equity's other waste production problems called for further evaluation of the plant's processes. Equity discovered that it had insufficient waste collection equipment, leaks in some machinery, and worn-out equipment and lines. Also, employees, unaware of Equity's water use and wastewater problems, were hosing most waste down the drain without attempting to pick it up and dispose of it in a "dry" manner. The task force conducted another plant survey of the possible causes of waste loss to the sewer. The chart on the next page lists the problems identified and the recommended solutions.

Equity also noted the need to revise sanitation procedures and to look into selling waste materials to animal feed producers.

4. Dry cleanup is pursued

Systems have been installed for collecting and disposing of drips and batters to help keep waste production down. Also, employees are instructed to remove all dry waste from the floor and the equipment before cleaning with water. Just by changing to dry cleanup methods, Equity has reduced BOD₅ levels in this plant by 50 percent.

5. Residual waste recovery and utilization

Most of the waste that comes out of the plant consists of carbohydrates or proteins. With dry cleanup, much of the waste is reclaimed and put to secondary use. Part of the "waste" collected during dry cleanup is shipped to a company in Atlanta to use for animal food. This material totals over 5 million pounds per year. The remaining waste from dry cleanup is sold to a renderer. Other ideas for the use and disposal of waste are presented in Table 3.

Table 3. Possible Utilization or Disposal of Food Plant Residues

Idea Utilization or Disposal Method
1. Direct uses: animal food
2. Install dryer to prepare animal food
3. Install or utilize incineration
4. Send to landfill
5. Contact recoverers
o Renderers
o Grain product

6. Pretreatment is the last line of defense

A grease trap, solids recovery basin, and an activated sludge system with provisions for pH control were in place before the current problems surfaced. Although the activated sludge system was not operating at its optimum level, even under ideal conditions it was not capable of significantly reducing BOD₅ levels. Nevertheless, as part of a total management approach, Keystone Foods corporate engineers removed the grease trap and solids recovery basin, and they enhanced the activated sludge basin with additional aeration. A dissolved air flotation system and a belt filter press, along with the enhanced basin, are now being used with promising results. Equity's modified pretreatment facilities are shown in Figure 2. A brick building was constructed to house the aeration basin, belt filter press, and system controls. The building was designed to conceal the system and to contain odors that had been a problem. The odors were eliminated by passing the building's exhaust air through a wet scrubber.

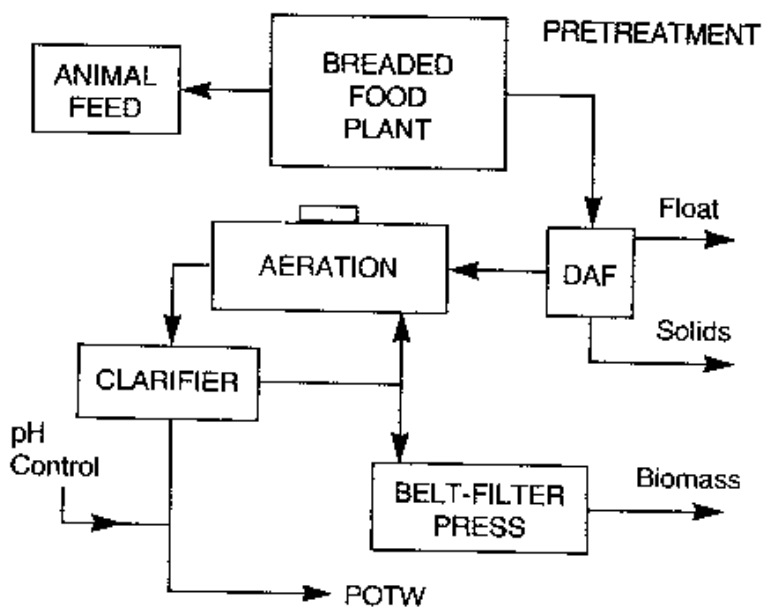


Figure 2. Waste Flowchart.

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Ensuring that pretreatment facilities are operating effectively is important to managing wastewater production. However, dry cleanup, proper equipment utilization, and employee awareness seem to be the most effective and economical forms of pretreatment.

Controlling wastewater is highly cost effective

A concept as simple as keeping wastes off the floors and out of the drains will save this company many thousands of dollars per year and reduce the strain on

the city sewage treatment plant. Most of the changes made to reduce water use and waste cost the company little or nothing. Carelessness, a costly trait for any business, was prevented simply by focusing employee awareness and management emphasis on the problem. Common-sense approaches to cleanup, such as using trays beneath machines to catch spillage, picking up spillage before hosing down the floors, and placing screens over drains, were used at little cost. Awareness of the serious problems caused by reckless water use and product waste cost the company nothing but the time needed to educate employees thoroughly. After all new procedures had been implemented and preliminary training completed, it was found necessary to conduct a detailed training course for each line. A successful pollution prevention program requires frequent retraining to keep employees focused and vigilant.

Problems and Recommended Solutions			
Problem 1	The equipment used to produce the nuggets	Problem 3	The employees, although conscious of the problems, were

	rendered heavy waste in the plunger area, the batterer, tempura containers, and mixers.		not properly trained to handle them.
Recommendation	<ul style="list-style-type: none"> • Repair or replace specified equipment. 	Recommendations	<ul style="list-style-type: none"> • Hire employees specifically for supervising floor and equipment waste pickup and separation of solids, liquids, and breading for both the first and second shifts. • Train and educate all employees, especially those in cleanup, as to the seriousness of the situation and the proper procedures for efficient cleaning. • Produce a videotape for training purposes. • Emphasize minimum water usage to all employees and management.
Problem 2	The containment trays and devices were insufficient, required maintenance, and needed to be redesigned.	Problem 4	There was a serious lack of communication among company directors.
Recommendation	<ul style="list-style-type: none"> • Obtain the specified equipment needed to reduce waste lost to the floor, such as trays under breaders to catch spillage. 	Recommendations	<ul style="list-style-type: none"> • Improve communication among directors, management, and employees. • Present specific areas of plant losses (such as where breading is spilled). • Encourage employees to express new ideas for water use and waste reduction to their supervisors.

The Equity Group has shown that it is possible to reduce the BOD₅ level by over 50 percent using dry cleanup alone. Overall, the company expects up to a 90 percent reduction in its waste load. Priorities and changes that were used to bring about Equity's significant success appear in Table 4.

Table 4. Prioritized List for Waste Control	
Priority Change Required	
<ul style="list-style-type: none"> • 1. Management attitude is the key. • 2. Think "wild" - look at all ideas. • 3. Listen to everyone - the employees may already have a solution. • 4. Look for help from associations, 	<ul style="list-style-type: none"> • 6. Employee attitudes are important. Employees must understand that without success the plant may have to close • 7. Note that "water, water everywhere" is not the way of business anymore. • 8. Contain wet wastes.

- friends, and agencies.
- 5. Identify your problem and note the problem areas.

- 9. Control dry waste.
- 10. Look not only at the costs but also at the savings. Begin a new way of life.

Cost savings resulted from a reduction in water costs, sewage surcharges, and expenditures for product and ingredients. Savings exceeded \$100,000 annually, without taking into account the savings realized by avoiding the proposed surcharge costs, which would have exceeded \$200,000 annually. Equity also saves by selling to renderers the solids recovered from the dissolved air flotation system and the belt filter press. Since more waste is reclaimed rather than released through waste-water, less pretreatment is necessary, holding costs down. If the program had not been successful, a \$1.5-million-dollar expansion of the pretreatment system would have been necessary, in addition to system modifications made, which cost about \$500,000. Operating costs for the expanded system would have exceeded \$100,000 annually.

Continuing to try new ideas

Equity managers are continuing to test and implement new ideas that may save water and reduce waste-water production:

- They have designated one of their production lines as an exemplary line. The maintenance crew regularly upgrades equipment parts, seals all leaks, tightens nuts and bolts, and replaces containment trays as needed to prevent spills.
- A "waste awareness program," or WAP, has been initiated to involve employees directly in waste reduction efforts. Under this program, employees form a WAP committee that meets monthly to focus on specific waste reduction issues or problems. The committee encourages employees to bring problems to its attention by offering one day off with pay for the best idea of the month. Employees form teams that meet weekly to help implement the solutions suggested by the WAP committee. Employees serve on the committee and teams in rotation so that everyone has a chance to share this experience.
- To keep employees aware of the need for waste reduction and focused on preventing pollution, frequent retraining sessions are conducted. Equity's managers found that the effectiveness of the waste reduction measures implemented in the plant diminished with time. Two years after the program began, waste production had again increased and surcharges had reached more than \$11,000 per month. Realizing the need to keep awareness and commitment high, managers initiated a detailed, shift-by-shift training program to train new employees and retrain the others. The results were gratifying: waste production declined enough to reduce surcharges from \$11,000 to an average of only \$39 per month.

The Equity Group demonstrated not only good social consciousness in working to reduce the waste it was sending to Reidsville's sewage treatment plant, but also good business sense in reducing water costs, waste removal costs, and finding creative ways to use its waste for the company's and society's benefit.

This publication was supported in part by the North Carolina Board of Science and Technology in cooperation with the North Carolina Pollution Prevention Pays Program.

Published by North Carolina Cooperative Extension Service

Publication Number: CD-35

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