WATER CONSERVATION AND REUSE IN POULTRY SLAUGHTERHOUSE OF MATELANDIA-PR BRAZIL – A CASE STUDY

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1 INTRODUCTION

Water is an essential element for sustaining life. The concept of water being a never-ending resource with a limitless renewable capacity belongs to the past, before population growth and industrialization led to the reduction of water quality and reduced availability (Beekman, 1998).

According Mierzwa and Hespanhol (2005), changing the relationship between water availability and water demand can occur for some reasons: natural phenomena associated with the climatic conditions of each region and population growth, ever more pressing water resources either by increasing demand or pollution.

The water conservation and water reuse are very important tools to minimize water scarcity problems in urban and industrial areas (Matsumora, et al., 2008), but high investment costs for water reuse treatment technology is a relevant challenge that the food industries need to face. The drivers for implementation of water reuse practices in food industries is essential due to increasing demands on declining freshwater supplies, severe water shortages and dry periods, and the fact that water quality discharge regulations have become stricter, also environmental and economical incentives (Casani, et al., 2005).

According Angelakis (1999), in some countries the application of wastewater for irrigation of crops still remains the main application of reuse of industrial wastewater.

Several authors have studied the potential for wastewater reuse in the food industry, in particular the practice of cleaner production: Amorim et al., 2007; Avula et al., 2009; Bixio et al., 2008; Casani et al., 2005; de Sena et al., 2009; Kist et al., 2009; Kupsovic et al., 2007; Manios et al., 2003; Matsumora, et al., 2008; Mohsen et al., 2002 and Sarkar et al., 2006.

According to the Manual of Water Conservation and Reuse for Industry, prepared by FIESP/ CIESP (2004), water reuse is defined as the use of wastewater or water of inferior quality: treated or not.

The production of poultry meat for export plays an important role in the Brazilian economy. According to the ABEF - Brazilian Association of Chicken Producers and Exporters, in 2008, Brazil was world's third largest producer of poultry meat, behind the United States and China, and the largest exporter.

The southern region of Brazil is the major area of poultry production and consequently the processing industries of poultry meat, accounting for approximately 75% of national production. The State of Paraná is the largest producer of poultry meat in Brazil, exporting in the year 2008 a total of 978,735 tonnes (ABEF - Annual Report, 2008).

The wastewater is characterized by high loads of suspended solids, oil and grease, nitrogen (N) and phosphorus (P), which may vary from plant to plant, depending on the industrial process and the water consumption per slaughtered chicken (Del Nery et al., 2001).

2 OBJECTIVES

This study sought to identify opportunities for reduction, optimization and reuse of water in a poultry slaughterhouse.

3 MATERIAL E METHODS

The company at the centre of this study is located in Matelândia city, in Parana state slaughtering 130,000 birds.d-¹ and exporting 43,199 tonnes a year of meat, mainly to Asia, and generates a flow of wastewater of 3,389.77 $m^3.d^{-1}$

The first step was to characterize the water flows within the city by collecting information about processes and activities. Data collection was conducted by analyzing lay-out processes, the water distribution system, sewage and drainage collecting systems, equipment specifications and chemical and energy consumption.

Industry sectors were divided by water consumption and waste generation. Production buildings were categorized according to activities carried out, and domestic uses were grouped in only one sector. After these steps, some options for rational water use were evaluated. After that, the feasibility of water reuse practices was evaluated. Water reuse options were considered for stages of the process which require a great volume of water and generate a large volume of wastewater. Water reuse from sewage treatment plants was not considered because of the high microbiological contamination risk. So, it was important to consider the collection and treatment of effluent from processes before using it in other ones, making its reuse possible.

The water used in the industrial process is provided by Xaxim River, approximately 180 $m^3.h^{-1}$ and also of springs in the area of the company, which provide approximately 40 $m^3.h^{-1}$. The System used by the Water Treatment Company comprises pre-chlorination followed by the water passing through a system of settling, filtration and disinfection.

The wastewater treatment system used by industry comprises pre- treatment, primary and secondary phases through the physical and biological processes. Pre-treatment consists of a static sieve to remove coarses solids, the primary treatment in flotation equipment for the physical process for removal of oils and greases and secondary treatment is the arrangement of two digesters in parallel, an aerated pond with sub-surface aeration by means of aerators and also six air vents and a facultative pond.

The main physical and chemical characteristics of wastewater are average COD on entry to the Biodigestor: 3,390 ± 1,275 mg L^{-1} and COD average output from the Biodigestor: 1,205 ± 300 mg L^{-1}.

Measurements of water consumption were made by water meters installed at seven points on the production process, which resulted in consumption values by sector, allowing the identification of points where there was greater need for rationalization.

The industry in question has a demand of 3,389.77 $m^3.d^{-1}$ accounting for water consumption in all productive sectors, from receipt of the birds, washing trucks, bleeding, scalding, evisceration, cooling room, cuts, water sanitation cleaning equipment and industrial plant, boiler until the dispatch of meat. Some items such as health and sanitation of the production plant by-products already have the reuse of water. The study identified points of reuse, classified as less noble uses, intermediaries and through visits to the noble enterprise and data collection.

4 RESULTS

4.1 Diagnosis of Water Use

Through the environmental assessment the indicators environmental find were:

TABLE 1 **Environmental Indicators**

Indicators	Value (poultry slaughtered)
Water Consumption	26 $L.poultry^{-1}$
Electric power consumption	0,8914 $KW.poultry^{-1}$
Inputs - Consumption of hygiene products	0,005536 $L.poultry^{-1}$
Consumption of scrap	0,001936 $m^3.poultry^{-1}$

The water collected from the Xaxim River and the water springs is used in industrial process, the ice plant, the boilers in the process of cleaning and sanitation of the plant, the company dining room and some toilets. The effluents generated in the industrial slaughtering go to the wastewater treatment system. The effluent from the last pond is pumped and applied in the eucalypt crop, with no release of wastewater to the water body.

The data in Fig. 1 indicate that the most water-consuming stages are the productive slaughtering process and cleaning of the slaughterhouse (platform trucks waiting, reception, bleeding, scald, evisceration, cooling and cuts room), which are responsible, respectively, for 71% and 15% of the total water consumed.

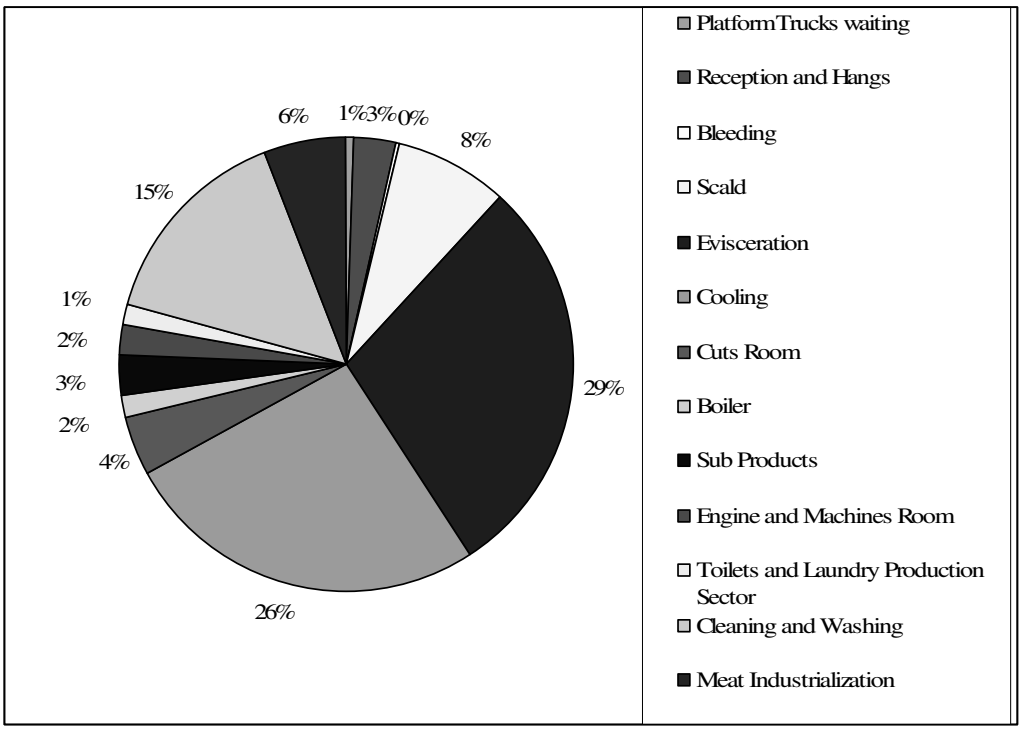

FIGURE1 **Percent distribution of water consumption at a poultry slaughterhouse**

The steps in poultry processing that consume the largest volumes of water are: evisceration (29%), cooling/chilling (26%), Cleaning and washing 15% and scalding (8%). Large amounts of water are consumed due to the constant washing and cleaning equipment and installations. The purpose of this washing is to prevent these wastes accumulating on the floor and equipment. The removal of the viscera and processing performed by evisceration, shows a large potential for water consumption and generation of wastewater containing high concentrations of organic matter, N and P, which are derived from fats and blood to join the effluent through contact with inner and leftover meat and skin.

The poultry slaughterhouse reuses the rainwater falling on the roofs. The rainwater is stored in three ponds built on compacted soil and are used to wash the patio and sidewalks outside the company, washing trucks, used in nebulizers, toilets in the production sector and cooling.

4.2 Minimization of Water Consumption and Wastewater Generation

The sectors that consume large volumes of water are the evisceration and cooling with 979.39 $m^3.d^{-1}$ and 883.77 $m^3.d^{-1}$ respectively and other sectors such as platform trucks waiting 22 $m^3.d^{-1}$, reception and hangs 104.69 $m^3.d^{-1}$, bleeding 5.32 $m^3.d^{-1}$, scalding 270.04 $m^3.d^{-1}$, cuts room 141.51 $m^3.d^{-1}$, boiler 61.27 $m^3.d^{-1}$, sub product 88.79 $m^3.d^{-1}$, machine and engine room 75 $m^3.d^{-1}$, toilets and laundry production sector 50 $m^3.d^{-1}$, cleaning and washing production sector 507.99 $m^3.d^{-1}$ and meat industrialization processing 200 $m^3.d^{-1.}$

The wastewater reuse from the desensitization tank, after preliminary treatment to remove coarse solids, for pre-washing the transportation cages would result in a reduction of about 15.8% of the total water consumed in the Reception sector and 0.5% the wastewater generated in industrial processes.

Reuse of the effluents generated in the cooling towers to wash the live poultry receiving and unloading yards and reuse of the effluent from the final rinsing of the slaughterhouse cleaning process to pre-wash the by-product room are measures that could optimize this operation and reduce water demand.

Applying more advanced technologies for water treatment and reuse programs conservation and optimization of water consumption per poultry, it is possible to achieve a reduction of up to 30% in global consumption of water used in processing of poultry (Matsumura et al., 2008).

5 CONCLUSIONS

We concluded that the effluent tank desensitization can be reused to wash the cages used for transporting birds, the effluent generated in the cooling tunnel, the storage chambers and cooling towers can be reused to wash the waiting area and unloading platform. The suggested alternatives can minimize the hydraulic load by 5.5% and lead to a reduction of about 7.5% of the total amount of wastewater generated. Therefore, it is possible to reuse 255.80 $m^3.d^{-1}$.

As result of this study, it can be concluded that water conservation and water reuse are very important tools to minimize water scarcity problems in industrial areas.

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