INPLANT WATER MANAGEMENT TO MEET NEW ENVIRONMENTAL REQUIREMENTS: POULTRY PROCESSING FACILITIES

PREPARED FOR ENVIRONMENTAL PROTECTION AGENCY TECHNOLOGY TRANSFER PROGRAM

DESIGN SEMINAR FOR INDUSTRIAL POLLUTION CONTROL

Little Rock, Arkansas
January 16, 17, 18, 1973

ENVIRONMENTAL ENGINEERING, INC.
Gainesville, Florida

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POULTRY PROCESSING WATER MANAGEMENT

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INTRODUCTION

The poultry processing industry is characterized by vertical integration from hatchery through feed mill, processing, and disposal of product on contract basis. The overwhelming mass of production is in broilers, turkeys, and mature chickens. The rise of poultry production reflects the general growth of the consumptive market with 3.8 billion pounds of broilers and chickens produced in 1950, 6.9 billion pounds in 1960, 9 billion pounds in 1965, and 10.8 billion pounds in 1971[1]. This represents a substantial number of birds at a 1971 average live weight of 3.7 pounds per bird. Turkey production in 1950, 1960, 1965, and 1971 was 0.8 billion pounds, 1.5 billion pounds, 1.9 billion pounds, and 2.3 billion pounds, respectively. Average turkey live weight may be considered 18.8 pounds per bird. In 1970 the percentages of Federally inspected poultry slaughter by product class were broilers at 77.7 percent, mature chickens at 6.3 percent, turkeys at 15.3 percent, and other poultry at 0.7 percent. The plants under Federal inspection slaughtered over 90 percent of the U.S. Poultry production in 1970[2].

The South Atlantic region is composed of Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida. The South Central region includes Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas. These two regions in 1970 accounted for 86.8 percent of total broiler production, 48.1 percent of mature chicken production, and 32.8 percent of turkey production.

There are approximately 402 Federally inspected slaughtering plants in the United States. Of these, there are approximately 218 plants in the South Atlantic and South Central Regions. In these two regions, 9 percent of the plants slaughtered less than 10 million pounds of live weight in 1970, 58 percent processed between 10 and 50 million pounds per plant in 1970, and 33 percent processed 50 million pounds or more.

The large size and concentration of the poultry processing industry becomes particularly important in view of its waste generation. In poultry processing, feathers, blood, dirt, and viscera are removed from a product that must be made acceptable for human consumption. Large quantities of water are consumed in both washing and cleaning the poultry in processing and also to carry away large amounts of waste to screening and ultimate disposal. The highly organic nature of the waste may cause bacterial blooms, depressed oxygen levels, and severely disrupted biota in receiving streams. Waste discharged to a sewage treatment system provides a substantial loading in terms of population equivalent, escaping grease, feathers, and offal. These constituents hamper treatment processes and are subject to substantial sewer use surcharges by municipalities.

A survey in 1970 of Federally inspected slaughtering operations indicated that 29 percent of the plants had some degree of private waste treatment, 65 percent had final municipal waste treatment, and 6 percent had no waste treatment whatsoever. The reduction of water usage in the poultry processing operations and the water reaching the final effluent will thus be a benefit to processors, municipal waste treatment facilities and the general public whose environment is affected.

Many communities are faced with having to provide advanced waste treatment to comply with Federal and State regulations. Individual industrial plants discharging directly to a water course are also coming under more stringent controls. In the General Session of this Seminar, the EPA has presented some of its plans for permitting wastewater discharges. It has been indicated that all poultry processors will eventually come under direct or indirect pressure to reduce their wastewater flows and strengths. Either wastewater characteristics will be directly regulated or those processors using municipal facilities will experience substantial sewer surcharges.

While a considerable number of plants are being charged minimal rates for their waste treatment at the present time, there is a rapidly growing trend among municipalities to make industry pay for its share of waste treatment. As regulations force municipal plants to improve their wastewater effluent qualities at greater treatment costs, the costs will be passed on to those industries discharging a significant amount of waste to the system. Normal sewer charges to industry are based on flow rate and allow up to 250 or 300 mg/l of BOD and suspended solids in the waste stream. Additional concentrations of BOD and suspended solids have been charged at rates of $25 to $80 per thousand pounds of each. The result of these factors is an increased incentive for wastewater reduction.

Based on a sewer charge of 25 cents per 1,000 gallons, typical water use and waste discharges, and a wastewater flow of 18.4 billion gallons, USDA has predicted a cost of municipal waste treatment to poultry processors at $4.6 million.[1] The live weight slaughter at the plants surveyed by the USDA was 8.4 billion pounds with a calculated sewer charge of 5.5 cents per 100 pounds of live poultry. Inefficient plants losing excessive solids to wastewater streams stand to have increased sewer surcharges and concomitantly increased processing costs. Total treatment costs were estimated for anaerobic-aerobic lagoon systems and extended aeration systems. Private waste treatment by lagooning could cost the processor from 2.2 cents to 0.8 cents per 100 pounds live weight for poorly to properly controlled plants, respectively. Extended aeration plants, which provide a higher degree of treatment with less land area, would require investment, operating, and maintenance costs of 11.0 cents to 4.0 cents per 100 pounds live weight for hydraulically unmanaged and managed plants; respectively. Careful and diligent in-plant water use reduction by the poultry processor may save him substantial quantities of money by allowing smaller waste treatment systems than those calculated here for "typical" poultry processing plants in 1970. At a normal sewer charge of $0.25 per 1,000 gallons of waste, a water use charge of $0.25 per 1,000 gallons of water supplied, and a sewer surcharge of $50 per 1,000 lb of BOD discharged <u>over</u> 300 mg/l in concentration, a typical 100,000 broilers per day, seven days per week, poultry processor with poor water and waste management may pay a monthly bill of over $20,000. With proper water management this bill can be reduced by approximately 50 percent.

Reduction of flows need not be completely at odds with the trend of industry toward modernization and improved processing using flowaway systems. It will remain for the industry to assess the costs of process changes to either "dry" or recirculating systems and compare them against legitimate wastewater treatment charges. In the event of borderline decisions, a processor should be aware that wastewater quality restrictions imposed by states and municipalities will become more stringent in the future and the most economical method to meet those restrictions is often by in-plant process modifications and water management.

Water management techniques also promise to provide the greatest reduction in wastewater flows. The operators of poultry processing plants often do not know how much water they are using, where they are using it, when they are using it, and, in some cases, why they are using it. Water, traditionally a resource of great convenience and minor cost, has not occupied the attention of either managers or workers. As a result, wasteful water use practices have been common throughout the industry. It will not be possible at this time to demonstrate a cure-all technique that will eliminate water use problems, rather it will be shown where water misuse can be prevented or corrected.

The USDA is very strict in its observance of process water quality standards. Great variations in water use and reuse are generally not permitted at this time. Therefore, discussion will be presented on water reuse methods that are permitted by the USDA, methods that are not presently permitted but which with further study may some day be allowed, and also methods that may never be allowed.

Poultry processing plants perform the functions of slaughtering and evisceration; cutting up of broilers, turkeys, mature chickens, and other classes of poultry; and further processing prior to retail marketing. Many plants engage in canning, freezing, and processing into specialty items. The principle concern of this seminar session will be the processing of poultry through evisceration to the chilling step.

DEFINITIONS

Common parameters of wastewater quality which will be referred to in this session include:

(1) Biochemical Oxygen Demand - BOD - A measure of the potential of a wastewater to utilize oxygen while experiencing microbial degradation; a semi-quantitative measure of the organic content of a waste. BOD_5 - The standard test conducted over a five day period.

(2) Chemical Oxygen Demand - COD - A measure of the potential of a wastewater to utilize oxygen while experiencing chemical oxidation; a semi-quantitative measure of the organic content of a waste. It does not necessarily correlate with the BOD test.

(3) Coagulation - The process of reducing the repelling forces between collodial particles in order that they may combine into larger particles that are more easily settled.

(4) Collodial Particles - Finely divided solids which will not settle due to gravity alone but which may be removed from a wastewater by coagulation, filtration, or biological action.

(5) Dissolved Oxygen - D.O. - Uncombined oxygen in solution in a liquid. A minimum of four or five parts per million (ppm) D.O. is necessary for the survival of fish in streams and a minimum of one or two ppm is necessary to avoid odors in wastewater.

(6) Nutrient - A substance that promotes cellular growth in organisms. Compounds of nitrogen and phosphorus are of concern in wastewaters due to their encouragement of over-enrichment of water bodies.

(7) Slug - A high concentration of a substance in a wastewater stream; usually beginning and ending abruptly and of short duration. Slugs cause problems in wastewater treatment facilities by disrupting biological or chemical activities, and in receiving streams by causing drastic D.O. reductions.

(8) Suspended Solids - Those inorganic and organic particles which exist in suspension in a liquid and which may be partially removed by gravity settling and completely removed by filtration.

(9) Total Solids - A measure of both suspended and dissolved solids.

(10) Volatile Solids - Organic solids which are combustible at 600 degrees centigrade.

POULTRY PROCESSING

All poultry processing plants have the same basic processing flow stream. This flow stream has evolved as the best way to proceed in what is a relatively simple procedure of slaughtering and cleaning poultry for marketing. Live poultry is unloaded at the processing plant and taken to a killing station where jugular veins are cut while the poultry is suspended from a conveyor chain. A bleeding area is reserved to confine blood from the carcass. The bird is then scalded with hot water to loosen its feathers. Feathers are removed mechanically and manually. Residual hairs and feathers are singed off with a flame or by wax stripping, and the bird is surface washed. The washed bird is eviscerated manually and washed internally and again externally. The carcass is then chilled or frozen, packaged, and shipped to a market. Figure 1 provides a brief flow sketch of this process.

Receiving Area

It may be generally stated for the industry that the receiving area is no longer used for extended holding of live poultry. Stays of several hours may be necessary in order to smooth out fluctuations in delivery; however, feeding, and fattening up of chickens is infrequently practiced in the battery room. Nevertheless, the birds will leave manure deposits in the holding area. These deposits are a source of BOD, bacteria, and solids, and are flushed into the sewer system when the floors, cages, and walls of the holding area are washed.

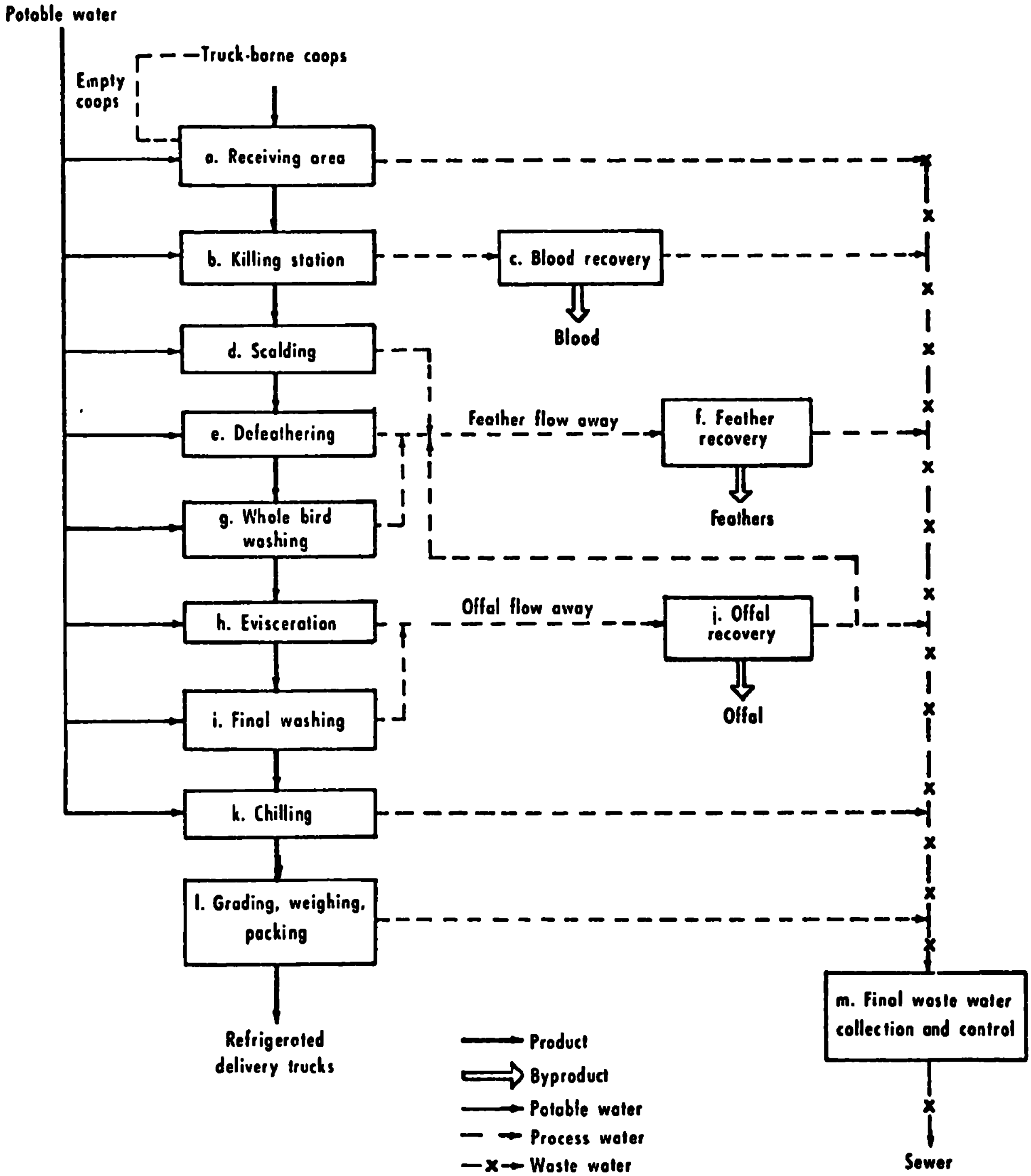

FIGURE 1. FLOW CHART OF POULTRY PROCESSING PLANT*

*Taken from reference 2

Killing of the poultry is usually done when the birds are hanging by their feet from a moving conveyor. The jugular veins are cut and there is considerable spillage and splattering of blood as the carcasses drain. In an old plant, the bleeding would be partially or entirely confined in a special room from which the blood would be washed directly to the sewer. The degree of the pollutant load resulting from such discharge is indicated by the 100,000 mg/l BOD concentration in blood.

Defeathering

After bleeding, the feathers on the carcass are loosened by scalding with hot water of approximately 130°F to 140°F. In most plants the bird is immersed in a tank of hot water, but a spray system is used by some processors. Water in the tank is kept warm and replenished by the addition of hot water at the rate of one quarter gallon per bird. The overflow from the tank and also the tank drainings at cleanup contain blood, dirt, and feathers, which pass into the wastewater system. Deposits of dirt and organic matter become concentrated in the bottom of the tank and are discharged during daily cleaning.

Feather removal from the carcasses is usually by mechanical action. In a few of the smaller plants birds are removed from the conveyor and placed in rotating drums which strip the feathers from the carcasses. The birds must then be manually rehung on the conveyor. Wash water may be sprayed in the drums on a continued basis to remove feathers, and the birds are subject to a final body spray. The more common method of feather removal, however, is to let the bird on the conveyor line pass between rotating spools containing rubber fingers which beat and pull feathers off the body. Continuous streams of water then wash the feathers to a central collection facility. Considerable amounts of water are lost through this procedure and equipment washdown at the end of this processing period adds further pollution loads.

Pin feathers remaining after defeathering may be removed by costly manual labor or by wax stripping. In the latter method, some wax will escape to the wastewater system when the wax is hardened by a cooling spray. Wax stripping is usually employed with fatty birds such as ducks which may be damaged by singeing.

A gas flame is used to singe hair and odd pin feathers on the carcass. The "plucked" bird is then washed with an external fine spray.

<u>Evisceration</u>

Evisceration takes place in a separate or enclosed area from the remainder of the plant to prevent contamination of the poultry. The surface cleaned birds are separated from their legs and resuspended on the conveyor belt to allow easier access to the stomach cavity. Heads may also be severed during this process. Manual operations remove all the inner organs and separate edible portions such as hearts, livers, etc. from inedible organs. Flow away systems continuously flush offal to the wastewater system with relatively large quantities of water. Spray washes clean the inside of the bird prior to USDA inspection.

Gizzard cleaning is a distinct sub-process of the evisceration step in which gizzards are separated from the bulk of the viscera, opened, and cleaned of food, sand, and gravel. Similarly, other recoverable organs must be separated and cleaned.

Birds to be cut up for parts such as legs, wings, and breasts are processed at this time. New York dressed poultry are not eviscerated, but this accounts for less than 5 percent of total production.

Chilling

Chilling of the carcasses to prevent bacterial decomposition is the final process associated with wastewater flows and immediately preceeds freezing or iceing of the meat and subsequent shipment to market. Large processing operations use counter current chilling. Specific details of the operation are government controlled. The first chill tank will lower carcass temperature to about 65°F. Regulations specify that overflow from continuous chillers must equal at least one half gallon per frying chicken. The meat is subsequently dipped in second and third chilling tanks which achieve an ultimate carcass temperature of 34°F. The overflow from the second and third tanks is used as make-up water in the first tank. Fresh ice and/or chilled water must be added to the second and third tanks in adequate quantity to keep all sections reasonably clear and in continuous overflow. Old and small plants, which do not use continuous flow and chilling, cool the meat in batch tubs of ice and water. Chilled birds are drained on a conveyor line and then sized, graded, and packaged.

Freezing of carcasses is a new and slowly growing innovation that has found greatest applications with turkeys, ducks, and exotic fowl. The freezing occurs after packaging but produces no inherent wastewater.

Consumer demands are causing the old process of shipping poultry in ice to change to packing with dry ice. This has little effect on wastewater flow.

Although poultry meat is sold principally through retail food stores, about 25 percent of broiler output is sold to institutional firms. Broilers are usually sold in chilled, ice-packed forms; turkeys are most often sold frozen; and mature chickens are usually further processed. Further processing accounted for about 13 percent of poultry slaughter in 1970[2].

WATER MANAGEMENT AND WASTEWATER CONTROL

The poor quality processing plant in terms of water management must be distinguished from the poor quality plant as measured in terms of product. The best, most modern processing plant turning out an excellent poultry product may be the worst plant from a pollution standpoint. In a typical poor water management situation, hoses are kept running when not in use, excessive amounts of water are used, and poorly designed water supply systems permit little if any control over pressures and rates of flow. In general water is used indiscriminately and the basic philosophy seems to be that the more water used the better the job.

A reduced water usage concept can nevertheless be applied to almost every area of almost every plant. Some of the more general reduction techniques are discussed below for the main sub-processes in a poultry plant.

Receiving Area

Live storage of chickens in a battery room may become a temporary necessity in even the most modern processing plant. Studies of the production in this room of wastes from manure and feathers have indicated BOD values exceeding 30 lb per 1,000 birds per day.[3,4] As a comparison, chicken manure production on farms is normally on the order of 240 lb per 1,000 chickens per day. Water quantities resulting from a daily wet wash of the receiving area will vary greatly among different plants and even in the same plant on different days. The wet wash may contain detergents and cleaning agents in addition to the poultry waste. Dry cleaning of the battery room with shovels, scrapers, or brooms can remove most of the deposits to a dry disposal container. A final wash of the battery room will then require less water and will contain significantly less pollutants. One study measured the reduction of BOD by dry cleaning operations to 5 lb per 1,000 chickens per day. This figure may be even further reduced by a rapid turnover of birds in the holding area, accomplished by scheduling staggered deliveries of poultry to coincide with processing line demands. Cleaning techniques using high pressure sprays, as opposed to low pressure-high volume flows, will significantly reduce cleaning water demands. There is at this time doubt as to whether the use of cleaning detergents provides more or less pollution than the manure and feather contents of the waste.

Killing and Bleeding

Blood drained from freshly killed carcasses constitutes an extremely high pollution potential and, as a result, in exceedingly fewer plants is it allowed to wash to the sewer directly. Chicken blood has an approximate BOD of 92,000 mg/l and 1,000 chickens may drain 17.4 lb of BOD in recoverable blood. In a poorly operated plant the blood will wash to the sewer and during post processing clean-up will be contained in the wash water.

Collection of blood may reduce the processing plants sewage strength by 35 to 50 percent. This is roughly equivalent to 17 to 18 lb of BOD per 1,000 chickens. Since poultry is bled while it hangs from a moving conveyor, the blood may be collected in a tunnel or a walled area. In a high walled tunnel, for example, the blood may be almost completely recovered and drained into receptacles spaced at regular intervals. A section of the killing room enclosed by a wall high enough to catch most of the spurting blood would provide a contained collection area. In most cases such an area would be cleaned of blood at periodic intervals after the blood has partially congealed to a slurry and can be shoveled or scooped. In this case, final cleanup of the floors and walls of the bleeding area would require more water than for an enclosed tunnel of limited dimensions.

Body movement of the slaughtered poultry may splatter blood on the conveyor, out of the bleeding area, and onto the feathers of adjoining birds where it can be washed off in the scalders. This is lost blood and increased wasteload. Stunning of the birds at slaughter will reduce such movement, allow greater blood recovery, and reduce wastewater BOD load.

Recovered blood may in some cases be sold to a local rendering plant and the profit used to offset pollution control costs. In other instances it may be necessary to give the blood away in exchange for its removal from the premises, or to even pay for its removal. In any event, efficient blood recovery practices provide the single most effective step of waste load reduction.

Scalding

The scalding operation which loosens poultry body feathers also provides a first wash to the carcass. The spent scalding water will contain blood, dirt, feathers, manure, and dissolved fats and greases. The scalding tank is continuously replenished with fresh water at the rate of one quarter gallon of water per bird. The BOD of scalder water has been measured as high as 1,182 mg/l, with suspended solids of 682 mg/l, and a grease content of 350 mg/l.

Scalding of the poultry prior to defeathering provides an opportune process for conservation of water. Scald water temperatures between 128°F and 145°F inhibit the growth of common bacteria and the water is applied as an initial wash to the dirty poultry. For these reasons scald water need not be fresh water; however, the USDA requires an overflow of one quarter gallon per chicken processed. Screened chiller overflow water which has been applied to a relatively clean, washed carcass, has twice the overflow rate of the scald water. Chiller water has fewer pollutants than spent scald water and would, therefore, appear to be an ideal makeup water for the scald tanks. Chiller overflow water from the first contact tank has been substantially warmed by residual body heat from the carcasses and will not differ greatly in temperature from cold water supply lines. The use of a simple heat exchanger between chiller feed to the heating tanks and scalder water overflow can reduce the fuel needed to heat the scalder feed water.

Defeathering

Defeathering under poor water management techniques is performed mechanically with continuous streams of water washing away the feathers and washing the carcass. While this is performed in many new and modern plants for expediency of cleaning, it represents a step backward in pollution technology due to the high volume of water involved in the feather flushing. Defeathering water will contain blood and dirt which exert a BOD while the feathers themselves, although they are somewhat resistant to the Standard BOD analysis, may create a BOD in the feather flume of nearly 600 mg/l[5]. Furthermore, feathers in the wastewater stream have a considerable nuisance value by clogging the mechanical recovery screens treating the wastewater flow.

The fresh water supply for mechanical feather removal has been measured to be 1.4 gallons per bird, inclusive of the final outside body wash and periodic area cleanup[5]. This water use was 11 percent of the total water supply to the plant. Additional in-plant water reuse for the feather flowaway flume raised the total water usage for the defeathering process to 2.8 gallons per bird, which was also the waste discharge for the defeathering process.

Defeathering operations have been shown to carry a pollution potential in wash and flume water. Feathers may be removed by screening operations of the wash water, but they have a high tendency to foul screens and cause polluted water overflow. Screened water from defeathering operations may be reused in the feather flume trough since there is no direct contact with the final poultry product. Reuse of feather flume water in the feather flume instead of another location would prevent mixing of stray feathers with other types of possibly recoverable products. Chiller water has been used in the feather flume at the Gold Kist facility in Durham, North Carolina.

Evisceration

The evisceration process consumes large quantities of fresh water in cleaning of the carcass, in viscera flowaway flumes, and in worker cleanup supplies. Wastewater from evisceration will contain high BOD's, suspended solids and grit, greases, blood, and bacteria from the intestinal tracts. Large volumes of water used to flush the offal would tend to dilute the BOD concentration, but the total pounds of BOD produced would remain unchanged. A typical example of eviscerating flume water has a flow of 3.1 gallons of water per bird and a demand of 24 percent of the fresh water supply[5,6].

Gizzard cleaning is a distinct sub-process of evisceration and presently requires potable water according to USDA regulations as does evisceration water. Gizzard cleaning water is discharged to the viscera flowaway flume for a combined water use of 6.1 gallons per bird and a BOD of 230 mg/l. While the BOD appears low due to the high volumes of flushing water in this process, it is still equivalent to 12.2 lb per 1,000 broilers.

Evisceration adds a large quantity of wastewater with a substantial amount of BOD to the plant effluent. During evisceration, workers hands are in contact with recoverable viscera, offal, and bacterial pollutants. Constant supplies of fresh water are used to wash workers hands and recoverable viscera, and to transport waste heads, feet, and offal down a flume to a screening operation. The nature of the waste and its high bacterial content make it inadvisable to reuse offal flume water in any process in which it can contact poultry products; however, in noncontact processes such as feather fluming it may be possible to reuse even this water. Gizzard cleaning water is similar in nature to the eviscerating trough water and should be treated similarly. Lung vacuum pump effluent is low in quantity and usually may be incorporated with the offal flowaway.

Wastewater from the final bird wash after evisceration will contain grease, blood, and scraps of meat. This has been measured at 0.8 gallons of water per chicken and 440 mg/l of BOD, but it will vary depending on the type of mechanical spray head used.

Final bird wash water, used to wash both the inside and the outside of the carcass, should normally be the freshest water possible and must be conducted with potable water according to USDA. This wash water may possibly be reused in another sub-process within the plant. All bird washing processes may be improved by the use of special water spray nozzles that minimize water use.

Chilling

Other than general plant cleanup, chilling of processed poultry is the final step associated with wastewater. Chillers are often separate for giblets and carcasses. BOD concentrations of giblet chill water have been measured as high as 2,357 mg/l, while the BOD concentrations of the two stages in a body chiller have been measured to be 442 mg/l and 320 mg/l[5]. The overall water demand for chillers is approximately three quarters of a gallon per chicken. USDA requirements are one half gallon of water usage per chicken. BOD production in a body chiller is on the order of 7.4 lb per 1,000 birds.

Chiller water requirements are established by the USDA and little can be done to reduce them. However, screened chiller water overflow has a great potential for reuse elsewhere in the plant. Also, measurement of water in the slush ice added to chillers should be credited against minimum chiller requirements.

Dry Cleanup

The basic processes presented above have been constrained by the limitation of using a flowaway system. Dry cleaning of feathers and dry removal of waste offal have a large potential for reducing wastewater flows and concentrations and were the processes in general use before industry conversion to "modern" flowaway systems. It is understood that flowaway systems have provided quicker and more economical automatic processing in an age of rising labor and food costs, yet new regulations on wastewater qualities may force processors to compare wastewater abatement costs with the return to more labor intensive, in-house dry cleanup systems.

Dry cleanup of feathers from defeathering operations may be performed manually or automatically, brushing feathers to a dry collection point where there is a limited storage before removal by a renderer. Vacuum removal of feathers may be automated and similarly provide for a central dry storage. Residual feathers clinging to the carcasses and to equipment may be washed away with greatly reduced quantities of water and substantially reduced feather screening facilities. The area of dry mechanical feather collection has great potential for an enterprising equipment manufacturer.

Dry removal of evisceration wastes will reduce wastewater constituent concentrations and some water flowaway requirements. Studies have shown that if waste solids from evisceration are put directly into containers at the table, effluent from evisceration would contain 6 to 8 lb BOD per 1,000 chickens[4]. This compares to a total evisceration- and gizzard-flowaway BOD of 12.2 lb. Finally, heads may be pulled and dropped directly into containers with no water use whatsoever.

By-Product Recovery

Dry or wet recovered feathers may often be sold to rendering facilities for processing as protenaceous animal feed. New agricultural foam products for field application use poultry feathers as a raw material. The products control insects, temperature, weeds, and humidity on the field.

Offal collection may also be economically attractive with a rendering plant located in the area. Rendering plants and some farmers will convert offal to animal feed or return it to the soil.

Recovered blood can at times be sold to rendering plants and rendering plant delivery trucks can be equipped with blood holding tanks to make pickup of the blood more economical and attractive to the renderer. In 1972, blood, feathers, and offal were sold to renders in Florida at the rate of $9 to $10 per 1,000 broilers processed.

In the 1970 survey performed by the USDA, it was found that 0.6 percent of processing plants did not salvage offal, 70.8 percent of the plants sold offal to renderers, 1 percent gave offal to renderers, 26.6 percent rendered offal "in-house," and 1 percent dumped or burned collected offal[1]. The same study revealed that blood was not salvaged by 14.2

percent of the plants, sold to renderers by 54.6 percent, given away by 7 percent, rendered in-house by 22.4 percent, and dry disposed by 1.8 percent. Feathers were wasted by 0.4 percent of the plants, sold by 71.6 percent, given away by 0.8 percent, rendered in-house by 25.9 percent, and burned or dumped by 1.3 percent.

Housekeeping

In-plant cleaning of equipment and housing is an important source of pollutants. When scald tanks are emptied at the end of a processing period, for example, they contribute a heavy slug load of dirt, feathers, blood, and grease. Little can be done to reduce the waste flow from this cleaning. In other areas, floors and tables should be swept prior to washing to remove gross solids in dry form to storage containers where the contents could be used for rendering. Floor drains and outlets should be accessible to wastes only during final cleanup after sweeping. Screens placed on the drains of non-flowaway plants will prevent gross organic solids from reaching the sewer system. Organic solids in flowaway plants may be processed through the offal and feather recovery screens. Floor washing and general sanitation is imperative, but there is no reason to provide large quantities of water to wash bulky solids through drain lines.

Employee awareness of the cost of water use will result in improved housekeeping procedures. Letting water hoses run freely on the floor between uses is wasteful and employees should be encourages to make the effort to turn off the water. Placing control nozzles on the hoses will facilitate this and will also help reduce water usage to the minimum necessary to do a good job.

Water Supply and Treatment Equipment

Improved spray nozzle designs at the Gold Kist facility were able to reduce fresh water usage in final bird washers by 60 percent, in hand washers at evisceration from 285 gpm to 100 gpm, and in whole bird washers from 45 gpm to 30 gpm. Mechanical improvements in the replacement of old free running hoses by a high pressure cleaning system using foam cleansers reduced daily cleanup water from 112,000 gpd to 46,000 gpd. Even plants not contemplating process changes or internal reuse of water can noticeably reduce fresh water usage and wastewater flow by the installation of the best available spray heads and cleaning equipment. Varying line pressures and water demands in different parts of the plant can make automatic or timed spray equipment nonfunctional. Pressure control valves placed at strategic locations in the plant can prevent such difficulties.

Screening is a vital process in the reuse of waste streams and general reduction of poultry plant waste. Rotary drum screens along with stationary flat screens have long been used for by-product recovery. The newest trends are toward vibrating screens which operate at higher efficiencies and are not as subject to clogging and overflows. But in any case, screening of feathers and offal should be done in separate channels by separate screens to facilitate water reuse without cross contamination.

Tabulated Water Analyses

A report released by the USDA(1) estimated total BOD and suspended solids production for poultry processing plants based on production figures and various sources for pollutant loads. The various sources resulted in Table 1 which lists a collection of coefficients for by-products, water use, and waste loads, to be applied to production figures. It must be noted that Table 1 may be reasonably accurate on quantities of by-product, but the numerous variables of processing, such as poultry type, water usage, spray nozzle design, cleaning practices, and screening efficiencies, make predictions on water use and wasteloads a gross estimate at best. Based on the values in Table 1, however, it was estimated that a typical poultry processing plant releases wastewater with a BOD of 448 mg/l and suspended solids of 344 mg/l. This is in agreement with our experience which indicates BOD's of 450 to 600 mg/l and suspended solids of 300 to 400 mg/l.

TABLE 1

COEFFICIENTS USED IN ESTIMATING BY-PRODUCTS, WATER USE AND WASTELOADS OF POULTRY SLAUGHTERING PLANTS

Variable	Unit	Value per 1,000 pounds 1/
By-products:		
Blood		
Young chickens.............	Pounds	70
Mature chickens............	do.	70
Turkeys....................	do.	70
Other poultry..............	do.	70
Offal		
Young chickens.............	do.	175
Mature chickens............	do.	170
Turkeys....................	do.	125
Other poultry..............	do.	140
Feathers		
Young chickens.............	do.	70
Mature chickens............	do.	70
Turkeys....................	do.	70
Water Use:		
Young chickens..............	Gallons	2,198
Mature chickens.............	do.	2,173
Turkeys.....................	do.	1,700
Other poultry...............	do.	2,100
Cut-up......................	do.	500
Further processing..........	do.	500
Wasteloads:		
BOD--		
Young chickens.............	Pounds	8.2
Mature chickens............	do.	8.7
Turkeys....................	do.	8.0
Other poultry..............	do.	8.0
Suspended solids--		
Young chickens.............	do.	6.3
Mature chickens............	do.	5.4
Turkeys....................	do.	5.0
Other poultry..............	do.	5.0
Time span of operation 2/:		
Young chicken, mature chicken, and other poultry plants...	Days	234
Turkey plants...............	do.	130

1/ Live weight except for cut-up and further processed coefficients which are ready-to-cook weight.
2/ These coefficients are based on a maximum of 260 operating days per year. We assumed that the chicken and other poultry plants operated at 90 percent capacity--0.90 x 260 = 234. Turkey plants were assumed to operate at 50 percent capacity--0.50 x 260 = 130.
Source: Environmental Protection Agency, Industrial Waste Study of the Meat Products Industry, 1971; U.S. Department of Agriculture, Processing Poultry By-products in Poultry Slaughtering Plants, Marketing Research Report No. 181, 1957; and industry contacts.

SUMMARY OF RECOMMENDATIONS

The changes that may be made in each plant to reduce water usage will depend upon the particular circumstances at that plant. A general list of steps for improved water management, which may be used as a framework by each poultry processor for their own actions is presented:

1. Choose a person specifically responsible for water management. This person should have reasonable powers to make and enforce changes.
2. Determine where water is used and in what quantities.
3. Install flow meters and pressure gauges in major flow areas.
4. Install water pressure regulators to prevent gross line pressure variations. This will help prevent occasional oversupply at unit points in the process.
5. Tackle each unit process to determine possible water use reductions.
6. In receiving area, dry sweep wastes to receptacles before washing floors.
7. In receiving area, replace open garden type hoses with nozzles that given high velocity spray, reduced water flow, and that may be turned off at point of application.
8. Cleaning with detergents and cleansers may further reduce water usage and will certainly produce a more hygienic area.
9. Stun carcasses electrically at slaughter to prevent body movement and splattering of blood.
10. Confine bleeding to a tunnel or enclosed area where blood for collection may easily be accomplished. Recover the blood for rendering or farmland disposal and do not let it into waste stream.
11. Use the minimum approved USDA quantities of water that will maintain your temperature.

12. Reuse screened chiller water as scalder feed water. Consider simple heat exchange between scalder overflow water and scalder boiler feed water.

13. Pay attention to new developments in vacuum removal of feathers in defeathering. Consider an application of such a system when practical.

14. Screen feather flume water and reuse in the feather flume.

15. Install spray nozzles on bird wash that will get the job done with a minimum amount of water.

16. Place nozzles on hand washers and evisceration meat washers that will clean adequately with minimum water use. Body or foot control valves can supply water only when it is needed for hand washers. Timed sprays can wash evisceration solids away with no wasteful water use between bursts.

17. Measure the ice-slush added to chiller water and credit it against chiller water overflow requirements.

18. Keep all screens in perfect working order. A clogged and overflowing screen costs the processor money.

19. Use dry cleanup in plant prior to "wet rinse" to reduce water use. Collect dry solids in container for disposal or rendering.

20. Consider institution of dry removal of wastes, such as on-site containers for heads.

21. Recover all possible by-products to improve the economy of in-plant water management.

22. Stimulate employee awareness of the expense and undesirability of poor water management. Encourage employees to be careful of their water use.

FUTURE EFFORTS

The methods for reducing water usage as discussed in this report are but a part of what can be accomplished toward recycling of water and reducing fresh water demand. The ultimate goal for industries, as envisioned by some people, is total reuse of water or zero pollutant discharge. Such an ideal goal may never be realized, but pressure will be brought to bear to approach it. Wastewater treatment will become more expensive in the future and incentives for in-house flow reductions will substantially increase.

Several water reuse schemes have been considered. These include total reuse of screened offal water in the evisceration flume, use of screened whole bird wash water in the scalder on the premise that the bird will contact water of that quality anyway, reuse of screened final wash water in the gizzard machine, and reuse of chiller water in the final bird wash. These schemes have not been approved by the USDA. They do, however, have the potential of reducing water usage by 18 percent over that in an uncontrolled plant. In time a detailed study will need to be conducted on these methods, not only to verify their technical and economic practicality but also to safeguard the public health.

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THE GOLD KIST CASE STUDY

by

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INTRODUCTION

My presentation will focus on the impact of in-plant process and equipment changes on water use and waste abatement in poultry processing. An attempt will be made to: (1) present the results of a research, development, and demonstration project conducted in the Gold Kist plant at Durham, North Carolina; (2) interpret the usefulness of these results for improving the operation of your plants.

A detailed study of opportunities for water and waste reduction was made throughout the plant. There has been a 30 percent reduction in water use (580,000 gallons versus 838,000 gallons) and a 65 percent reduction in waste discharged to the city system (1,400 pounds versus 4,000 pounds of BOD). Blood from the killing room has been effectively eliminated from plant effluent, and feathers in the plant effluent have been controlled. Biological quality of the final product has been maintained.

The Water Quality Office, Environmental Protection Agency, and Gold Kist supported the study on a 70-30 cost-sharing basis. North Carolina State University provided technical and research requirements including a biological evaluation of all phases. Effectiveness of the project has been greatly enhanced by the full cooperation of the Poultry Inspection Group at all levels.

THE STUDY

One of the special features of this project was the joint development of the project. The demonstration project, although conceived by the University and EPA, was asked for and granted to the Gold Kist organization. The actual tests were run at their Durham plant. The Durham facility was managed by Mr. Byron Hawkins with Mr. Lawrence Carter as the in-plant project director, and the project became known as the Gold Kist Study. The North Carolina State University (NCSU) role, which is very unusual in a research project of this type, was involved with Gold Kist in what we call a subcontract. We had from the Department of Economics Dr. Crosswhite and myself, and from the Food Science Department Mr. Roy Carawan, Dr. Marvin Speck and Dr. Fred Tarver who gave unlimited assistance, and led to the interdisciplinary research team.

Since the trend of poultry production has been a great increase over the past two decades, and the total production in the United States in 1970 was approximately 3,000,000,000 birds, we began this study with the realization that the cost of water and wastes could be very significant in poultry processing. Although the unit costs are small, they are still significant. When only approximately 7.3 cents per pound exists for live hauling, processing, selling, delivery, and profit, and you add a cost of 0.1 to 1 cent per bird, it becomes very significant.

We started developing the project with the belief that managers in poultry processing would act providing they had the necessary knowledge.

We didn't believe that the supervisors and managers knew how much water they were using. We also didn't believe they knew how much wastes were being discharged or where they were coming from.

Now, getting to the specific objectives of the project: (1) to install and/or modify the processing equipment itself. What could we do in modifying the equipment that was in the plant to enable it to use less water, to generate less wastes? (2) to evaluate the impact of these changes. How much water reduction would a change make? How much waste would one of our changes eliminate? (3) to determine the economic implications of these changes. Could a poultry plant justify the expenses of the process modification? In other words, would we save enough water and would we eliminate enough wastes to justify spending the money to make the changes? Not all of our changes panned out. We didn't expect them to, and this is why we had the demonstration grant. If we had the answers before we started, we wouldn't have to do the work.

Our basic plan of work was first to obtain bench mark information. By bench mark information, we mean just how much water was used in the plant. Where were the wastes coming from in the plant? This was just to give us an overall feel for what was going on. The second thing was to approach the technical developments in the plant itself. These were the process modifications or changes.

The applied systems analysis was done by Mr. Bob Ward a graduate student in the Biological and Agricultural Engineering Department. The supporting biological work was done by Dr. Marvin Speck, Food Science Department. Our reason for the biological work was that as we were making these water reductions and eliminating wastes, we had to assure ourselves and the USDA that the wholesomeness of the birds was not affected. We appreciate the cooperation of USDA in this projcet. They helped us in deciphering regulations, analyzed our work, and helped keep us on an even keel. Also, we appreciate all the cooperative work relations. There were the employees of the Environmental Protection Agency; the state water resource people, the Water Resources Research Institute and the university staff.

The way we approached the bench mark data and the biological work was to go to different points in the plant. We took each unit operation in the plant and looked at it in its entirety. For example, we took the scalder exit; the chill entry and the pre-chiller, water samples to determine where the wastes are generated. Then we added these up for the total waste stream of the plant. Also, we did the same thing for the biological work.

Now if you wonder what this means just in North Carolina, in 1971, we produced somewhat over 300 million birds. Using average water use figures, this amounts to over 3.60 billion gallons of water that was used in North Carolina last year for the processing of poultry. From two to ten million pounds of BOD_5 were discharged from the plants. You will notice I used a wide range there. It all depends on whose figures you are using for what plant. We do not have figures on most of the plants so I am averaging these myself. But I would say somewhere in the two to ten range and this shows you the magnitude of the problem. There is quite a lack of information in this area and this is one of the problems and one of the reasons that we started the project.

PROCESS AND EQUIPMENT CHANGES

Look at this project from the standpoint that we were primarily using the plant as a "laboratory in action." We made mistakes; we purchased materials that were not suitable for the job, but in making our mistakes, we were able to say these mistakes led to success. It is very hard to measure the quantity of goods going out of a plant, but water was squirting out of so many places in this plant it seemed impossible to measure all of the water going out. At the beginning the volume was close to a million gallons a day.

Flow Measuring Devices

Measuring devices that we used were Parshall flumes, water meters, V-notch weirs with automatic recorders for the large flows. With a bucket and a stopwatch you can find out how much water is being discharged from small sources.

Housed above our Parshall flumes were Thompson recorders that recorded the total flow of the water. Measuring to get the original volumes was one of the first things done throughout the plant. We put in water meters in just about every logical place to measure the daily volume of water. We could then monitor what was happening in each individual process. Meters were a very important part of our testing program.

The next thing was to find out if we could get the same results twice. Let me say that you can take samples all day long only to find out that if a worker comes in the next day and opens up the valves differently than he did the day before, you are right back where you started. You don't know how much of what is passing through where. So the first thing we learned to control the flow by regulation. Before we could ever get a uniform pattern on waste generated in this plant, we had to get regularity of processing or at least some uniformity of operation.

Blood Collection and Control

One of the first major equipment developments was one of the most difficult of all. The high BOD, concentrated blood was being scattered over everything in the blood tunnel. A stainless steel, sheet metal trough container was fabricated. A series of electrical shocking bars were used so the birds could be stilled by the shocking machine early after being killed. The body and the feathers are now kept clean, the blood is well contained in the trough; therefore, we are collecting not only the worst pollutant in the plant but it is now a good by-product.

Scalder

Reuse of chiller water eliminated the use of fresh water for scalder make up. Our primary objectives were to do two things: to reduce wastes but at the same time minimize our water usage, and this was one case in which we are minimizing the water. The scalder is a chamber used to heat up the birds and wet them so that the feathers can be flailed from the birds. In this case instead of using regular fresh water, we installed the recirculation pumping system to go back to the scalder. This was a reuse of water and put the water from the chillers into the scalding machine.

Defeathering

Flow away flumes were redesigned to efficiently remove the feathers from beneath the pickers with the use of less water. Water for this purpose is now solely supplied from the screened eviscerating line effluent.

Whole Bird Washers

Small opening and higher efficiency spray nozzles were installed in both washers. Regulations and control valves were also installed in the water supply line of each bird washer.

Evisceration

a. Hand Wash Outlets -- The largest volume users of water in this plant are the little hand nozzles at each eviscerating station along the evisceration line. Spray nozzles are used by the workers to both cool and rinse their hands from bird to bird. When we first went to the plant they were using shower heads just like the ones found in home showers. Instead of washing their hands, the volume would be equal to the amount for washing a whole human being. The shower type nozzles used three and a half gallons per minute. Our last nozzles use about 0.4 gpm.

Water flow rates vary slightly from place to place and station to station. However, with this drastic reduction in the amount of water these operators today do just as good a job as when they were using three and a half gallons of water per minute per nozzle.

Very important is the pressure gauge regulating the flow out of these nozzles. Here is what was happening to Durham prior to this study.

The pressure going into the plant might be the same but due to the variable use of the water throughout the plant, the pressure would bounce up and down like a rubber ball and would range anywhere from about thirty-five to forty pounds up to eighty pounds or more. When the pressure ran up high, these nozzles would fog, and wet you as if you were going through a shower of rain. Before we could even use the nozzles the water pressure had to be regulated to them.

Shown in our slide is a tickler nozzle. This nozzle has not been approved by the USDA. A tickler type hose nozzle is like one you would have seen at a service station that quits running when you drop it down. We have found the total bacterial count on this nozzle was very low, and we are going to pass the information to the USDA for their evaluation hoping that some day this nozzle may become useful to you. It does cut the water off completely. It will not run until you push this little bar to one side. They are sold by your local supplier.

b. Side Pan Wash -- Another thing we wanted to do along the eviscerating line was to further reduce the amount of water. We found that the pan on each side has to be flushed with water to keep the slides clean while the workers are working. If I could show the regulating valve, it would be a timed unit. When the water is on, it flows full force to properly flush the surface of the eviscerating pan, and then an electric timer cuts that water off immediately. It stays off a predetermined length of time, and then it is turned on again. We have found that this sequence gives a very clean surface along the pan while reducing the amount of water used. Before, in trying to control the water they had reduced the flow by merely cutting back on the amount of water flowing down the pan. Here, we felt like it needed the full force of the water to clean the total surface of the pan, and yet, we did not need it every moment of the operating time.

Final Bird Washer

New high efficiency nozzles were installed in these process units to improve the cleaning action while applying a smaller volume of water per bird processed. Good regulation was obtained with the control valves and water pressure gauges as described previously. By use of the quick opening shut-off valve the employees will even turn the water off during break periods, lunch, and downtime.

Chillers

By the USDA regulations one half gallon of water per bird is required. To assure this quantity they require water meters for verification. To cool the water in the chiller and subsequently the birds, ice is being put into the chillers through a slush water system. This plant gets no credit for the amount of water used against the amount required. As soon as a device is developed or engineered to measure the slush ice, we can reduce the amount of water running into the chillers by the quantity that is flowing as slush ice.

Packing

In many plants ice is used on top of the product to keep it cool during transportation. At a considerable cost Gold Kist installed a CO_2 snow system in their plant to replace this use of ice. This replaced 15 pounds of ice per 65 pounds of product or the equivalent of nearly 2 gallons of water.

Plant Clean-up Water

Last but by no means the least was the sizeable volume of water being used to clean all the processing equipment, building, and receiving yard area. Several types of new chemical formulations were tried. Combined high pressure spray equipment and chemicals were used in the final selection to minimize the volume of water used, reduce the time for cleaning, reduce the chemicals needed and reduce the overall cost for the total clean-up operation.

Final Waste Water Collection and Control

To further reduce the suspended solids and grease in the plant's final wastewater effluent, a commercial air flotation and skimming mechanism was purchased including the associated pumps, sumps, tanks, and by-product holding chamber. Although this was not strictly an in-plant change the additional by-products recovered increased yield and by-products income while further reducing the waste surcharge cost. With both cost advantages it has been economically feasible to install and operate this air flotation system.

SUMMARY OF RESULTS

Given in Table 1 is the volume of water that was being used for all purposes in the processing of approximately 70,000 birds per day. This bench mark data indicates a usage of nearly 13 gallons of water for each bird processed. It also identifies where the water was being used in the plant at the beginning of the project.

Shown in Table 2 is the bench mark data relative to the waste characteristics of selected wastewater flows throughout the plant. These values are averaged over several weeks of testing.

The bench mark data presented some interesting points that can be examined in Table 1. The total water consumption is about 840,000 gallons per day. The important point is that the eviscerating trough itself accounted for appoximately 200,000 gallons of this 840,000 total. This consisted of the hand-wash outlets and the side pan wash. The other area with a tremendous amount of water use is the gizzard machine and the gizzard splitters where there is 194,000 or almost 200,000 gpd so the eviscerating trough and the gizzard operation consume almost 50 percent of the total water used in the whole plant.

Another thing I would like to point out is for those of you associated with hoses, a hose used for ten minutes uses 340 gallons. One hose used for one hour is 2,000 gallons of water. How many times in your poultry plant do you see hoses just running? Realize that that is 2,000 gallons of water an hour going down the drain from that hose laying on the floor. Also, why do you not have nozzles on the ends of the hoses?

TABLE 1

Process	Source	Flow Rate (gpm)	Total Volume (gal)
1. Killing Station		2.0	1,080
2. Scalder	Fresh	38.7	20,898
3. Pickers	Fresh	38.0	20,520
4. Feather Flume	Fresh	94.3	50,922
	Chiller Effluent	54.6	--
	Re. Offal Water	111.7	--
5. Neck Scalders	Fresh	1.5	810
6. Whole Bird Washers	Fresh	37.3	20,142
7. Defeather Cleanup Hose (1 @ 1 hr.)	Fresh	34.0	2,040
8. "Hang-Back" Belt	Fresh	9.1	5,460
9. Eviscerating Trough			
a. Hand Wash Outlets	Fresh	285.0	153,900
b. Side Pan Wash	Fresh	90.0	48,600
10. Final Bird Wash	Fresh	100.0	54,000
11. Lung Vacuum Pump Effl.	Fresh	14.2	7,668
12. Gizzard Machine & Giblet Flumes	Fresh	360.0	194,400
13. Evisc. Cleanup Hose (2 @ 30 min. ea.)	Fresh	72.0	2,040
14. Giblet Chiller	Fresh & Ice	4.5	2,430
15. Neck Cutter	Fresh	4.0	2,160
16. Chillers	Fresh & Ice	72.1	38,934
17. Packing Ice	Ice	15 lbs/box	6,111
18. Bird Pickup (10% in chillers)	Fresh	--	8,640
19. Packing Cleanup Hoses (3 @ 10 min. ea.)	Fresh	102.0	1,020
20. By-Product Cleanup Hoses (1 @ 10 min.)	Fresh	34.0	340

Normal processing day runs from 7:00 a.m. - 4:00 p.m.

Water Meter Readings: a. Processing (7:00 a.m. - 4:00 p.m.) = 725,600 gpd
b. Cleanup (4:00 p.m. - 7:00 a.m.) = 112,200 gpd
Total 837,800 gpd

Undetermined Process Water: 850,000 - 837,800 = 12,200 gpd

Note: Cleanup hoses are used to rinse off equipment at break periods and lunch during processing operation.

TABLE 2

BENCHMARK DATA ON WATER AND WASTE
GOLD KIST PLANT
DURHAM, NORTH CAROLINA

DECEMBER, 1969

		BOD	COD	Solids Total	Solids Dissolved	Solids Suspended	Grease
1.	Scalder Entry	1,182	2,080	1,873	1,186	687	350
2.	Scalder Exit	490	986	1,053	580	473	200
3.	Whole Bird Wash	108	243	266	185	81	150
4.	Final Bird Wash	442	662	667	386	281	580
5.	Giblet Chiller	2,357	3,959	2,875	1,899	976	1,320
6.	Chiller I	442	692	776	523	253	800
7.	Chiller II	320	435	514	331	183	250
8.	Feather Flume	590	1,078	894	382	512	120
9.	Eviscerating Flume	233	514	534	232	302	430
10.	Plant Effluent	560	722	697	322	375	150

Note: All values are in mg/l

Why is this water wasted? Is an employee too lazy to go over and turn it off because in thirty minutes he is going to want to use it again so he leaves it running?

Getting into the area of reduction and to summarize the results -- It may be interesting for you to know a little something about the City of Durham. This plant was consuming approximately 10 percent of fresh water production of the City. We reduced the water from 838,000 gallons per day or something more than that to in the neighborhood of 580,000 gallons per day. This total reduction is 30 percent or a little greater. The amount of BOD_5 coming out of the plant in pounds was reduced from 4,000 pounds a day to 1,400 pounds. This is approximately 65 percent reduction in wastes. The BOD of the effluent at the present time has been reduced from 600 to 300; and with the final air flotation system it has been reduced to 200 mg/l. Grease of 200 mg/l was reduced to 90 mg/l in the plant and further to 40 mg/l by use of the air flotation mechanisms.

The reductions in the various areas of the plant, are given in Table 3. In the evisceration area the use of improved nozzles in the final bird washer reduced the potable water consumption from 50 GPM to 30 GPM. That is quite a reduction in itself, just by changing the nozzles. The hand washers resulted in a change from 285 to 100 GPM.

Cycling of the side pan wash was originally about 90 GPM. Now it has been reduced down to 30 GPM. Of course, this would depend on the time period and effect of the cycling and other things, but this is on one particular set of conditions.

TABLE 3

WATER REDUCTION DEVELOPMENT ACTIVITIES BY AREA OF THE PLANT AND CHANGES IN FRESH WATER

Area of Plant	Activity	Reduction in Fresh Water Use	
		From	To
Evisceration	Use of improved nozzles		
	Final bird washers	50 gpm	30 gpm
	Hand Washers	285 gpm	100 gpm
	Cycling of side pan wash	90 gpm	30 gpm
	Rearrangement of giblet handling	360 gpm	320 gpm
Scalding and defeathering	Use of improved nozzles in whole bird washers	45 gpm	30 gpm
	New design of feather flume for reuse of offal flume waters	94 gpm	0
	Use of chiller water in scalder to replace fresh water	40 gpm	0
Cleanup	New high-pressure cleaning system with foam	112,000 gpd	46,000 gpd

In the rearrangement in the giblet handling, we made a small reduction there. Another area where we made an impact was in the eviscerating flume water, by changing the design of the feather flumes. We eliminated the fresh water that was going into these and eliminated 94 GPM. Previously they had some additional fresh water hoses stuck in the flumes trying to flush the feathers down because they weren't moving properly. Multiplying this flow by sixty, you come up with a figure of 6,000 GPH.

The dramatic reduction of water used in clean-up has been caused by the installation of new equipment coupled with good chemical utilization.

Not to be overlooked is the reuse or multiple continued use of process waters. The best example of this type application is the fresh water first used in final chiller. Then it is pumped to the prechiller. The collected effluent from the prechiller is then skimmed and pumped into the scalder as make up water. As a scalder effluent the same water discharges into the feather flow away flume to assist in transporting the feathers to the by-product recovery screens. Thus the water is finally discharged in the plant's final drain.

This multiple use of water was responsible for most of the reduction of fresh water in the feather flume and 40 GPM as continued-used chiller water.

Figure 1 depicts the total plant operation from the period of setting up to March of 1971. The heavy line represents water used, and the dashed line waste discharged. The trend is down to just over eight gallons per bird received. Waste discharge was up about .045 pounds of BOD per bird, and now we are down to .025. These have been reduced slightly as far as what goes into the city system by the use of the air flotation system.

Most of you who are in a city know when you buy water you are charged for water and sewage. The water, sewer, and surcharge costs are shown in Table 4. For those of you who have a surcharge, you will add this additional cost. At the beginning of this project the water bill was running $6,446 a month. Then after some changes were made, it was running $5,382. You say that is not much different? Before that the water and sewer costs went up by 20 percent and the surcharge was enacted. If the changes had not been made in the plant, their water would have been in excess of $11,000. The difference is more than $6,000. The surcharge alone would have been about $3,600. The water and sewer charges would have been over $8,000 per month.

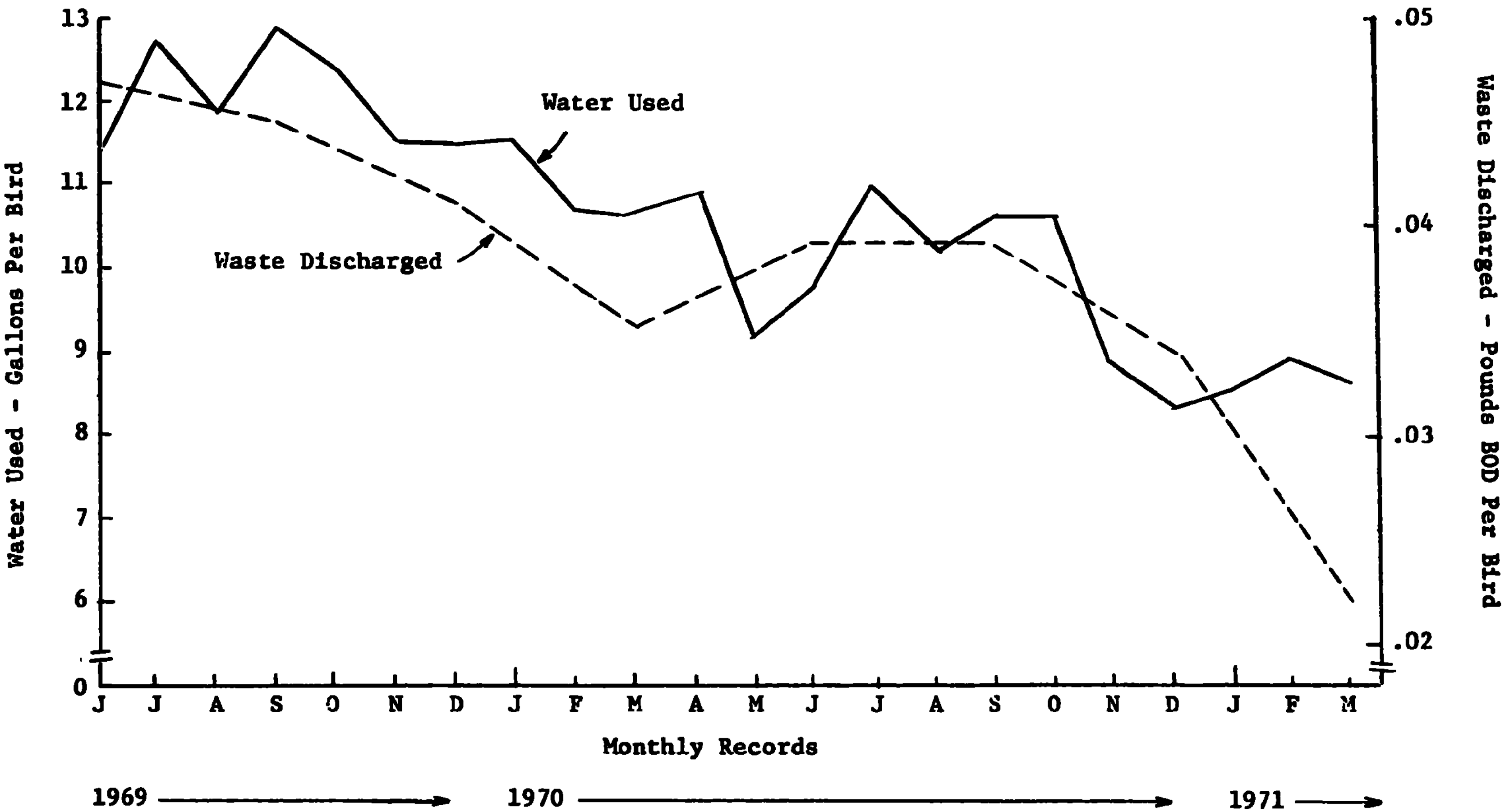

Figure 1 Quantity of Water and Waste Per Bird, Gold Kist Plant, Durham, N. C.

TABLE 4

WATER, SEWER, AND SURCHARGE COSTS
FOR SELECTED MONTHS

Item	Month	
	July 1969	December 1970
Water	$ 3,069	$ 2,157
Sewer	3,377	2,372
Surcharge	--	853
Total	$ 6,446	$ 5,382

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WATER SUPPLY IN OFFICIAL POULTRY PLANTS

by

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WATER SUPPLY IN OFFICIAL POULTRY PLANTS

The amount of water per bird used in poultry processing increased significantly during the middle and late 1950's when most poultry plants remodeled for government inspection and at the same time installed flowaway systems for moving organic waste and flumes or pumps for moving giblets. Since that time, further mechanization such as continuous chillers and gizzard machines has added still more to the demand for clean water.

Section 381.50 of the Poultry Products Inspection Regulations outlines the general requirements for water. More detailed references may be found in the Poultry Inspector's Handbook and The Guidelines for Implementation of Sanitary Requirements in Poultry Establishments. Some of the provisions of Section 381.50 are as follows:

1. The water supply shall be ample, clean, and potable; the pressure and facilities for distribution must be adequate and protected against contamination and pollution.
2. A water potability report issued under the authority of the State Health Agency, certifying to the potability of the water, must be provided.
3. Nonpotable water must be restricted to parts of the plant where no poultry product is processed or otherwise handled and then only for limited purposes such as condensers not connected with potable water supply, vapor lines serving inedible product rendering tanks

and in sewer lines moving heavy solids in sewage. Nonpotable water shall not be permitted for washing floors, areas or equipment, nor in broilers, scalders, chill vats or ice making machines.

4. In all cases, nonpotable water lines shall be clearly identified and shall not be cross-connected with potable water supply unless it is necessary for fire protection. Any such connections must have adequate breaks to assure against accidental contamination and must be approved by local authorities and the Administrator.
5. Any untested water supply in an official establishment must be treated as a nonpotable supply.

In reviewing Section 381.50, it can be seen that the use of nonpotable water is very restrictive. A good question then is - where can water be reused?

Pages 4 and 5 of the Poultry Inspector's Handbook outline areas and conditions under which water from chilling units, condensers, and compressors may be reused. I might also add that while it is not mentioned in any of these references, recirculated water from the refuse room is permitted in the drains to float feathers in the picking room. This drain is then considered the same as a sewer and any carcass that makes contact is condemned.

In permitting chilling water reuse, the Handbook may appear to contradict Section 381.50. The Handbook is taken by USDA Inspectors as the official, working interpretation of Section 381.50 and administratively is much easier to update or amend.

The Handbook provides that water from poultry chilling units may be reused:

1. To aid in the movement of heavy solids in the eviscerating trough, but not for flushing inner surfaces or side panels of the trough.
2. After removal of visible solids by screening for:
   (a) Scalding tanks
   (b) Flushing feathers from the picking machine aprons
   (c) Feather flowaway
   (d) Washing down the floor in the picking room, or
   (e) For hardening the wax in pinning operations.

Water from condensers or compressors may be used in any of the locations stated above provided the system is closed and there is a vacuum break in the line to prevent back siphonage. It may also be used for any other purpose in the plant where artificially heated water is permitted provided it is covered by a potability certificate issued under authority of the State Health Agency.

If pumps or pipes are required to convey water intended for reuse from condensers, compressors, or chilling units, they must be of the same type that can be readily dismantled as required for sanitizing.

Specific amounts of overflow water in giblet and carcass chilling units are required, and the Handbook suggests a minimum amount of overflow from scalders. All other requirements regarding the amount of water required are on an "adequate amount" or what is necessary basis.

Sanitary processing requires enough running water on goose-neck washers to keep hands and hand tools rinsed, enough on bird washers to thoroughly wash each carcass, and enough on equipment to keep contact surfaces rinsed. In addition, some non-contact surfaces, such as the inside of troughs, must be continuously rinsed to prevent accumulation of waste. There is, however, a difference in an adequate amount of water and a wasteful amount. Many plants waste water -- by running more than is required or necessary, or failure to cut it off when no longer needed, or both. In many instances, water can be saved by paying more attention to plumbing.

Most plants now take advantage of melted ice to count toward the required overflow in the first chilling unit, but few that I know of have made any attempt to utilize the overflow water from chillers. Perhaps that is because it is not generally needed in the areas where permitted. Most plants do utilize some source of recirculated water to move feathers to the refuse room.