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FACTORS AFFECTING MANURE SEDIMENT WASH

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One of the main tasks of the "Agrarian Business" program for 2021–2025 is to develop the production of organic products and reduce the negative impact of chemicals, growth hormones, antibiotics on the environment and human health [1].

One of the ways to solve this the task in animal husbandry is the introduction of new technologies and technical means into production, allowing the rational use of material, fodder and other resources. This can be accomplished by constant modernization of equipment and, in particular, mixers for mixing manure in manure silos.

Equipment for mixing manure is currently a must for any livestock enterprise. In the process of preparation before applying manure to the fields, it becomes necessary to mix it in advance in the manure storage using a stationary or tractor-mounted mixer. So, due to the absence or incorrect selection of equipment that allows you to quickly and efficiently mix manure, there is an accumulation of sediment in the manure storages. A manure storage tank filled with sludge will entail material costs for solving problems of cleaning them.

The mixer device [2] includes a frame, a long shaft mounted on intermediate bearings and at the end of which a propeller agitator is installed. To create a directed flow of liquid manure, the mixer is enclosed in a casing.

The installation of the nozzle (figure 1) allows, by increasing the speed of the liquid manure flow, to create a jet with a greater impact force, which will lead to an increase in the length of the sediment erosion section.

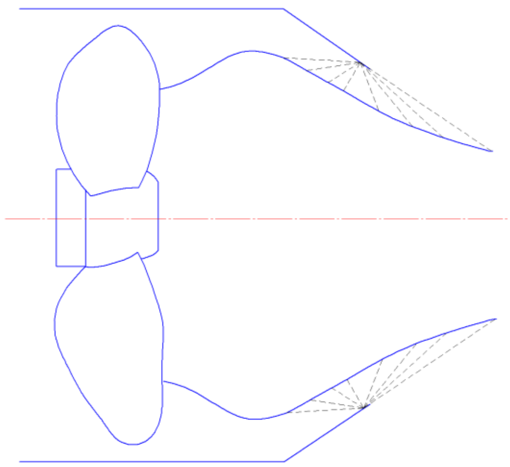

Figure 1 - The movement of liquid manure in the casing

Sludge washout is mainly dependent on the power of the slurry jet injected into the compacted bed. So the more power, the deeper the jet will penetrate into the sediment.

The power of a stream of liquid manure in general form can be determined by the formula:

$$N = F_{\text{с}} V_{\text{о}}, \qquad (1)$$

where $F_{\text{с}}$ – is the force of the jet pressure on the site of erosion of the manure sludge, N;

$V_{\text{о}}$ – is the axial velocity of the flow of liquid manure at the site of erosion of the sludge, m/s.

Based on experiments with jets A. Milovich found that the axial velocity of the jet in the area of sediment erosion changes along the jet according to a hyperbolic dependence.

$$V_{\text{о}} = \varphi \frac{V_{\text{н}} d_{\text{стр}}}{l}, \qquad (2)$$

where φ – is the experimental coefficient;

$V_{\text{н}}$ – is the outflow rate of the manure mass in the compressed section of the jet, m/s;

$d_{\text{стр}}$ – is the diameter of the jet in the initial section, m;

l – is the distance from nozzle of the casing, m.

The force of pressure of the jet on the area of erosion of manure sediment is determined by the formula [3]:

$$F_{\text{с}} = \rho S_{\text{о}} V_{\text{н}}^2 \sin\alpha, \qquad (3)$$

where ρ – is the density of manure, kg/m^3;

$S_{\text{о}}$ – is the area of the outlet in the nozzle, m^2;

α – is the angle of attack of the jet on the manure sediment, degree.

Substituting formulas (2) and (3) into the initial formula (1), the power of the stream of liquid manure is determined from the expression:

$$N = \frac{\varphi \rho d_{\text{стр}}}{l} S_{\text{о}} V_{\text{н}}^3 \sin\alpha. \qquad (4)$$

Thus, factors such as the density of the manure, the area of the outlet in the nozzle and the rate of flow of the manure mass affect the erosion of manure sludge. An analysis of formula (4) shows that the power of the liquid manure jet stream changes with a change in the distance of the erosion area from the casing nozzle.

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