



TECHNICAL UNIVERSITY OF THE NORTH

FACULTY OF ENGINEERING IN APPLIED SCIENCES

CAREER OF ENGINEERING IN MECHATRONICS

TECHNICAL REPORT

TOPIC:

**AUTOMATION OF A FOWL SCALDING TANK
FOR “AVIFLORES PUGLLA” ENTERPRISE**

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Ibarra – 2014

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ABSTRACT

In the current research project, the scalding process is described and done by the AVIFLORES PUGLLA Company, which has been automated to improve and optimize fowl production. The objective is to optimize the chicken scalding quality process pertinent to this company through a scalding tank’s upgrade and through the implementation of electronic devices. However, the main task consists on the implementation and new design of a new control system, using the PLC, LOGO type: SIEMENS brand that controls output used to obtain proper scalding operation, such as valves and sensors. Processing capacity is 1000 chickens per day, though this quantity may vary according to the characteristics of the bird to be scalded.

KEYWORDS: automatization, control, scaling, motor, plc, sensors

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1. INTRODUCTION

The AVIFLORES PUGLLA Company processes the slaughtering of fowl, but it doesn’t count with an automated scalding tank thus the animal’s skin is left to the operator’s criteria by introducing the bird to the tank and remaining in it for an extended period of time, which causes the animal’s skin to redden and deteriorate. Otherwise if the animal is left in the cauldron, its skin does not reach optimum scaling, whereby at the precise skinning moment, the feathers detach along with the fur causing some bruising on the skin.

2. CONTENT

2.1. COMPANY BAKCGROUND

AVIFLORES PUGLLA Enterprise is engaged in the fattening of fowl, slaughtering and

commercialization of white meat. It was created in the city of Ibarra in the year 2005. It is located at Esmeraldas and Santa Cruz intersection, Huertos Familiares neighborhood.

The breeding of fowl in Ecuador is raising, according to the survey “Farming Surface and Production Continua Espac—2012 done by the Census and Statistics Ecuadorian Institute (INEC) which conducted an analysis in regards to the country’s production poultry and found that 6 types of fowl are bred within the national territory.

These fowl types are chicken, hens, ducks, turkeys, quail and ostrich. Increased production of chicken is concentrated in the mountain range with 62,33. According to the INEC’s study, the number of fowl bred in warehouses increased almost 8% between the 2012—2013 breeding period. (Lideres 2013)

The AVIFLORES PUGLLA Company aims to guarantee good practices with regard to food safety, animal well-being and its employees and operators safeness.

Figure 1. Enterprise

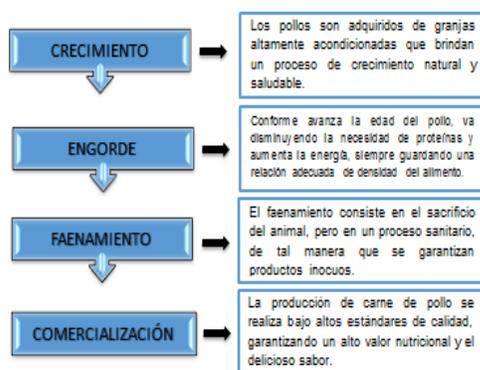


Slaughtering –Consists of killing the animal in a hygienic process so that safer, high quality, high nutritional value products are guaranteed.

2.2 COMPANY’S ACTIVITIES

Currently the company engages in white meat production. In order to obtain the final product, is must go through the following stages:

Figure 2. Process



The establishments in which the slaughtering takes place must comply with certain minimum requirements such as:

- Optimum cleaning conditions

- Acceptable lighting / ventilation
- Adequate machinery
- Job performance under Quality Standards

Being a company that produces human consumption products, is must comply with all formalities requested by the food safety standards utilizing good acceptable manufacturing practices. As previously mentioned, slaughtering takes place daily, the variables are in place by determining the quantity of birds produced according to the number of orders. Average production is 1000 birds per day.

2.3 SCALDING

One of the slaughtering stages is scalding, since it is necessary to dilate skins` follicles. This is done after the bird has been bled and before it is eviscerated. During this stage, the transferring of warmth to the follicles occurs for the purpose of facilitating plucking, being that it would be impossible to pluck or sanitize over a dry bird’s fur. The purpose of this research is to automate the scalding process thus process descriptions are being explained.

The scaling process can be done in 2 ways: the first one is performed by hot water immersion. This method is used by the AVIFLORES PUGLLA Company, being this the most popular method within the fowl slaughtering industry. The second method is done by hot and humid air.

2.3.1- SCALDING BY HOT WATER IMMERSION

It begins by introducing the already bled birds in a hot water receptacle. The type of equipment

needed includes a chain which holds a basket where the birds are placed and a false bottom tank in which such basket is immersed.

Figure 3. Scalding by hot water immersion



The temperature and scalding time are parameters that should be monitored and controlled to achieve the proper feather loosening to avoid overheating that generates the birds cooking. The temperature in which scalding is performed without any complications reaches up to 54 degrees Celsius. Scalding time usually takes 2—3 minutes, depending on the animal's characteristics.

2.3.1.1. Advantages

This method performed by the artisan mode, implies a cost-effective investment considering the obtained result.

2.3.1.2 Disadvantages

This activity becomes monotonous for the operator who must be in the lookout of scalding time, temperature and the tank's water condition.

In case that all these conditions were not recorded, the meat would get damaged, whether by over-boiling or under-boiling courses, thus complicating the plucking process.

2.3.2. SCALDING BY VAPOR APPLICATION

Generally this process is developed within the big slaughtering industries because it requires a mayor financial investment. It consists of a closed environment where bled chickens circulate for a period of time.

Figure 4. Scalding by vapor application



In its interior, blowers inject only 50 milliliters of humid hot air to each bird, while a ventilation system makes hot air circulate among the fowl and bristles the feathers so the transferring of heat to the follicles takes place.

2.3.2.1. Advantages

Water consumption is minimum resulting in low energy consumption. Cross contamination is practically eliminated if there is not adhered dirt dissolution taking place in feathers, legs and body.

2.3.2.2. Disadvantages

In the case where energy black out happens by either automatic or mechanic malfunctions, there would be losses within the chain process causing over scalding.

The high cost of acquisition restricts its use to big companies which by the same token investment returns rise.

These types of limitations can negatively affect scalding quality; as a consequence chicken breast quality can also be compromised

Chicken enter the scaling machine with its feathers and fecal contaminated skin, therefore bacteria load is increased if proper procedures do not take place.

Quality, Safety and Performance aspects are as follows:

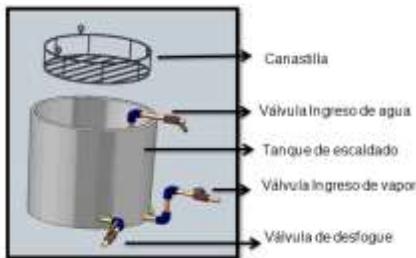
- Skin color unevenness
- Inefficient plucking
- Chicken breast over scalding

The subcutaneous fat melts causing performance loss, the skin loses resistance thus increasing skin rending up to breast level and upper thighs.

2.4 INICIAL SCALDING PROCESS— AVIFLORES PUGLLA ENTERPRISE

The company performs this activity in manual mode utilizing several elements described as follows:

Figure 5. Description



2.4. DESIGN CONTROL SYSTEM

Within this chapter the design control system is done, scalding, description and element selection that are being used.

2.4.1 SYSTEM BLOCK DIAGRAM

The control system is the most important part within an automated process while it controls each action to be performed. Automation is made by the utilization of PLC.

Figure 6. Diagram



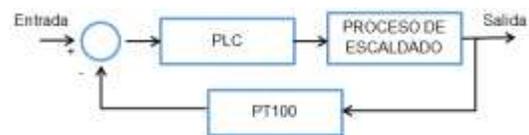
The scalding general process consist of the placing of the birds in the basket, the immersion of the basket in hot water and the bird extraction from the same hot water within a predetermined period of time.

A block diagram details the elements that are to be implemented.

2.4.2. CONTROL SYSTEMS

The control system used is called closed loop. This system is where the exit sign has effect over the action control. In the following figure a general outlook of what the closed loop looks like and its feedback establishes the difference between desired value versus obtained value. Based on this difference control actions may be adopted.

Figure 7. Scheme



2.4.2. Motor Selection

One of the activities required to automate the basket mobilization is to acquire vertical motion which requires a motor that has to be appropriately dimensioned according to the load to be transported.

Once the water has reached desired temperature, it activates the output of PLC which turns on the gear motor that displaces the basket including the birds toward the tank's interior. Scaling time depends on the animal characteristics. In order to realize this stage it is necessary to select a gear motor. We have made the following data calculations:

Height to be roamed; $h = 1,06 \text{ m}$

Weight 15 chicken; $m = 40,82 \text{ Kg}$

Elapsed time; $t = 10 \text{ s}$

$G =$ gravity acceleration

To find the motor's potency to be utilized, the following formula has been applied: (ERMAN,1997)

Performance (w) = $(m \cdot g \cdot h) / t$

$$\text{Potency (W)} = \frac{40,82 \text{ kg} \cdot \left(\frac{9,8 \text{ m}}{\text{sg}^2} \times 1,06 \text{ m} \right)}{10 \text{ sg}} = 42,40 \text{ W}$$

Conversion: $\text{HP W (HP)} = 424,4/736$ which grants a 0.7 potency HP

A 0,7 motor to lift a 40k load having a 116 cm in height in 10 seconds approximately. Due to margin error, it is necessary to over-dimension the required potency for the motor used, which in this case its potency increases to 1HP.

An electric motor has a predetermined potency in HP, and has a certain operation speed in which an arrow surrounds it. To exemplify: 188 Revolutions per minute (RPM's). Together these characteristics, Speed and Potency pair out a certain "torque" or pair which are capable to liberate the motor.

It is precisely this "pair" that allows to turn or not a predetermined load, the higher the "pair" the bigger the load to be turned around will be. Speed depends on the gear motor's potency. Both characteristic are interrelated and depend from one another.

3. CONCLUSIONS

The bird scalding process has been designed for an automated or manual operation mode, and the operating mode is to be selected according to the required need. The interface was created in a way that the operator works in a safe and easy manner.

The scalding optimization process and the atomization implementation to the correct maneuvering of the appropriate machine on the operator's end, helps to increase bird production and the quality of the same. The production change process result changed to 1080 birds per day without being damaged, being that using the prior process, around 30 chickens had been wasted.

The immersion and agitation established follicles dilating quality detaching its feathers, while that depended on the product's final presentation so an excess in time did not allow easy plucking, causing skin bruising or tearing of the same.

Average production capacity is 1000 birds per day; this value can vary according to the animal's characteristics. A cost reduction has been achieved so automation guarantees product quality therefore eliminating mistakes within the next tasks.

4. RECOMMENDATIONS

Efficiency performance within the scaling process was obtained after an appropriate mechanic control systems installation. In order for these systems to function it is recommended to use quality elements and prove the right functioning of the same elements in an individual way after verifying how the complete system works to achieve desired results

Every control system must have a security level that guarantees the operator's health, as alarms must be included and malfunction warnings must be visible being that in the case of an inconvenient event, the operator is able to visualize the error occurred and will try to solve it to continue doing the process.

To initiate this process one has to make sure that the tank is free of impurities, the draining valve is closed and that enough vapor is present in the environment.

The operator must be aware of the procedure to be followed in order to do scalding. He also must study the user's manual so that any accident can be prevented. It is worth the training employees through intense workshops until they are completely familiarized with the new control system.

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