Method for sealing ground in trench closed drain

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Abstract. To improve the reclamation state of the land, a big role is played by a horizontal horizontal drain, which does not give for raising the level of groundwater and collect salt water during irrigation. For the protection of drainage from destruction and flushing, an important role is played by the compaction of the ground, which inside trench. The article addresses the issue of ground compaction in trenches of closed drains. The article gives the advantages and disadvantages of the existing methods of compaction of ground in trenches of closed drains, the results of a study of methods of compaction of ground in trenches of closed drains showed that backfilling and compaction of the ground is done separately, these operations must be performed simultaneously, this article gives the design of a compaction device that must be performed simultaneously, the basis theory of ground compaction, the results of laboratory research, the results of the study determined: acting ground force on the surface of the sealing blade (\( F = 12 \text{ kN/m}^2 \)), the outer diameter of the sealing blade (\( D_{ou} = 300 \text{ mm} \)), the inner diameter of the sealing blade (\( D_{in} = 60 \text{ mm} \)), the coal between the blades (\( q = 15 \ldots 30^\circ \)), the rotational speed of the blade shaft (\( n = 360 \text{ r/min} \)), degree coefficient (\( k_x = 1.22 \)) of ground compaction, ground density \( \rho_g = 1375 \text{ kg/m}^3 \).
In this way, the ground pressure is compressed and tightened by the forces acting on the surface of the compacting machine during the movement.

2. Methods
This method is used in the embedded trench or in the ground trimming process. Ground compression and compacting are done through simple or active work equipment [11]. The general view of the trench compacting machine with simple work equipment is shown in Figure 1. This machine is comprised of the following main components: machine tractor 1, blade 5, and work frame 4, hydrocylinder that unloads the work equipment 3. The ground compacting with this machine is done after the trench is fully filled with the ground. The trench is lodged between the machine's chain-driven walking equipment and the car moves along the trench axis. During the movement of the machine, the ground-tightening unit is immersed in the trench to the required depth. The ground-tightening machine consists of several blades that fall at a specific angle relative to the horizontal. During the joint movement of these blades, the blades are well positioned at the expense of the ground angle beneath them and are compacted by compression.

![Figure 1](image)

**Figure 1.** Ground compaction by compression located in trenches with passive working bodies

In this method, the following are the disadvantages of ground compaction: difficult to keeping the working equipment in the center of the trench, causing it to disruption the walls of the trench as it is difficult to control; ground compression is carried out at the expense of high gravity, causing the tractor to fail quickly; does not work well in grounds with low moisture content (6… 10%); the dense ground wall with the trench walls is not well connected; tractor movement in the backfilled ground layer it reduces its bite with the earth and as a result, the tractor will move (rotate) where the walking equipment is located.

The drainage trench is fully buried Figure 2 shows the general layout of the multi-layered compacting machine [9]. This machine has the following main parts: drainage box 1, ribbon ground loader 3, ribbon loader fastening special frame 2, compacting ground coating rinks 4, preserving ground and consists of a distributor hole 5.

The Drainage Machine Multibucket Dug the Trench, Raise the Ground, transmits the transverse ribbon to the loader. The transverse ribbon conveyor directs the ground to the longitudinal lentic conveyor, which is arranged parallel to the bin. With a longitudinal ribbon loader, the ground gets into the
distributor device, keeping the ground in the back of the drainage box. In the back of this installation there is a hole that serves for layering ground. The outgoing ground layer from each hole is compacted by matching rinks. Outgoing ground from the hole is compacted with appropriate rinks.

Figure 2. A general view of the static compacting machine by forming a layer in the trench

The disadvantages of this method are as follows: technological complexity; high metal capacity; the fact that the buried ground is not united with the mother ground; at low ground moisture the required ground density is not ensured.

Consider the hydromechanical (water supply to the ground) ground compaction method:
1. Two-way water injection method for drainage trenches was developed by experts and scientists and is included in the drainage construction project [16, 17].

Ground compaction with two-way water supply. Before applying this method it is necessary to solve the problem of water supply. That is, the use of water to collector or canals together with the to consider close drainage to them by running water or pumps will be solved issues to bring. Water will be bring if needed. This process must be taken into account, especially during the winter and spring seasons. In summer and autumn there is a shortage of water, which is mainly used for irrigation of crops.

This method is used for full backfilling of the drainage trench. The following technological processes are performed to implement this method: In the upper part of the backfill, a channel for supplying water opens; given that the process is mainly in the direction of the drainage slope drain pipe opening closes leaving holes in slope route open;

Control wells will be installed at 100 ... 400 m. There is a lid at the top of the control wells, they are locked, tightly guarded and controlled. Dumping of all kinds of garbage into the control wells without lids will result in drainage failure without their effective use. Water was pumped 8 to the control wells 9, while through the drainage pipe 6, the water rises to the top, water rise to 2/3 of the height is observed through tubes 4, at the same time, the water supply is supplied from above and the process continues until each other meets the upper and lower direction of water flow (Figure 3).
In this method, the water consumption for each meter of the drainage part is 3... 4 m$^3$. The reason for such water consumption is that the water used for soaking spray is absorbed into the ground around the trenches. Ground compaction this method is obtained with a water-saturated state of the ground. That is, the density of compacted ground is equal to or greater than the density of the mainland. In some cases it may even be higher. As mentioned above, this method has not been able to play its role in production due to its various organizational, technical, technological, water and water resources. In addition, this process is supposed to take place over a period of time after the completion of the drainage process, ie when the collectors and the canals are flooded. This method is mainly used in winter and spring. After the drainage trench is backfilled, it becomes more difficult to adjust the his arrows (drainage and canals) when constructing a canal to provide water to the upper drain.

2. With this method, ground compaction is obtained simultaneously by supplying water to the ground to be backfilled. This is because the ground buried in the trench is broken down during the excavation process and expands at the expense of cavities (air). When water is transferred to the ground, it removes airspace, at the same time, water lubricates the ground particles, as a result, the volume of ground decreases.

Water on the ground, must be supplied simultaneously with continuous backfilling. Using a screw conveyor when moving the ground into the trench is a good result. Because of the rotation of the screw conveyor machine, the moving ground is broken down and its initial density is achieved by the mixing of the wet and dry layers. As recommended by some experts and scientists using a screw conveyor the ground is crushed, wet, during dry mixing, water is supplied through a special water sprayer, water-saturated is diverted to the drainage trench. In this way, the soaked ground will have the required density. However, due to coupled re-buried grounding of the trench walls not well connected and considerable energy expenditure on the mixing process and other technical reasons, it has not been able to play its role in production. The method of water spraying recommended by A.N. Mirsagatov is comprehensive, convenient, economical and qualitative, and differs from other methods for the recycling of soaked the ground with water (Figure 4) [12, 13].
Figure 4. Soaking the ground with water

The advantage of this method is that moistening the ground re-buried in the trench starts at the bottom of the trench and up to the desired height that is, the amount of volume ground in the trench is covered by all layers. For this need to set the water sprayer to the required height. The economy of this method is that the amount of water used for soaking is 15 to 20 times less than that used by other methods. This is due to the fact that water is spent on the ground floor where the soaking is required. The disadvantages of this method are as follows: The process is performed separately from the drainage; a special machine is required to fill the ground with a trench and moisten it.

3. Results and Discussion
The results of the analysis of existing methods showed that it is necessary to create an improvement in technology for the construction of drainage, backfilling of the ground with simultaneous compaction. The article gives a new method of compaction of ground in trenches of closed drains by simultaneously filling it.

Figure 5. Paddle equipment for ground compaction
Our preliminary studies have shown that the most acceptable method for ground compaction is the theory of ground compaction of the basis and a comparison of the existing and recommended method of ground compaction [17-22].

The recommended method of compaction of the ground in the trenches of closed drains is implemented, simultaneously with its building [13, 23-25].

To do this, make a hole in the back of the drain box 4 (Figure 5a), which is equipped with a 2-wire 3 and bolt attachment.

Blade shaft 1 receives movement from hydraulic motor 5.

A sample of the manufactured shaft with blades is shown in Figure 5b.

To determine the angle between the blades and the force acting on the surface of the blade, a laboratory stand is made (Figure 6a). Its circuit diagram is shown in Figure 6b, it consists of the following parts: blade equipment 6; motionless cylindrical vessel 5; movable cylindrical vessel 7; column 3; handle for rotating the blade shaft 1; table 9; wheel cart 8; steel rope 11; funnel 4; suspension for betting weights 10; rope guide wheel 2.

Procedure for launching laboratory equipment; the bottom of the movable cylindrical vessel should stick to the end of the stationary cylindrical vessel through the funnel the stationary cylinder with ground (wherein determines the mass $m_{softened}$ of ground) is replenished (its volume is $V = 4 \cdot 10^{-3} \text{m}^3$), the compaction process begins with rotations of the blade shaft, we continue to fill the space with the ground until the cart moves, we place stones in the loader and continue tightening until the cart stops moving, find the sum of the putting masses $\Sigma m$, that.

The experiments are repeated several times for different types of ground and with different moisture content.

The density of the softened ground is determined as follows:

$$\rho_z = \frac{m_z}{V}$$

Density of the compacted ground is determined as follows:

$$\rho_z = \frac{\Sigma m_z}{V}$$

When the second equation is equal to the first equation, the coefficient of density is:

$$k_z = \frac{\Sigma m_z}{m_z}$$
The first experiment was carried out on a healthy ground with a moisture content of 16%, and the ground was placed \( m = 4.5 \text{ kg} \) in the bowl. The density of ground in the vessel (1) is based on the formula \( \rho_{yu} = \frac{m_{yu}}{V} = \frac{4.5}{4 \times 10^{-3}} = 1125 \text{ kg/m}^3 \) when compacting ground in a vessel. \( \sum m_{z} = 5.5 \text{ kg} \) of ground is located. The compaction of ground in the vessel (2) is \( \rho_{z} = \frac{\sum m_{z}}{V} = \frac{5.5}{4 \times 10^{-3}} = 1375 \text{ kg/m}^3 \) kg according to the formula.

By putting these formulas values (3), we determine the coefficient of ground intensity:

\[
k_{z} = \frac{\sum m_{z}}{m_{yu}} = \frac{5.5}{4.5} = 1.22
\]

4. Conclusion

Experimental studies on this technique in laboratory conditions have shown that when ground is compacted with moisture of 15 ... 20% mechanically, it is possible to achieve optimum density (1.45-1.65 t/m\(^3\)) and a strong bond between the backfill ground and the walls of drainage trenches.

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