Technical solutions for working elements of machines for efficient compaction of soil

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Abstract. The modernization of machines for compaction of soil on a modular basis has the following advantages: some of their structural elements (working equipment and working elements) can be performed as unified modular units, from which, depending on the technological requirements, it is possible to assemble the required configuration of the sealing machine; the initial state of the machine does not deteriorate, to which it is easy to return; the nomenclature of structural elements and machines in general decreases, as the machine can be completed with variable modules, which leads to an improvement in their quality. When consolidating the soil massive use static, dynamic and combined action on the soil in the form of rollers, vibro-and ramboards. Machines of the boot-type are classified into light, medium and heavy, which determines the order of its application. It is obvious that the reduction of technology for the process of soil compaction is possible due to the creation of machines that can change the intensity of the impact on the soil in a wide range.

1 Analysis of literary data and raising of problem

In modern conditions of ground works during the construction of soil embankments, in particular railway tracks, at the final stage, the issue of effective compaction of soil is relevant, since the stability of the soil structure depends to a large extent on the stability of the parameters of soil moisture and settlement load.

Known soil compacting machines (SCM) rollers, vibration plates and ramps traditionally comprise freshly ground soils in successive passages with the basic condition - not exceeding the surface pressure of the working element (WE) on the soil of the boundary of soil plasticity. To do this, there are certain technological sequences of the use of the Ministry of Emergency as a whole, and their WE [1 - 8].

In particular, the order of the SCM of the boot type involves, at the first stage, the consolidation of the soil with smooth, small and medium type, with subsequent use of their vibration systems (VS), followed by cam rollers with subsequent use of the aircraft. Further intensification of soil consolidation is possible with the use of trenches and vibration tracks of shock type.

The operation procedure of the SCM is characterized by either a gradual decrease in their contact area with the soil due to the change in the size and shape of their working

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surface, for example, the gradual decrease in the diameter of the cylindrical metal roller, the installation on its surface of variable bandages with cam sizes and profile, gradual increase in pressure in the pneumatic boats, or a gradual increase in the load on the WE.

The general disadvantage of the work of all known SCM is that they do not limit the yield of soil from under their working surface (do not block the soil) in case of excess surface pressure of the soil to the soil of the boundary of soil plasticity.

Goal - the purpose of the work is to develop the principal variants of technical solutions of the SCM WE for accelerated blocked consolidation of soil.

2 Main part

The scientific hypothesis put forward by the authors is to exceed the surface of the soil's plasticity by blocking its movement from the working surface of the WE and using this effect to accelerate the process of soil consolidation by reducing the number of WE SCM passages and the use of the blocked and maximally compacted soil in the WE as the transmission link of pressure on the lower and, perhaps, insufficiently sealed layers of soil.

The structure of the blocking action on the soil proposed by the authors suggests that they create the conditions for blocking the soil from transverse dislocation from under the WE and during its movement.

This result can be achieved by executing the working surface of the WE roller of the roller or the working surface of a plate or a special form molding, for example, profile. The proposed technological series of profiles can be, for example, rectangular, triangular, trapezoidal, wavy, combined (Fig. 1).

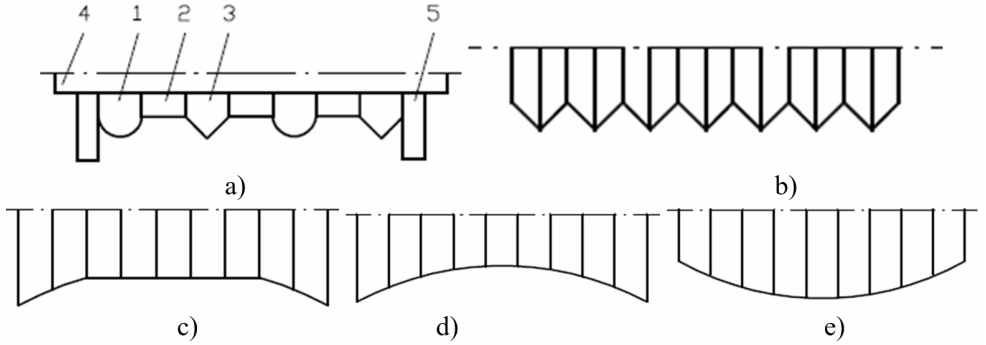

Fig. 1. Scheme of the working surface of the WE of special shape (blocking effect on the soil): 1, 2, 3 - variable discs; 4 - axle; 5 - side locking discs; a) example of a working elements with different types of disks; b) triangular profile roller; c) a trapezoidal combination roller; d), e) a roll with a convex and convex curved profile.

The authors proposed and protected by the patents a number of constructive decisions of the SCM, which provided for a change in the number of contacting with the soil WE, as well as developed technological sequences of the use of new SCM and machine tools in general with an emphasis on blocked seals [9, 10].

The proposed variants of the implementation of the variables WE of vibro-tramways and platforms provide a profile continuous or sectional execution of their working surface for the implementation of blocked consolidation of soil, both without moving the machine, and in the vertical and horizontal directions during the translational movement for the combined implementation of both blocked consolidation of soil and pressure changes at the point of contact of the working surface of the WE with the soil.

Proposed and investigated rollers with profiled working surface blocking action on the ground (Fig. 2).

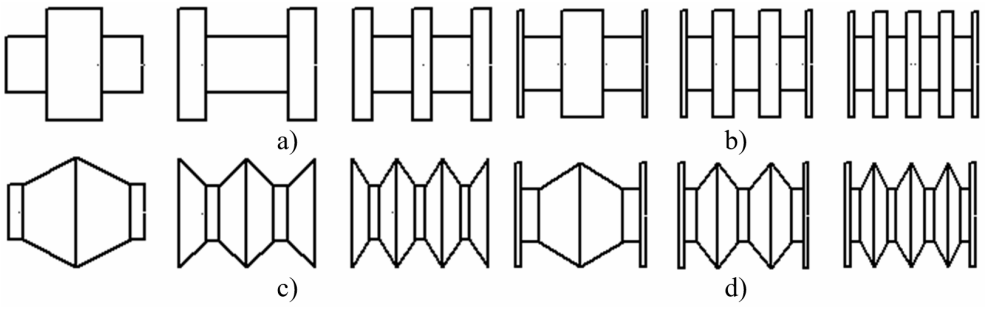

Fig. 2. Scheme of rolling rollers with a profiled working surface of blocking action on the soil with: a) is a cylindrical stepped form without side thin cylindrical disks; b) - cylindrical step form with lateral thin cylindrical discs; c) - a conic-cylindrical working surface without lateral thin cylindrical disks; d) - a conically cylindrical working surface with lateral thin cylindrical discs.

Thin lateral cylindrical disks are designed to limit the lateral slipping of soil from the working surface of WE rollers.

Also offered are variants of schemes of rollers of rollers with variable working surfaces, which are made to block the excavation of soil in the course of the rolling roller (Fig. 3).

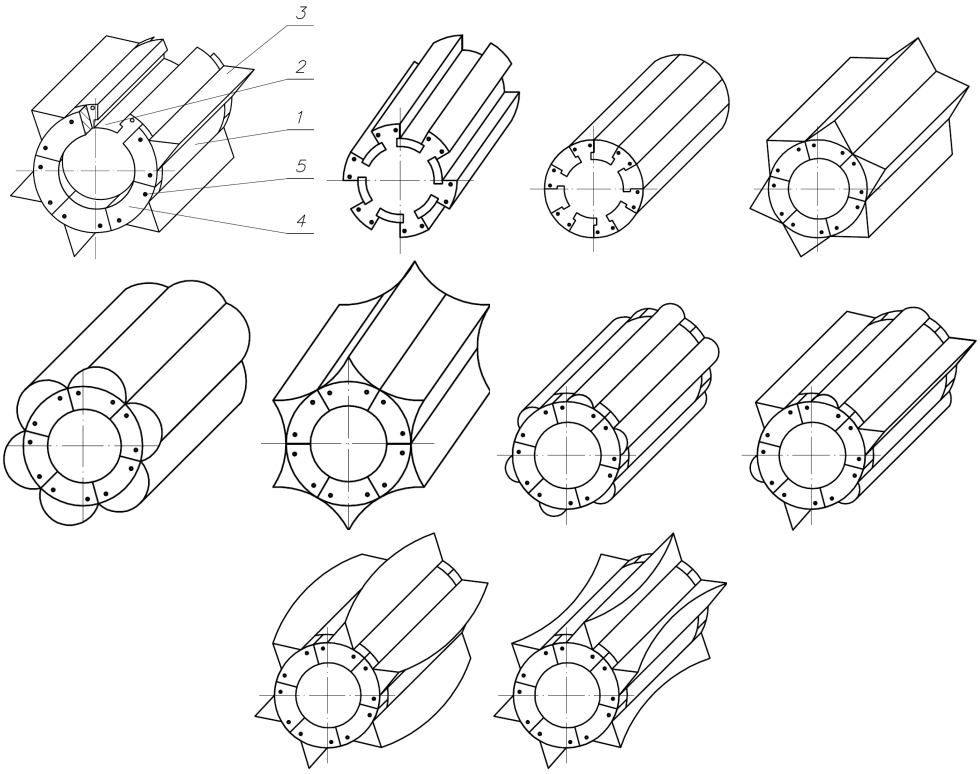

Fig. 3. Schemes of rollers of rollers with variable working surfaces: 1 - body; 2 - through slots; 3 - variable inserts; 4 - face fixing strips; 5 - threaded elements.

Variants of the profile of the working surface, blocking action on the soil (Fig. 4) are proposed to study WE ramps.

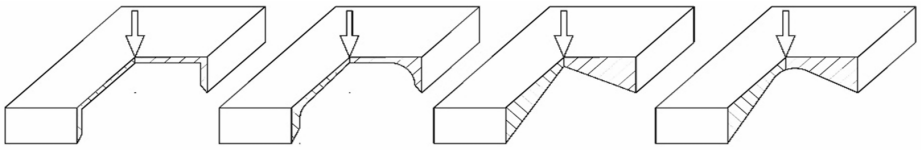

Fig. 4. Schemes of variants of working bodies of tractors of blocking action on the ground.

Variants of the profile of the working surface, blocking action on the soil are proposed to study the WE vibroplate (Fig. 5-8).

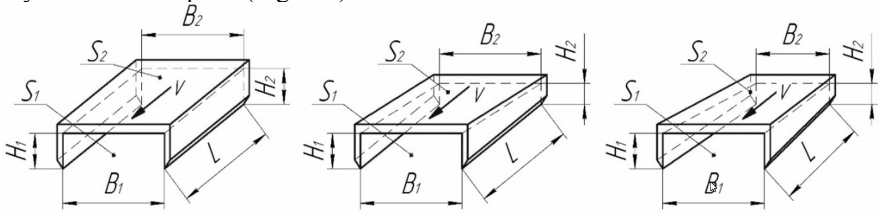

Fig. 5. Scheme of the П-shaped vibroplate profile.

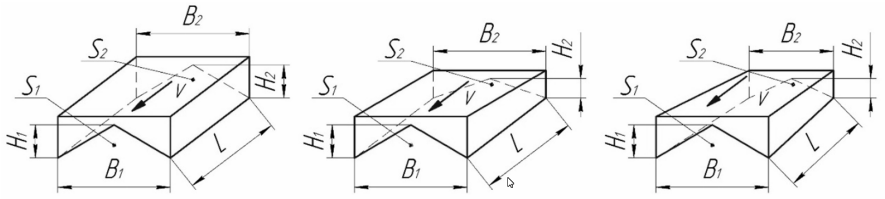

Fig. 6. Scheme of the triangular profile of the vibroplate.

In Fig. 5-8 possible value $H_1 = H_2$; $H_1 > H_2$; $B_1 = B_2$; $B_1 > B_2$; $S_1 = S_2$; $S_1 > S_2$ on the base length of the vibroplate L, and the direction of its movement is indicated by an arrow with the mark V.

In addition, to intensify soil consolidation, active use of vibration is foreseen in the form of integrated or modular vibration systems (VS) with the ability to regulate the disturbing force vector, type of oscillations, their amplitudes and frequencies.

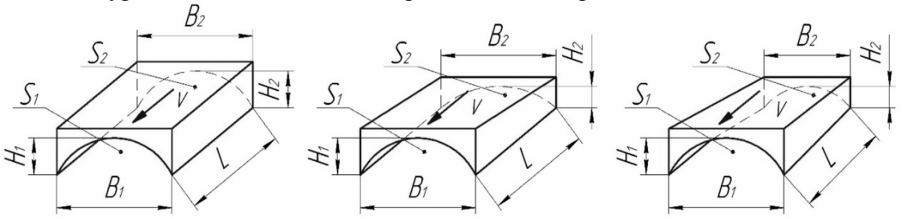

Fig. 7. Scheme of arched concave profile vibroplate.

The specified variants of the profiles of the working surfaces of the WE will restrict the transverse separation of the soil from the working surface of the WE and will allow:

- intensify the process of consolidation of soil by applying additional pressure on the soil, not limited to the limit of its plasticity;
- effectively perform seals of unconnected soils without disassembling them in the direction in relation to the direction of movement of the WE;
- to effectively perform seals of the surface layer of coherent soils, especially using the profile of the working surface WE in the variant (e) with the active application of the vibration system.

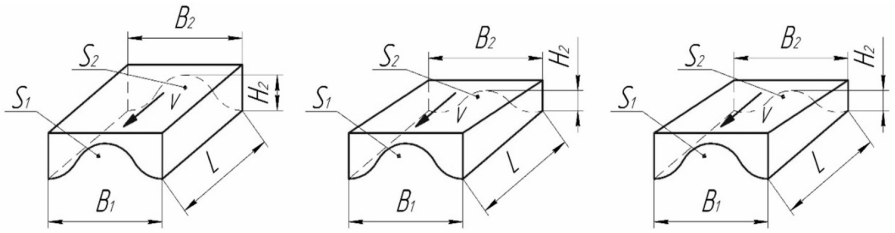

Fig. 8. Scheme of wavy Π-shaped vibroplates.

Execution of the working surface of the WE relief will increase its contact area with the soil, and, consequently, reduce the specific pressure on the soil. This will allow smoother removal of the gaseous and liquid phase of the soil from the compacted array.

The relief of the outer surface of the compacted layer of soil will create conditions for additional blockage of the next lumped soil layer with its consolidation.

Conclusions

The proposed development of the principal variants of technical solutions for the accelerated blocked consolidation of soil will ensure the achievement of the expected result by accelerating the process of soil consolidation by increasing the working stress of the soil below the surface of the WE due to its blocking.

The process of sealing the soil under the blocking surface of the SCM WE will be carried out not only in the vertical, but also in the horizontal and sloping direction, which will increase the efficiency and quality and sealing.

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