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Upgrading of Squeeze Chutes for Sheep.

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ABSTRACT

The lack of theoretical bases and experimental data of processing equipment for fixation and chutes sheep at zootechnical and veterinary treatments became the purpose of scientific research. The goal of work is theoretical and experimental research installations for fixation and chutes sheep at zootechnical and veterinary treatments with two-conveyor belt which form gutter and reasoning of existing efforts at the animal, excluded of injury. Scientific research confirmed the correctness of the analytical dependences. The results will enable designers to create technological equipment for fixation and chutes sheep at zootechnical and veterinary treatments excluding injury of animals.
Keywords: sheep, veterinary treatment, equipment for fixation and chutes sheep, belt conveyors

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INTRODUCTION

Sheep farming is a complex industrial and economic system aimed at the needs of the population in food and raw materials for industry. The most time-consuming processes of service animals are veterinary treatment (shearing, tavrenie, valuation, trimming hooves, immunization, vaccination, etc.), Which are an integral part of the production technology of sheep breeding [3, 5].

During the year, need more ten such treatments each sheep that requires intensive labor. For example, for treatment one thousand ewe per year, needs 1360 ... 1440 man-hour.

Practically all treatments the animals on the operator station and fixing them in a convenient position requires considerable physical effort of the operator, which often causes injury to animals. Therefore, today, we have created the technology and means of production for sheep based on animal safety.

RESULTS AND DISCUSSION

An installation with two conveyor belts arranged at an angle φ to each other and β to the horizontal. Installation shown schematically in Figure 1 and consists essentially of a frame 1, two conveyor belts 2 and 3. When the inclined board installation development focused rationale structural components and modes of operation in terms of excluding the possibility of injury to an animal.

The animal enters the installation of a split "entrance" and a wedge-shaped arrangement of conveyor belt moves at an angle β to the surface of the operator's area. Movement of conveyor belts at an angle to the horizontal ensures separation of the supporting legs of the animal lands and grooved shape with an angle φ detects sheep mass m_1 under the force of gravity m_1g. Given the basic dimensions of the sheep (the uterus: length 940 mm, muttons - up to 1300 mm), the length of the installation adopted within three meters. Simultaneously, the installation may be two sheep, one at the inlet and the second outlet [1, 6].

The main source of the forces acting in the system is the gravity of transported animals.

To study the forces applied to the animal and resulting in the movement of the sheep to install, are consider two planes: plane gravity II and the plane II-II, perpendicular to the conveyor axis (Figure 2) to allow the link between a basic power and structural parameters [2, 4].

Gravity m_1g decomposed into two components: the axis along the conveyor $m_1g \sin\beta$ and normal force to the conveyor axis $m_1g \cdot \cos\beta$, from which arise on inclined conveyors normal pressure reaction force N (Figure 2).

To determine the normal force N on the pressure conveyors acting forces should be projected onto the plane II-II

$$2N \cdot \cos\left(90° - \frac{\varphi}{2}\right) - m_1 g \cos\beta = 0;$$

$$N = \frac{m_1 g \cos\beta}{2\sin\frac{\varphi}{2}}, \tag{1}$$

m_1 - mass of sheep, kg;
g - acceleration of gravity, m/s^2.

The components of the normal force N to the pressure of the conveyor are defined in the plane II-II (Fig. 2) is transported through a mass of sheep as $\frac{m_1 g}{2}\cos\beta$ and $\frac{m_1 g}{2}\cos\beta \cdot \mathrm{ctg}\frac{\varphi}{2}$.

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The analytical dependence allow us to determine the efforts on the part of transporters latching onto the animal.

Belt speed V_l is justified by the condition that during the movement of sheep should be keep immobility of the animal with respect to the conveyor belt. This will occur at a certain length of belt slippage from the initial V_0 animal to a final steady tape speed V_l. Animal acceleration causes inertial forces (Figure 3).

The condition of equilibrium of the animal on the tape, taking into account the friction forces Nf_0

$$m_1 \frac{dV}{dt} + m_1 g \cdot \sin\beta - 2Nf_0 = 0. \quad (2)$$

Substituting (1) in (2) - the equilibrium equation is

$$\frac{dV}{dt} = g\left(\frac{\cos\beta}{\sin\frac{\varphi}{2}} f_0 - \sin\beta\right).$$

For an infinitesimal displacement dx $dt = \frac{dx}{V}$, than

$$\frac{V_l^2 - V_0^2}{2} = g \cdot l\left(\frac{\cos\beta}{\sin\frac{\varphi}{2}} f_0 - \sin\beta\right);$$

$$V_l = \sqrt{V_0^2 + 2g \cdot l\left(\frac{\cos\beta}{\sin\frac{\varphi}{2}} f_0 - \sin\beta\right)}, \quad (3)$$

l – Sliding length m, the speed in this area varies from V_0 to V_l; small transporters can be taken l = 0,5...1,0 m; f_0 – friction load on the material in the tape movement, $f_0 \approx (0{,}7 \div 0{,}9) f$; f – static friction coefficient.

When the initial velocity of the load V_0 reaches the speed of the belt V_l, than $V_l^2 - V_0^2 = 0$, this shows that

$$gl\left(\frac{\cos\beta}{\sin\frac{\varphi}{2}} f_0 - \sin\beta\right) = 0 \cdot$$

So as the speed is change from V_0 до V_l, то $l \neq 0$; $g = 9{,}81 \neq 0$; than $\frac{\cos\beta}{\sin\frac{\varphi}{2}} \cdot f_0 - \sin\beta = 0$,

than

$$\mathrm{tg}\beta = \frac{f_0}{\sin\frac{\varphi}{2}}. \quad (4)$$

Expression (4) defines the maximum value of the angle of inclination of the conveyor β for certain values of coefficient of friction f_0 and the angle between the conveyors φ.

The forces acting on an animal in the installation shown in Figure 1.

The force (F_f), locking the animal in the installation, determined as the sum of the normal forces (F_n) from the conveyor and friction (F_{f1})

$$\overline{F_f} = \overline{F_n} + \overline{F_{f1}}, \text{ or } \qquad F_{\phi} = \sqrt{F_n^2 + F_{f1}^2}. \qquad (5)$$

So as $F_f = F_n f$, expression (5) will be

$$F_f = F_n \sqrt{1 + f^2}. \qquad (6)$$

Considering Figure 2, that $F_n = N = \frac{m_1 g}{2} \cdot \frac{\cos\beta}{\sin\frac{\varphi}{2}}$, expression (6) will be

$$F_f = \frac{m_1 g}{2} \cdot \frac{\cos\beta}{\sin\frac{\varphi}{2}} \sqrt{1 + f^2}. \qquad (7)$$

Analysis of the expression (7) is based on the literature, theoretical and experimental research and is presented in the form of graphs (Fig. 4).

Analysis of plots shows that the retaining force of the animal can be represent as the sum of the weight and the additional force arising from the inclined conveyors

$$F = G + F_{\varphi\beta}.$$

Experimentally established to secure the animal with limited mobility animal legs to make enough effort (0,7…0,8) animal weighs (0,7…0,8)G. Accordingly, $F_f = G + (0,7...0,8)G = (1,7...1,8)G$. Then, for an animal weighing 40 kg for a single conveyor F_f = 340…350 N; for m_1 = 60 kg, F_f = 1510…5401 N; for m_1 = 80 kg, F_f = 680…720 N.

The plot shows that the necessary strength of fixing the animal is provide at an inclination of 90 degrees between the conveyors.

Experimental studies of the forces acting on the animal in chutes sheep, made in teaching and research laboratories of the Stavropol State Agrarian University.

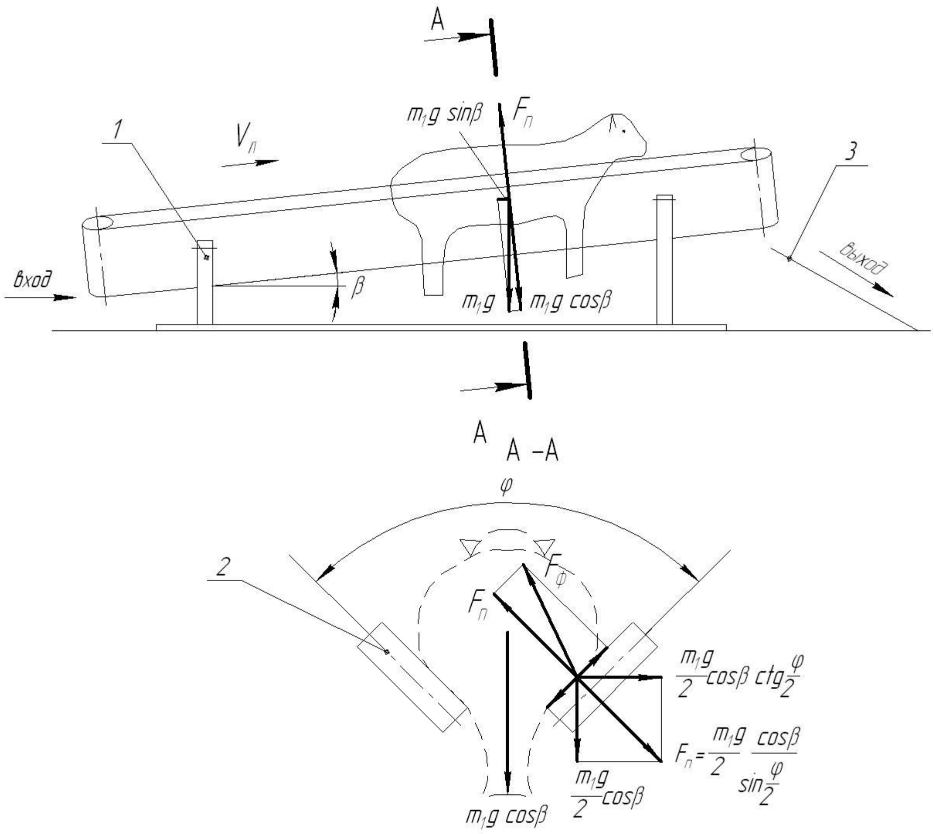

Figure 1: Schematic of for fixation and chutes sheep at zootechnical and veterinary treatments and the forces acting on the animal, for example a conveyor: 1 - installation of the frame; 2 - belt conveyors; 3 - inclined board for sheep gathering.

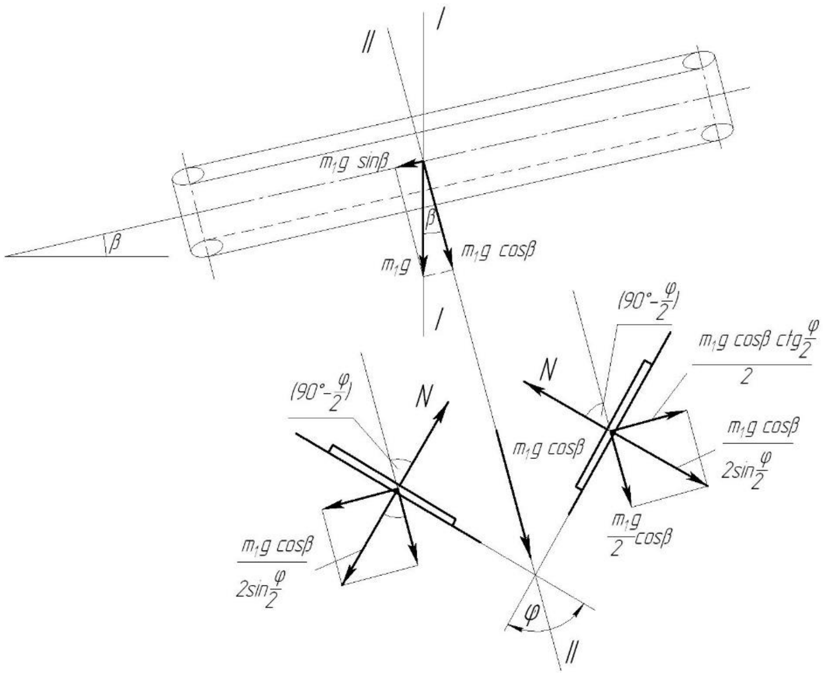

Figure 2: Scheme of the conveyor to the calculation of power relations

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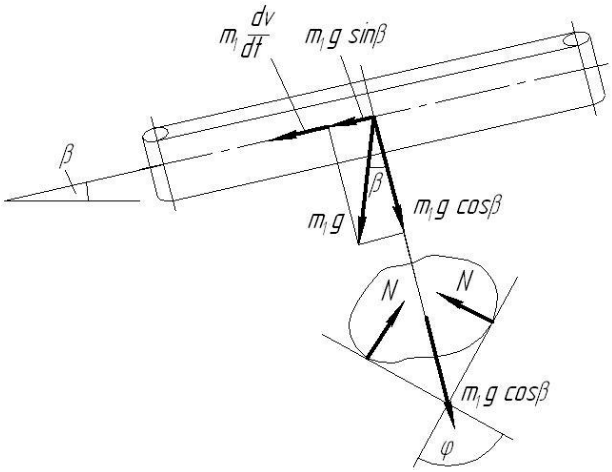

Figure 3: Scheme for calculation of belt speed

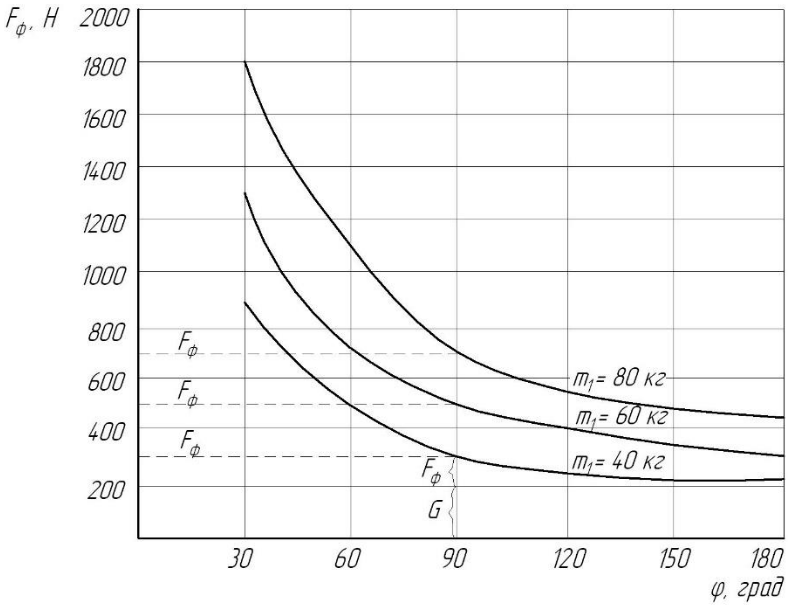

Figure 4: Dependence of the locking force of the tilt anglebetween the conveyors and weight of the animal

CONCLUSION

Experimental studies show that the relative variation in the forces acting on the animal in the in chutes sheep, calculated theoretically and experimentally derived, ranged from 4.2% to 15%. This confirms the correctness of the analytical expressions for theoretical study and sufficient adequate description of the real process. The results will enable designers to create equipment for for fixation and chutes sheep at zootechnical and veterinary treatments excluding injury of animals.

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