Ecological Safety of the Internal Space of the Cattle-Breeding Facility (Cowshed)

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Abstract. The article emphasizes the importance of observing the ecology of the internal airspace. The factors affecting the state of the air in the internal space of the cattle-breeding facility (cowshed) are revealed. Technical and technological solutions providing for a reduction in the airspace contamination of the livestock facility are proposed. The results of investigations of a technological operation for treating skin integuments of cows with activated water are disclosed, as well as the constructive solution of a heat and power unit that ensures a change in the hydrogen index of the treated water. The justification of the efficiency of the proposed technical and technological solutions is given.

1. Introduction

Efficiently selected technological equipment in the cattle-breeding premises, in this case it is a barn, allows improving the quality of the performance of technological processes for servicing animals, increasing the productivity and comfort of the maintenance personnel and, as a consequence, increasing the quantity and quality of the main product (milk, meat) and secondary raw materials (hide, hair, manure).

However, failure to perform certain operations of the mechanized technological process or poor performance of these processes increase the risk of disturbance of the ecological balance within the cattle-breeding premises. In the context of the technological processes of servicing animals, the technological equipment used inside the cattle-breeding premises also affects the ecological background of the internal space of the cattle-breeding premises, in particular the cowshed. The use of mobile means in the process of distribution of fodder increases the gas contamination and the dustiness of the space (distribution of dry coarse fodder) and stationary means which as a result leads to the contamination of the interior space of the premises, stabling equipment and the surface of the skin of animals (cows). It contributes indirectly to contamination of the final product, in our case it is milk.

A number of researchers have established that the dust particles of dry fodder, as well as the ones of the introduced litter within the technological process of the maintenance of the cows, contain a certain kind of microorganisms (bacteria, molds and others), which increases the risk of contamination of the final milk product, as well as the sickness rate of the maintenance personnel [1, 2, 3]. In this connection, it becomes necessary to perform a technological operation of processing fodder at the stage of fodder intake into the zone of its distribution along the aft line and the inclusion of a periodic operation of wetting the skin of the cows with activated water (according to the content of the pH-value) into a technological operation for treating the skin integuments of cows.

2. Results and discussion.

To reduce the dustiness of the air space from the dust particles of the fodder, we propose to use heat treatment of coarse fodder with warm water at a temperature of 20...30 ° C with a periodically valid qualitative pH indicator (alkaline or acidic medium) during the process of its distribution [4].

Depending on the used production line of fodder distribution, it is advisable to perform point-by-point processing of coarse fodder in the feeding zone of a stationary fodder distributor or continuously along the fodder distribution line (mobile distribution) Figure 1.

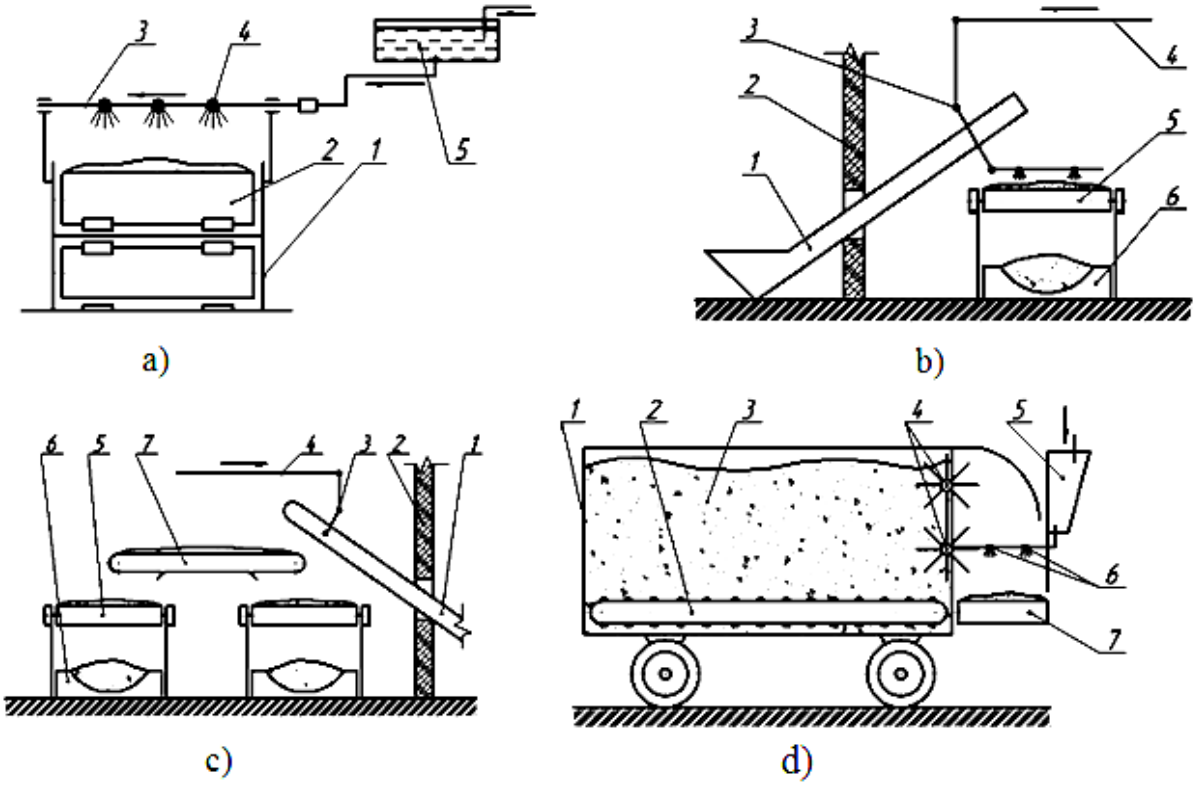


Figure 1. Schemes of organizational options for processing coarse fodder:
a) distribution of fodder to a stationary fodder distributor: 1 – the body of the fodder distributor inside the feeding bowl; 2 – movable operating element of the fodder didtributor (scraper plate or tape); 3 – distribution perforated pipeline; 4 – pulverizing hole; 5 – water storage; b) distribution of fodder to the fodder distributor above the feeding bowl: 1 – inclined conveyor; 2 – wall of the cowshed; 3 – perforated pipeline for wetting fodder with water; 4 – water supply line; 5 – fodder distributor; 6 – feeding bowl; c) distribution of fodder to the fodder distributor above the feeding bowl with reverse loading: 1 – powered incline; 2 – wall of the cowshed; 3 – a perforated pipeline for wetting the fodder water; 4 – water supply line; 5 – fodder distributor; 6 – feeding bowl; 7 – powered reverse; d) mobile fodder distributor: 1 – bunker of the fodder distributor; 2 – longitudinal conveyor; 3 – monolith of the fodder; 4 – beater; 5 – storage capacity of water; 6 – perforated pipeline for wetting fodder with water; 7 – transverse fodder conveyor

In order to improve the protective properties and the metabolism in the animal body (cow), to increase productivity and reduce contamination of the product in the process of milking cows, technological equipment has been developed and is still being developed to care for the skin of animals [5, 6, 7, 8]. In the technological environment, special spring brushes or rotating brushes with an electric drive are used to care for the skin. At the feedlots in the USA special equipment "Chesalo" is used to take care of the cattle. In some cases during the technological process, vacuum cleaners of various designs were used, as well as mobile cattle washing appliances. In the design solutions of livestock buildings, a separate room is sometimes provided for cleaning, washing and drying of animals. However, for the most part they do not correspond to the complexity of performing technological operations, they do not exclude the possibility of contaminating the air of the environment of the cattle-breeding premises with

structural components of the skin, they are also low in effectiveness of reducing the bacterial contamination of the skin and do not exclude the possibility of injury to the maintenance personnel by the animal on the leash (cows) [9].

In order to preserve the ecological safety of the internal space of the cattle-breeding premises, reduce the risk of sickness of maintenance personnel and injure them while caring for the animal (cow), and reduce the harmful effects of bacterial contamination of the animal's skin on the quality of the products, we have developed a system for the sanitary treatment of the skin of the cows on a leash Figure 2 [10].

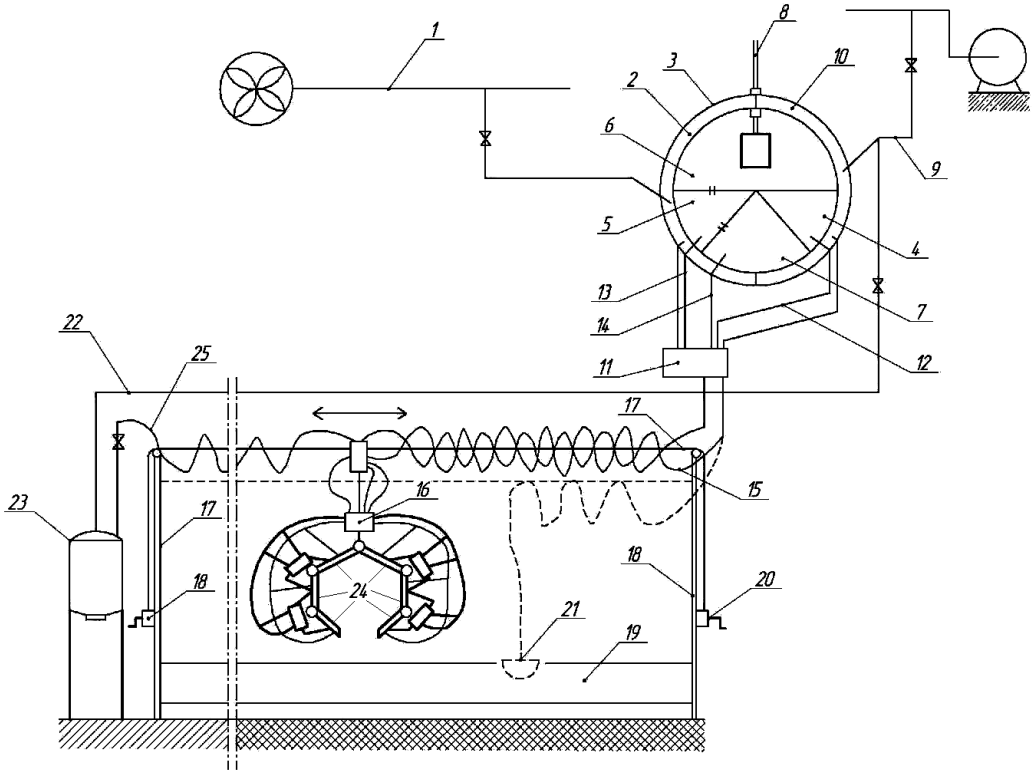


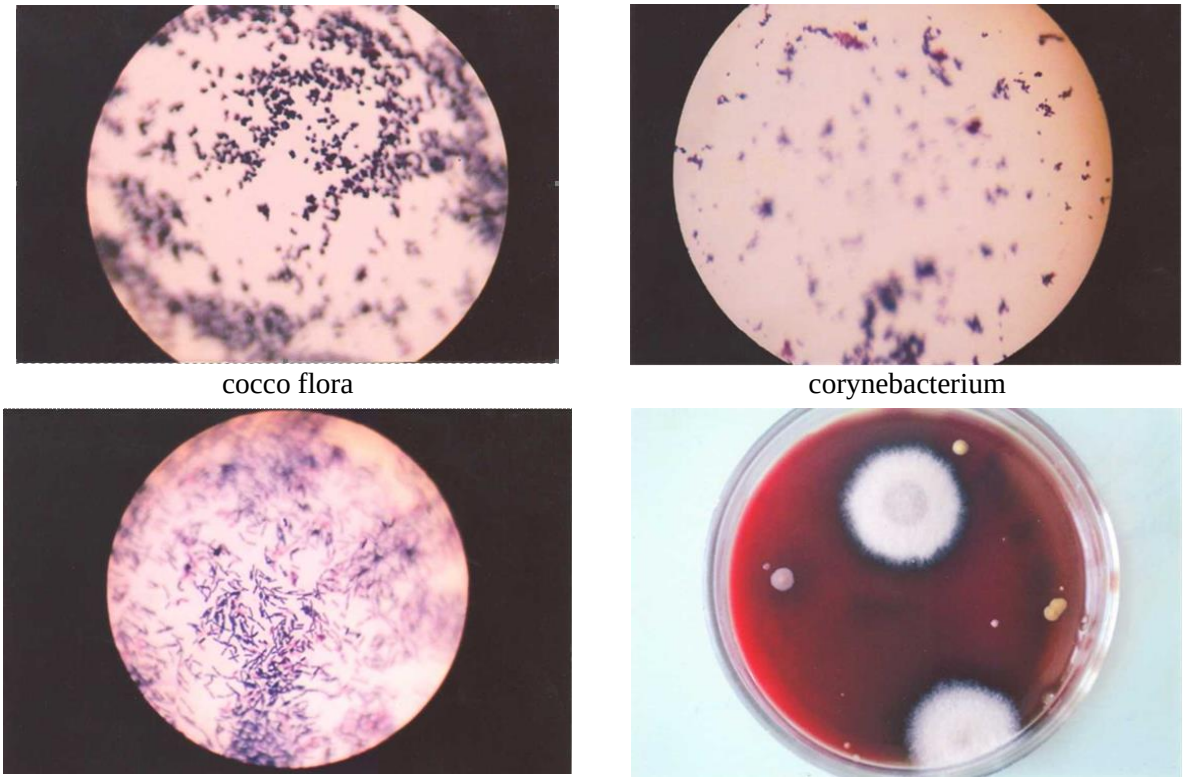
Figure 2. Scheme of the sanitary treatment system for the skin of the cows on the leash:
1 – high pressure air supply pipeline; 2 – chamber of internal air pressure accumulation; 3 – water heating tank; 4 – chamber for disinfecting solution; 5 – water chamber with a lower pH relative to the normal one; 6 – water chamber for needs of automatic drinking; 7 – water chamber with increased pH; 8 – supply pipeline; 9 – pipeline of vacuum supply; 10 – chamber of vacuum accumulation; 11 – distributor of processing agents; 12, 13, 14 – trunk pipelines for delivering disinfectant solution and water with different pH levels; 15 – working pipeline for the supply of processing agents; 16 – two-section device for treating the skin; 17 – flexible suspension; 18 – supports; 19 – fodder table; 20 – winch; 21– device for washing the udder of the cows; 22 – a vacuum tube; 23 – a tank for collecting contaminants and hair; 24 – working organs for treating the skin; 25 – transport pipeline for the transport of contamination

The proposed system of sanitary treatment of the skin of the cows provides for a full range of technological operations, including mechanical processing with vacuum removal of contaminants and hair during the shedding of hair into storage tanks, the wetting and the drying of the skin, periodic sanitization.

One of the features of this system is the possibility of treating the skin with activated water with a selected (justified) hydrogen index (pH).

To justify the feasibility of this technological operation, studies were carried out to determine the species composition of the bacterial contamination of the skin and the effect of activated water with a different pH value on its vital activity. The research was based on taking washouts from patches of the

skin of the cows before their treatment and after their treatment with a solution (activated water). The material was taken by sterile swabs, mounted into sterile tubes with a content of 0.5 ml. sterile saline solution. Before sowing the resulting material, a series of tenfold dilutions were carried out, followed by seeding on Petri dishes with nutrient agar to determine the total microbial count (TMC) and with blood agar for the growth of the microorganisms. Aerobic and facultatively anaerobic microflora were subjected to the analysis. As a result, it was found that the microflora of the skin of the cow on the leash consists of the cocco flora and microorganisms p. Corynebacterium (corynebacterium). Along with this, there are spore and mold microorganisms (transient bacteria coming from outside) on the skin Figure 3.



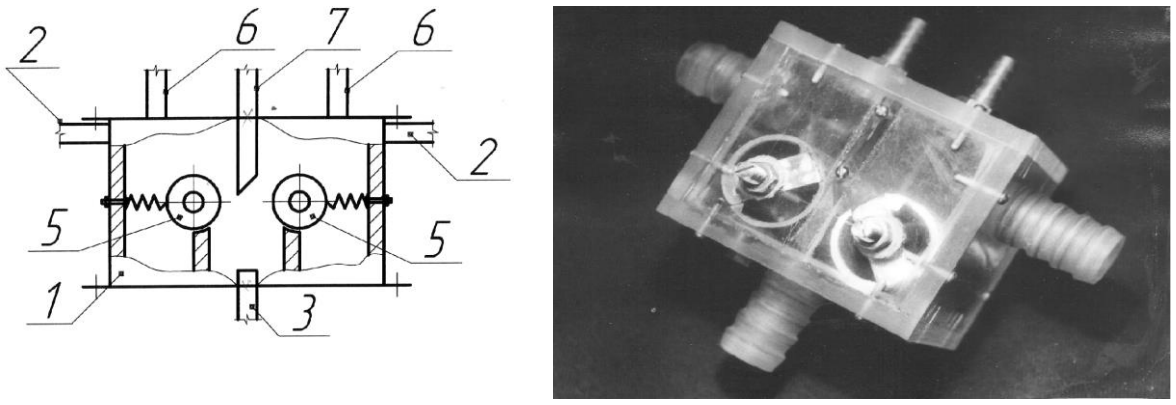
cocco flora corynebacterium

cryptogamous microflora mould

Figure 3. Fragments of sowing the microflora of the skin of the cow

Studies have also found that the use of activated water in the treatment of the skin reduces the total microbial count (TMC) and suppresses the growth of spore microflora.

The process of water activation is provided in Sections 5 and 7 of Storage Tank 3 of the system Figure 2 using a heat and power unit Figure 4.



a) b)

Figure 4. The construction scheme of the heat and power unit (a) and its full-scale sample (b): 1 – the case of the block; 2 – circulation pipes; 3 – an inlet branch pipe; 4 – adjusting screws; 5 – electrodes; 6 – gas pipes; 7 – division wall

The investigations have established the time and temperature regime of the block, as well as the changes in the physical and chemical characteristics of water during its activation, which corresponds to the technological process of treating the skin of cattle (cows) Figures 5, 6.

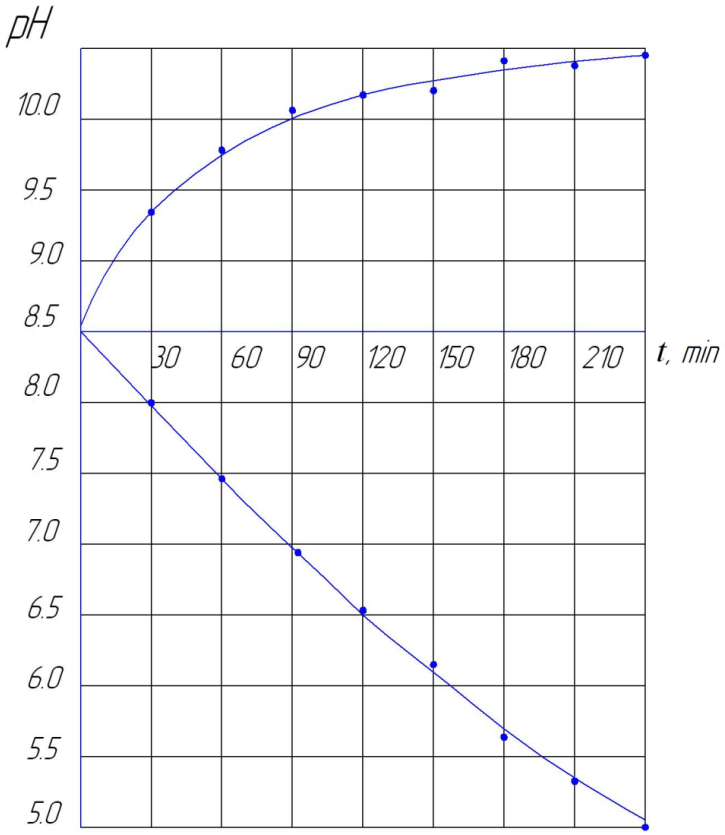


Figure 5. pH change depending on the duration of water treatment

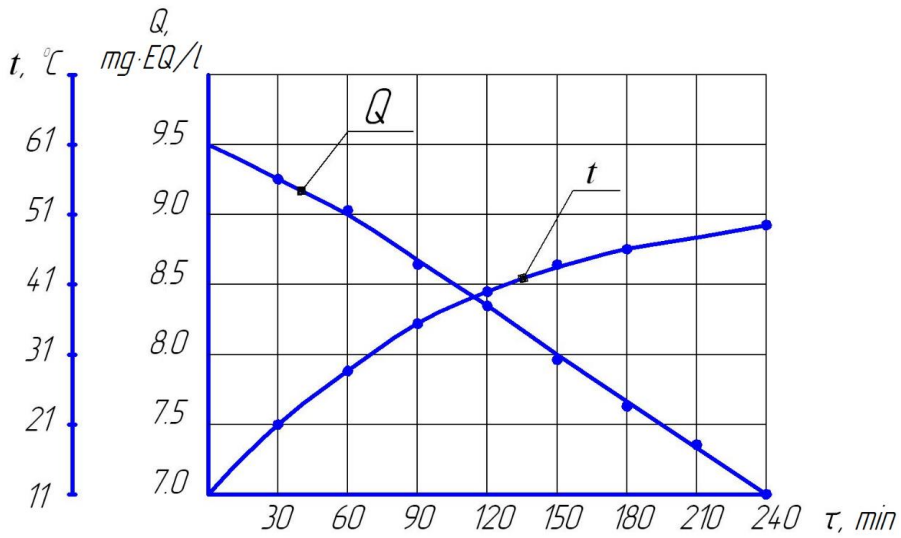


Figure 6. Change in temperature t and water hardness Q, depending on the treatment time

3. Conclusions

1. Ecological safety of the internal space of the cattle-breeding premises (cowshed) depends on the strict performance of zootechnical and sanitary requirements for performing the technological process for servicing animals and in particular the process of sanitary treatment of the skin of animals (cows);

2. The proposed systems for processing coarse fodder and skin of cows on the leash, while observing the technological requirements for processes, allow to reduce the ecological safety of the internal space of the cattle-breeding premises (cowshed) for maintenance personnel.

3. The proposed system and the technology of treating the skin of the cows on the leash allow to reduce the level of pollution of the internal air environment, the risk of diseases of the maintenance personnel (pneumonia, sepsis, endocarditis, meningitis, wound suppuration, bacteriemia and others) caused by the microflora of the skin of the animal, as well as the maintenance personnel' injury risk through contact with animals;

4. It was found that activated water with hydrogen pH in the ranges 5.8...6.0 and 8.6...9.0 is the most effective in the treatment of the skin.

5. The implementation of the technological operation for the treatment of the skin with activated water helps to reduce the total microbial count (TMC) by 11.1 ... 12.8 times, while the growth of spore microflora being suppressed completely.

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