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RESULTS OF FIELD STUDIES OF THE WORKING BODY OF THE HYDROMECHANICAL SEALING DEVICE

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ANNOTATION
The article deals with the topical issue of soil compaction of layer-by-layer backfill with simultaneous locking. The results of an experimental study in laboratory and field conditions to determine the optimal density of the soil, its high-quality compaction by the hydromechanical method is given, as well as the basics of the theory of soil moistening and calculations for the required water flow for soil moistening.
KEY WORDS: *Soil, soil density, water, humidity, stress, compaction, pressure, working body, nozzle, knife technology, design.*

At present, soil compaction is carried out mainly by static soil-compacting machines (Fig. 1).

The analyzes show that the selection of soils used for hydraulic structures does not meet the requirements, bulk soil layers have not been studied, the number of passes of machines for soil compaction is multiple, they are mainly effective only in soils with optimal moisture content, soils with lower moisture content are moistened with water. The heavier it is compacted, the greater the mass of compacting machines (on average 3–4 kg per square centimeter of surface).

Rice. 1. Machines for soil compaction: *a* - *with a* smooth roller; *b* - cam; *with* - on pneumatic tires

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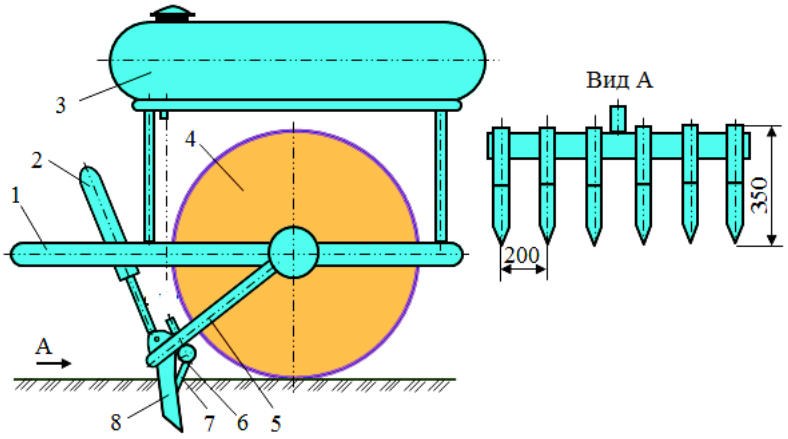
We have developed and manufactured a working model of a device for layer-by-layer soil compaction with simultaneous backfilling (Fig. 2), which reduces the number of passes and the mass of machines.



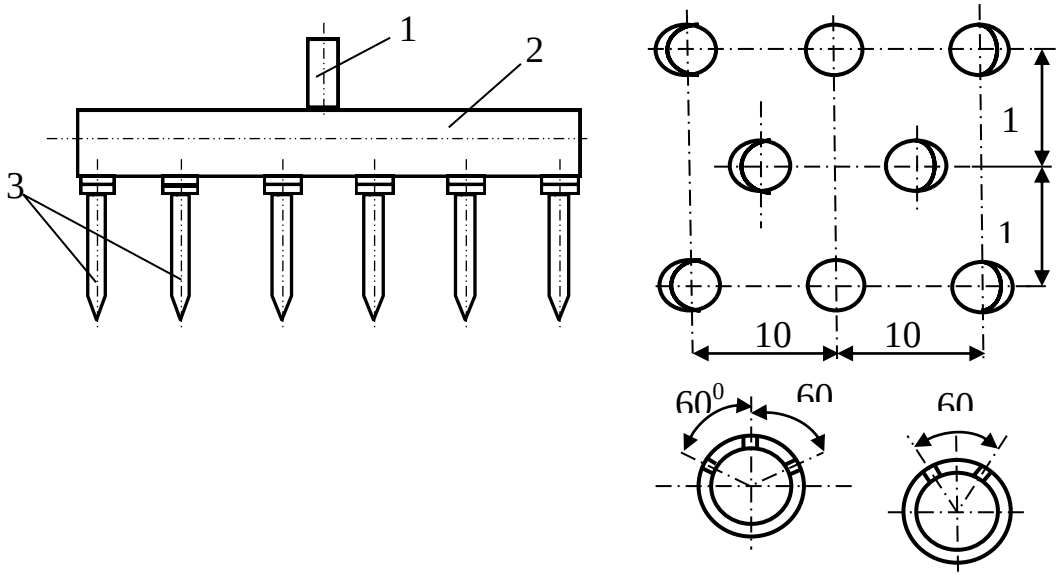
Rice. 2. Hydromechanical sealing device

The working body is attached to the base tractor through a traction frame 1, which is equipped with a pressure roller 4 for compacted soil, a hydromechanically compacted roller and a water tank 3. The moistening body consists of cutting knives 8 with a distance between them of 20 cm and a length of 35 cm and installed to each of which 7 sprinklers for spraying water. Raising and lowering the soil compactor is carried out by hydraulic cylinder 2.

Based on the results of the study, the optimal form of hydraulic (water) soil compaction was selected, as well as a device for moistening the soil by spraying water using a perforated metal pipe installed in a checkerboard pattern. In this device (Fig. 3), water is distributed from pipe 1 to pipe 2, located transversely, and transferred to perforated sprayers 3, which are installed in a checkerboard pattern.

Number of sprinklers 6…8, 14…16 holes with a diameter of 3 mm.

Sprayers are located at an angle of 120 ^{0}, at an angle of 60 ^{0} to each other in the direction opposite to the movement of the machine (Fig. 3).



Rice. 3. Water sprayer and the location of the holes in it.

High indicators of soil density are the timely impact of soil pressure on the upper layer with the help of water, a decrease in the resistance of particles in it, a decrease in volume due to air compression in the soil.

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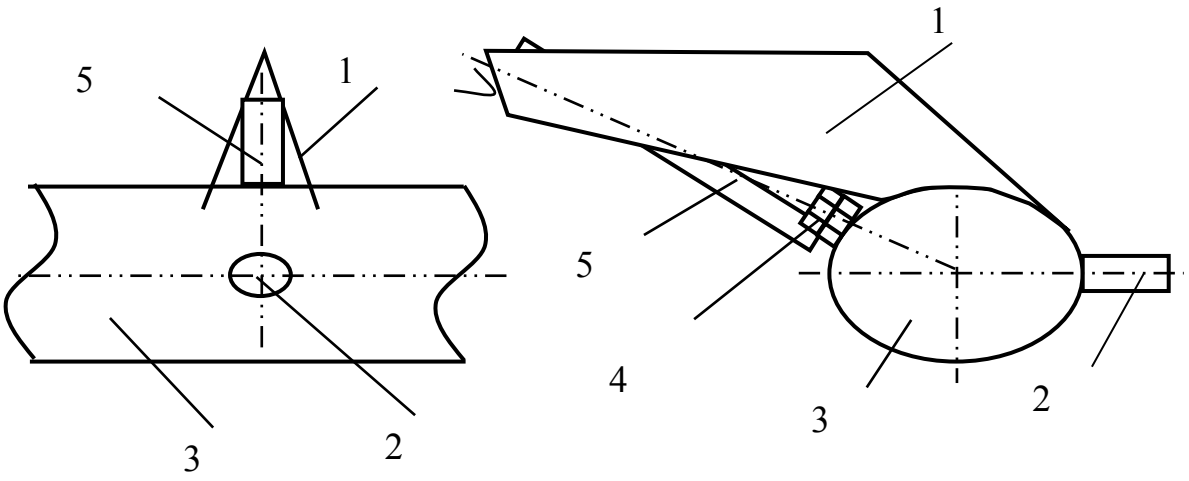
The water tank installed in the equipment is designed to supply the water contained in it through a rubber hose to the water distributor 6. In this case, the amount of water is changed by a special device. Water is delivered to the reservoir using special water carriers.



Rice. 4. Device for cuts and locks of the soil.

The water tank in stalled on the equipment is designed to supply water from it through a rubber hose to the water distributor 6. In this case, the amount of water is changed by a special device. The cistern is supplied with water by means of special water carriers.

A drawing of the working equipment that cuts and moistens the soil is shown in Figure 4. A knife 1 is welded to the water distribution pipe 3, holes are cut in certain places of the water distribution pipe, to which a pipe with an internal thread is welded, this pipe with an internal thread is connected to the water pipe 5 through a nozzle 4, the water distribution pipe 3 is supplied with water through the water pipe 2.

The amount of water supply when moistening the soil must comply with the following conditions:

$Q_t \leq Q_{\text{according to}}$ (1)

where: Q_t - the amount of water supplied to the soil, m^3/h; Q_{on} - the required amount of water supplied by the supply equipment, m^3/h.

The amount of water supplied to the soil for moistening is determined by the following formula:

$$Q_т = B \cdot H \cdot \frac{W_o - W_т}{100} \cdot \vartheta_ю \, m^3/h \quad (2)$$

where B is the width of the rink, m; H - soil layer to be soaked, m; W_o - optimal soil moisture,%; W_T - natural soil moisture,%; $\vartheta_м$- machine speed, m/h.

The amount of water required for the humidifying working body can be determined by the formula:

$$Q_{по} = 1000 \cdot \mu \cdot \frac{\pi \cdot d^2}{4} \cdot n \cdot \sqrt{2 \cdot g \cdot h}, \text{ l/s} \quad (3)$$

where μ - hydraulic coefficient, taking into account the amount of water in pipes and holes; d is the diameter of the water outlets when the soil is moistened, m; h is the height of the water column in the system, m.w.s.; n is the number of holes in the system.

Using formulas (1), (2) and (3), you can determine the speed of the base machine during operation:

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$$\vartheta_{\text{м}} = 900 \cdot \frac{\pi \cdot d^2 \cdot \mu \cdot n \cdot \sqrt{2 \cdot g \cdot h}}{B \cdot H \cdot (W_{\text{вн}} - W_{\text{e}})}, \text{ m/h (4)}$$

where W_{vn} - moisture content of water-saturated soil; W_e - natural moisture content of the compacted soil.

Table 1 shows the various speeds of the roller, taking into account the supply of water to the soil to a water-saturated state.

Table 1

The speed of the roller, taking into account the supply of water to the soil to a water-saturated state.

Water supply to the ground $(W_{\text{тўй}} - W_{\text{таб}})$,%	**Ten**	**13**	**Fifteen**
Roller operating speed, m/h	255.7	196.7	170
Required mass of water for one hour of machine operation, t	12.3	9.44	8.16

For irrigation studies of the working body of the soil-compacting device, its model was made on a scale of M1: 3. Its general view is shown in Figure 5.

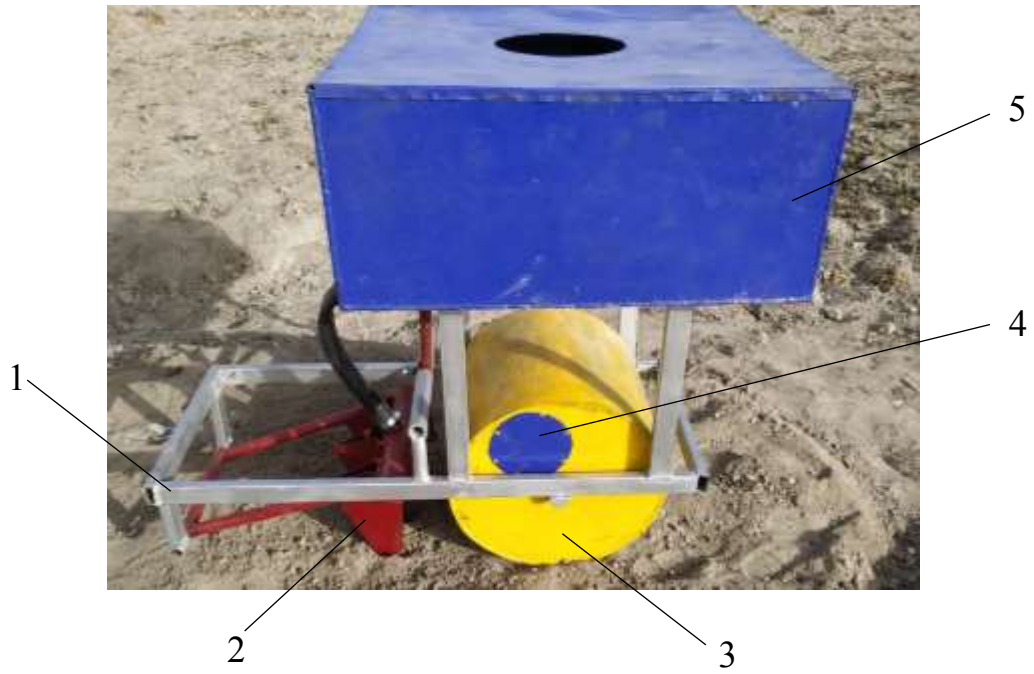

Fig.5. General view of the soil-compacting body: 1-frame; 2-moisturizing body; 3-skating rink; 4-lid; 5-capacity for water.

The results of irrigation studies are shown in Table 2.

Table 2.

Results of Irrigation Research.

Experiments	Mass of sealing body, kg	Natural soil moisture, %	Roller speed, m/coat	Water consumption for additional investment, l / s	Average density of compacted soil, g / cm ^{3}
Ice rink test without water and sand	70	12	170	one	1.45
Testing a skating rink without water and with sand	140	12	170	one	1.50
Water and sand rink test	200	12	170	one	1.60

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CONCLUSION

1. According to the research results, to ensure the optimal amount of water consumed, the following parameters of the sprayer are set: hole diameter $2 \leq d \leq 3$ (mm); number of holes $40 \leq n \leq 60$ (pcs.); water level height $1 \leq h \leq 3$ (m).

2. Based on the results of the research, an optimal design of the soil moisturizing body was developed, which provides the necessary moisture for soil compaction.

3. The checkerboard arrangement of the openings of the dampening pipes led to the formation of a high-quality compacted soil layer due to uniform soil moistening.

4. With soil moisture W > 30%, its density practically does not change, with pressure on the soil P \u003d 7 kPa and humidity W \u003d 18 ... 22%, soil density ρ\u003d 1.45 ... 1.55 t / m ^{3} . With soil moisture W = 22 ... 30%, its density practically does not change.

5. When the proposed technology is introduced into production, along with the quality of soil compaction, labor productivity will double and metal consumption will decrease by 30%.

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