RESEARCH ARTICLE

Research, design and manufacture a pig stomach cleaning machine

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ABSTRACT
To obtain clean meat products is a process of production starting from seed, food, water, veterinary care in breeding to cattle are taken to the slaughterhouse, the process of blending , preservation, transportation to the processing and consumption. In that slaughter is very important, it greatly affects food safety and hygiene. One problem is that if slaughter is to be sanitized, a slaughtering system that meets the standards is required. Each stage must be equipped with appropriate machinery to ensure food hygiene and safety, improve the efficiency of slaughter, reduce labor and protect the health of workers. This paper proposes a new model of a pig stomach cleaning machine to complete and lower the price of pig slaughter in Ho Chi Minh City. The machine must ensure to be simple, easy to fabricate and apply to production. The test showed that the stomach washing machine has met the requirements of food hygiene, safe use and technical expenditures. Moreover, the paper also demonstrates the dependence of individual energy consumption and cleanliness after the washing time, the number of wash cycles and the amount of water needed. Verification of the optimal parameters in the process of operating in the practices is done in this research.
Keywords: pig stomach cleaning machine; slaughtering system

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I. INTRODUCTION

At present, the slaughter situation in our country is a big problem, most of the slaughterhouses are small, manual and backward. Except for a few imported lines installed such as D & F (Dong Nai), Duc Viet (Hai Duong), Vissan (Ho Chi Minh City, but also backward since 1975). However, the prices of imported products are quite high, so these lines only import some of the remaining main components which have been manufactured, manufactured in Vietnam or still handmade. In slaughter lines, almost no enterprises have imported stomach cleaners because of the high cost and the secondary work so little attention. While cleaning the stomach is very difficult, workers working hard in the unhealthy environment due to direct contact with undigested food, water consumption and cleanliness by the workers feelings should not check. Therefore, food hygiene and safety is not ensured.

At present, the whole city has over 40 slaughtering establishments with an average of 6,500 - 7,000 pigs slaughtered each night (equivalent to about 325-350 tons), 100-150 buffaloes (about 10 - 15 tons), 15-20 goats (about 450kg - 600kg). It is concentrated in 06 large-scale facilities including: Vissan, Nam Phong, Tabico, Binh Chanh Center, District 12 Center, Hoc Mon Town; providing about 80% of meat and animal products for the city's consumption. The remaining facilities have the capacity to slaughter 20 - 100 pigs/night (equivalent to 1 - 5tons) mainly serving the needs of each locality. In remote communes in Can Gio, Cu Chi has an average slaughterhouse of only 2 - 5 pigs per night (equivalent to 100 - 250kg), not including slaughtering sites. The total capacity of the city's cattle slaughtering system is 330-370 tons/day (approximately 6,600 - 7,400 cattle), mainly from the following systems: State slaughterhouses with a capacity of 190-200 tons of meat per day (equivalent to about 3,800-4,000 cattle) account for 50% of the city's total capacity. However, in the capacity of slaughtering from 190 to 200 tons of meat per day, the actual state-owned units directly slaughter about 50-55 tons of meat per day (equivalent to about 1,000 to 1,100 cattle). Private pledges are available for hiring. Slaughterhouses of cooperatives with a capacity of 30-35 tons of meat per day (equivalent to about 600 to 700 cattle), accounting for 10% of the total capacity of the city. However, in practice the cooperatives directly slaughter about 5-10 tons of meat per day (equivalent to about 100 to 200 cattle), the rest are privately rented for slaughter. Private slaughter facilities with a capacity of 72-120 tons/day (equivalent to about 1,500-2,400 cattle)

account for 30% of the total capacity. Smuggled slaughterhouses with a capacity of 30-35 tons / day (equivalent to 600-700 cattle) account for 10% of the total capacity of the city (Bui Nguyen, 2010, Vietnam Agriculture News).

Most of the cattle slaughtering places in the city are manual and outdated, which does not ensure the technical procedure from entering livestock to the stages of slaughter and processing, leading to the situation of cross-contamination. Particularly, there are some places where slaughterhouses are located in the slaughter area. There is no separation between dirt and clean areas causing serious pollution and poor water supply. Water is not tested, wastewater does not have treatment system, drains into the surrounding environment, drains into the ground, pollutes the soil and water sources in rivers and canals, polluting the water surroundings. These limitations affect the quality, food safety and hygiene. However, fixing these shortcomings still has some difficulties:

- Foreign investment: the price is too high, the design is not suitable with slaughter characteristics in our country, only some state-owned facilities are invested but not effective.
- Medium-sized slaughterhouses: They are afraid of big investment in conditions of relocation according to the policy of the city.
- Small slaughter facilities: There is absolutely no possibility of investment.

Therefore, the research and production of appropriate machines, effective working equipment for the slaughter line is an urgent need today.

II. LITERATURE REVIEW

Washing is one of the steps used to prepare the product for the next stage or to preserve the product. When washing, we pay special attention to the quality of the washing material because of the continuous metabolism between the material and the dirt. Choose the washing principle depending on the mechanical properties of the washing material. Washing the tomatoes, washing the potatoes, carrots, radishes, and squashes, etc., are used to wash the tomatoes. The general rule is to rub, scramble raw materials in water. People often mix raw materials and water stand still.

The washing/cleaning principle based on the drum style

At work, the thickness of the material layer in the drum (2) changes continuously from end to end of drum. The drum rotates in the water tank (4), under the action of centrifugal force and material friction force moving in each cell bc, de, fm, etc. Under the action of its own gravity, it moves along the axis of the drum, moving the material along bc, de, fm, etc. The movement of the material in the drum is a complex movement that does not stop the entire work of the drum. As a result, the material is washed and moved to the end of the drum. Material passes through the door (3) and dirt is discharged through the door (5).

- Advantages: clean, low cost, durable, and simple
- Disadvantages: For sweet potatoes, cassava, broken leg, broken net screen, or if the roots are too dirty dust, the machine must be washed two or three times, washing water is used repeatedly, so does not ensure the food hygiene.

This machine is designed to wash the piglet. Piglet has a slime layer, so they cannot be rubbed on their own, but when rubbed against the wall, the dirt will be cleaned. However, the rotational speed of the wash is not large (40-50 rpm), the rubbing mainly depends on the weight of the stomach so long washing time and cleanliness is not very high. The washing water should not be changed continuously (if the amount of water used is very large), so if this type of washing to wash the stomach, food safety problems are not guaranteed.

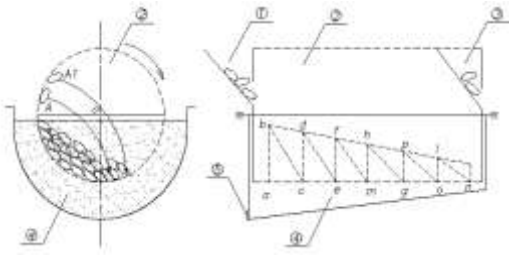

Figure 1: Diagram of washing principle of drum type(1: supply trough; 2: washing drum; 3: exit door; 4: Water containers; 5: Dirty exiting door)

The washing principle of lever type

Commonly used to wash spherical, sweet potato, cassava, galangal, fish ... can also be used to wash vegetables and grass. The working process of the machine is as follows: the material is put into the drum (2), outside the drum (5) filled with water, handled by rotating hand (1), the rubbing fruit rubbed against each other, rubbed into the sieve and hand wash, was washed and moved along the barrel. The material moving along the barrel compartments is due to the swing mounted on the axle and sometimes installed in a tilt direction. The water in the hand-wash rinses provides a continuous supply of raw materials. Dirty and dirty water drains out through the drainage holes (4). 20 -25 revolutions per minute.

- Advantages: Large capacity, clean, solid.
- Disadvantages: Easy to break, stamping materials, the amount of washing water used, not often replaced, the wings easy to jam.

This washing machine cannot be used to wash the stomach because of this type of washing

using the principle of scrambling for self-friction material, the stomach has a greasy and low friction, so it does not friction itself to clean and the structure of the trap can be jammed stomach can be stamping or tear the stomach during cleansing.

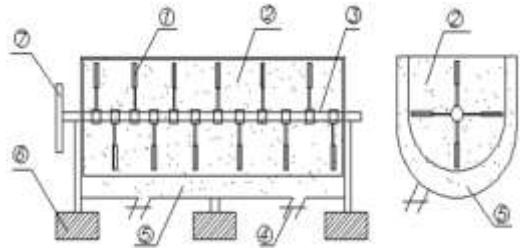

Figure 2: Diagram of washing principle using blade lever

1: blade; 2: Wash drum; 3: machine shaft; 4: the mouth for exiting the stone;
5: Water containers; 6: Machine support; 7: Motor drive.

Centrifugal washing principle

Centrifugal washer used for washing fruits, fish ... thanks to the centrifugal force arising during the operation of the machine. Put into the washing room (1), the engine through the transmission (4) will make disk (2) spin. Under the influence of centrifugal force the material is disturbed and moving in the washing chamber at the same time the water in the system (8) is sprayed from the top down. Clean fruit outlet (6), water and dirt through the hole on the plate and the gap between the chamber and dish washing out through the door (5).

- Advantages: Fast cleaning, no break, jam, stamping with large elastic washing materials. The water is discharged from the top down and used only once, so safe hygiene is ensured, the structure is simple, easy to use.

- Disadvantages: The wings make up the large impact force, which makes it easy to break, with low elastic washing materials.

This type of machine has been made to wash the stomach, centrifugal force generates relatively large impact, rubbing between the lever and the wall of the washing room with the stomach. Simple construction, no clogging, fast cleaning time, clean water is not stored in the machine and save more than other types. So choose this principle to design, manufacture piglet cleaning machine will have more advantages.

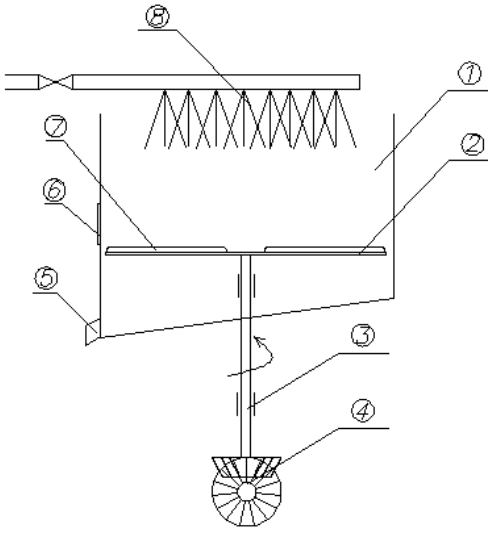

Figure 3: Centrifugal washing principle.
1: washing chamber; 2: washing dishes; 3: support; 4: actuators; 5: Drainage and dirt outlet; 6: exit door; 7: horizontal bar; 8: Water injection system

Engineering Design Solution

Initial Design Database

Based on the results of the survey and some of the existing washing machines in the world, we have some initial design data:

- Technical characteristics of the machine:
  + Productivity: 15 stomachs / batch
  + Clean stomach after washing ≥ 95%
  + Post-wash stomach damage ≤ 5%
  + Three-phase electric motor
- Technical requirements of the machine
  Low energy costs
  + The machine is stable
  Safe, easy to operate, easy to use
  + Ensure food hygiene, low cost.

Schematic diagram of washing machine stomach

Main parts: Washbasin (1) is the main working area, on the wall of the washbasin add vertical bars to create more friction. Inside the dishwasher (2) is mounted on the shaft (5), on the disk are drilled the dirty drainage holes. Between the washing chamber and the disk also create a gap of about 5mm to get rid of the dirt. The shaft is fixed by two ball bearings (3). The belt drive (4) drives the motor from the shaft. The motor (7) is fixed on the support (6).

Working principle: The motor (9) operates via the belt drive (5) and the shaft (7) as a spin disk (2). In the rotary dish washing process, the horizontal rollers collide with the stomach and simultaneously produce a centrifugal force that causes the stomachs to be flushed into the collision chamber with the vertical rollers, which are sprayed by the system (1) down. In the course of 2-3 minutes the stomach will be cleaned. Dirty water is passed

through the small holes on the dish and the gap between the washroom wall and the dish goes down to the dirt container and goes out.

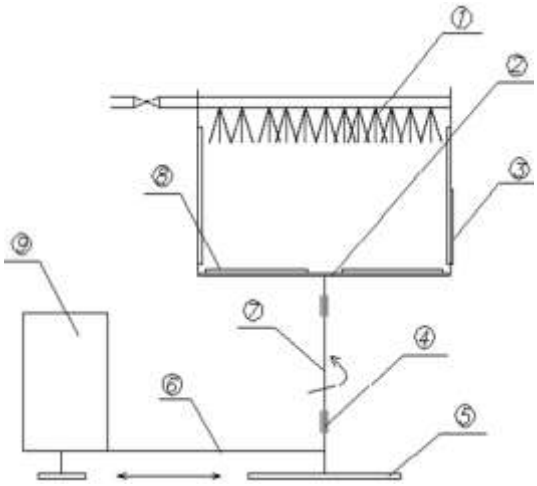

Figure 4: Principle of stomatch cleaning machine
1: sprinkler system; 2: washing dishes; 3: exit door; 4: support; 5: actuators; 6: Support plate; 7: machine shaft; 8: bar horizontal and vertical; 9: engine

Diagram of design the structure of pig stomach washing machine

After calculating the main parts of the machine, in conjunction with the principle diagram we have completed the installation drawings and detailed drawings are presented. The machine consists of the main parts as shown in Figure 5. The principle of structure consists of the main parts: the sprinkler system (1) mounted on the machine wall, the vertical rollers (2) attached to the washing chamber, horizontal bar (3) mounted on the washing plate (4), on the dish was drilled holes to drain dirty water. The dishwasher is connected to the shaft (5) through the flange (9) by the bolt and the keyway. The bracket (10) is fastened to the dirt container (6), the dirt outlet (14), and the belt drive (8). The engine (11) is mounted on the machine platform. The machine operates such as roll in the bag out, open the lid to the stomach to wash, each time from 10-15. Close the lid and open the engine. The engine running through the belt drive causes the dish to rotate the horizontal bar against the stomach and simultaneously produce centrifugal force that displaces the stomach into a collapsing chamber with vertical drum washers. The system (1) sprayed from the top down. In the course of 2-3 minutes the stomach will be cleaned. Dirty water passes through the small holes on the dish and the gap between the wash chamber wall and the dish goes down to the dirty container (6) and escapes.

Experimental manufacture in enterprise

Offered at Hoa Lap Engineering Company, 135 Luy Ban Bich, Tan Phu - Ho Chi Minh City. After about 15 days we have completed the stomach washing machine meets the mechanical engineering criteria as shown in Figure 6. After the construction, we transported the machine to the slaughter center Binh Chanh district for operation to verify and validate our proposed design solution.

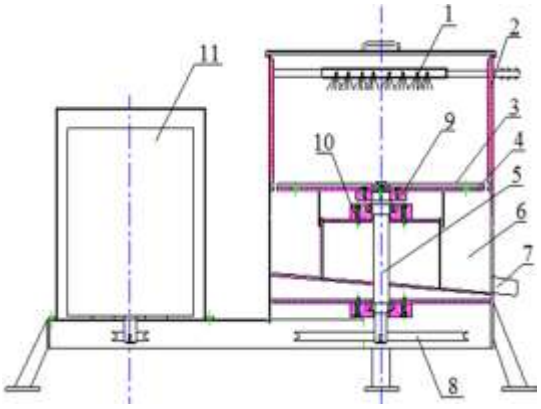

Figure 5: Diagram of pig stomach washing machine
1: water spray; 2: Standing bar; 3: bar horizontal; 4: washing dishes;5: shaft; 6: dirty containers; 7: The drain pipe is dirty; 8: belt drive;9: Flanges; 10: Bearing; 11: Engine.

Figure 6: The pig stomach washing/cleaning machine after manufacturing in the practice

III. RESULTS AND CONCLUSION

In this research, we have proposed the design solution for a pig stomach cleaning machine and implemented the model in practice to verify and validate the proposed design. A new swine stomach washing machine helps complete and lower the cost of pig slaughter line in region. The machine was tested and verified to select the operational parameters as follows.

Determined the work area and optimal indicators of the machine:

+ Power consumption: 144 Wh / batch
+ Cleanliness after washing: 96%
+ Washing time: 2.5 minutes / batch

+ Number of wash rinses: 176 rpm
+ Required washing water: 10.5 liters / batch.

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