Symposium: Water Reuse and Conservation in Poultry Processing

Water Reuse and Conservation in Poultry Processing

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ABSTRACT Water consumption during the processing of poultry has continued to increase. Water treatment costs now are more than 10% of total processing costs, primarily due to the ever-rising costs of energy and labor. This paper attempts to review the "state-of-the-art" in water conservation and pinpoint ways in which water usage can be reduced during processing of poultry. (*Key words:* water conservation, diatomaceous earth filter, chilling poultry carcasses)

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DISCUSSION

The ever-rising costs of all kinds of energy have skyrocketed and since 1974 are estimated to have quadrupled. During 1982, the cost of water and water treatment in poultry processing plants amounted to about 11% of total processing costs. In Harrisonburg, VA, the center of poultry processing in Virginia, the city sells its water and wastewater treatment at about $3.50/1000 gal (3.785 liters). One large plant located there pays nearly $26,000/month for water and sewer charges. There are two main solutions to the problem of reducing water pollution from processing plants. The first is to continue present practices and to build ever larger, more complex, more costly treatment systems, until the necessary effluent quality is achieved, or owner bankruptcy is filed, whichever comes first. This is about the way the problem has been approached. The second method is to improve scientifically the systems used in processing plants, so that lower volumes of less-polluted water are generated. Our National Pollution Discharge Elimination System (NPDES) requirements have helped some, but more help is needed. What is needed, in my judgment, is for our regulatory agencies, Environmental Protection Agency (EPA) and US Department of Agriculture (USDA), to allow technology currently available for reuse of processing water and to reduce current requirements for chiller overflow by about 50%. This combined with filtration processes, can result in less hydraulic volume and lowered total effluent strength. The chiller overflow requirement alone is responsible for 2.18 billion gal (8.25 billion liters)[1] [.5 gal (1.89 liters)/bird for 4 billion broilers, and 1 gal (3.79 liters)/bird for 1980 million turkeys]. This could be reduced by 50% with no detrimental effect on carcass quality. Poultry processing plants have four major sources of wastewater: 1) scalder and chiller overflow, 2) viscera carriage flume, 3) handwash stations and evis trough rinses, and 4) plant sanitation efforts.

Broiler processors used 9.3 gal (35.2 liters)/bird in 1973 (Singh *et al.*, 1973), about the same in 1974 (US EPA, 1974; Witherow *et al.*, 1978), but had reduced this figure to 7 gal (2.65 liters)/bird by 1982 (Wesley, unpublished results) and have had similar reductions to broiler processors during the past 10 years. Obviously, great opportunities exist to reduce these values by sound water conservation measures. In the chiller and flume operations used in poultry plants, water potability is lost when the first poultry tissue contacts the process water. Major input of fresh water results in great energy losses but does not reestablish the original potable quality of the water in use. Hence, conserving of water must also conserve energy. Water reuse has been shown in a plant in Missouri to save 22 tons of ice/day (Anonymous, 1977). At this same plant, chiller overflow was pumped through a plate heat exchanger where it lowered incoming water by 13.3 C, resulting in such a savings in ice (Anonymous, 1977).

Efforts to reduce water in giblet processing (Carawan *et al.*, 1974) used a combination of final-bird and chiller-overflow for flushing gizzards in the splitting machines. These workers indicated that such reuse of these waters resulted in "no detrimental effect on either wholesomeness of the gizzards or the whole carcasses." The reuse of process water

for giblet fluming was examined (Lillard, 1978e) and found to be superior to chiller overflow water, but the organic content of splitter water was higher. This researcher (Lillard, 1978a) concluded that "if microbiological quality could be accomplished by bactericidal treatment, either source would be suitable for reuse." Carcass bacterial counts (Brant, 1974) of 10^5/ml showed little crosscontamination in an immersion chiller, when compared with carcasses entering the chiller at 10^9/ml. Therefore, the importance of lowering carcass contamination during chilling is dependent on the initial carcass bacterial level prior to chilling. Recycling of chiller water for chilling purposes has also been reported (Rogers, 1978). In this study, treatments were used that could maintain chiller quality with the use of filters. It was concluded that when solids and microbial populations were controlled, recycled effluents could replace potable makeup water without detrimental effect on carcass quality. By reuse of chiller water, it is estimated that $26 million could be saved annually by poultry processors (Lillard, 1978c). In this study, gizzard splitter or chiller water recycled without bactericidal treatment could be used with little effect on the product (Lillard, 1978a). Chiller water, filtered through diatomaceous earth and used for neck fluming, resulted in products that were microbiologically equivalent to necks flumed in potable water. This could, Lillard (1977, 1978b,c,d) said, "considerably reduce the requirement for potable water, as well as reducing the volumes going into waste treatment systems." (p. 00). The EPA studies (Hamza *et al.*, 1977; Witherow *et al.*, 1978) involving chilling, prechilling, washing, and scalding in Egyptian plants found a direct relationship in carcass quality when either one-third of the process water came from potable or from recycled water that had been screened and filtered through diatomaceous earth. A study was conducted at Sterling Processors in Oakland, MD (Clise, 1974), in which reclaimed water was found to meet the bilogical, chemical and physical standards of the 1962 US Public Health for potable water. It was concluded that it is technically and economically feasible to recycle totally poultry processing effluent, but it was not allowed, because "trace constituents could build up and be absorbed by poultry carcasses" (Andelman *et al.*, 1977). It was concluded (Andelman *et al.*, 1977) that "there would not be a significant health risk with a 50/50 mixing of recycled and potable water." (p. 00).

An attempt was made by Virginia Tech in 1976 (Wesley, 1977) to provide USDA/Food Safety and Inspection Service (FSIS) with documented evidence of the effect of 0, 50, and 75% reduction of chiller overflow on carcass microbiological and hygienic quality. The research included turkeys, broilers, and Cornish hens. Four carcasses were selected for 10 consecutive working days at 2-hr intervals during the process day for all the species (8 carcasses/day). A similar number were tested for chiller water turbidity and shelf life. The Virginia Tech workers concluded that there were no significant differences in carcass quality when as much as 50% chiller overflow reduction was provided, although there were slight increases in microbiological populations. No significant differences in chiller water turbidity or shelf life were noted. USDA/FSIS considered changing the chiller overflow requirement, but later rescinded their *Federal Register* proposal.

A Canadian study (Gallop *et al.*, 1981) is perhaps the most comprehensive study provided yet on water reuse in the processing plant. Gallop and coworkers developed a "closed-loop" system that provided only for replacement of water that left the chiller by carcass uptake and spillage. With the use of Powdered Activated Carbon (Hydrodarco Atlas Chemical Industries), antibiotics, and a very sophisticated filtering system, they demonstrated that chiller water could be reused up to 2 weeks with no detrimental effect on carcass quality. This procedure is still being studied by the regulatory agencies.

An attempt has been made in this presentation to summarize the state-of-the art in water reuse and conservation in the processing plant. Research is still being conducted, and USDA is testing a reprocessing method that seems promising. It would appear that the wheels of progress turn very slowly. The poultry processing industry could gain approximately $25 million annually in savings in energy and processing costs if the regulatory agencies would lower the chiller overflow requirement by 50%.

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