TO THE QUESTION OF INCREASING EFFICIENCY OF DEVELOPING SOILS OF HIGHER STRENGTH

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Abstract: *in the transport and other sectors of construction, a significant share in the total volume of earthwork is made up of work on small in volume, dispersed objects, and work carried out in cramped conditions.*
The article discusses ways to improve the development of solid soils in cramped construction conditions. At the same time, one of the promising directions in the creation of mechanization tools for the development of soils of increased strength in cramped conditions continues to be the improvement of excavator buckets with active action. It should also be noted that mounted dynamic cultivators are interchangeable working bodies of single bucket hydraulic excavators.
Keywords: *increased strength, active action, work, dynamic action, soil development, strong soil, machine.*

К ВОПРОСУ ПОВЫШЕНИЯ ЭФФЕКТИВНОСТИ РАЗРАБОТКИ ГРУНТОВ ПОВЫШЕННОЙ ПРОЧНОСТИ

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Аннотация: *в транспортном и других отраслях строительства значительный удельный вес в общем объеме земляных работ составляют работы на небольших по объему, рассредоточенных объектах и работы, выполняемые в стесненных условиях.*
В статье рассматривается пути повышения эффективности разработки прочных грунтов в стесненных условиях строительства. При этом одним из перспективных направлений в создании средств механизации разработки грунтов повышенной прочности в стесненных условиях продолжает оставаться совершенствование экскаваторных ковшей активного действия. Следует также отметить, что навесные рыхлители динамического действия являются сменными рабочими органами одноковшовых гидравлических экскаваторов.
Ключевые слова: *повышенная прочность, активное действие, работа, динамическое действие, разработка грунтов, прочный грунт, машина.*

A significant proportion of earthwork is carried out in cities and towns, near existing enterprises, power lines and other closely located engineering structures and communications. The proximity to the work site of engineering structures and communications, as well as the restrictions associated with the small size of the construction site, and other cramped conditions hinder the use of a number of methods for developing strong and frozen soils [1].

Under constrained construction conditions it is customary to understand the conditions that lead to a decrease in labor productivity. For example, broadening the excavations during the construction of the second railways, arranging approaches to bridges and other artificial structures, working near underground utilities and urban buildings, on slopes, in the presence of electrical and other utilities, and limited construction site size. Such conditions not only cause a decrease in the performance of earthmoving machines, but also significantly limit the possibility of their application. Excavation becomes even more time-consuming and expensive when performing them in soils of increased strength, requiring preliminary cultivation.

Currently, for preliminary loosening of soils of increased strength and preparing them for excavation, various methods and means of mechanization are used. The decisive factors when choosing one or another method are the physic mechanical properties of the developed soil, specific construction conditions and technological features of the work.

Among the traditional methods of loosening the soils, the drilling and blasting method and mechanical loosening carried out by special machines of static or dynamic action are the most effective.

Among the drilling and blasting methods, the most productive is the method of blasting with trench charges, which is widely used for the construction of hydraulic structures in various soils. However, the main disadvantage is the high cost of 1,5-2,0 times higher than the cost of excavation [2]. In addition, excavation work in construction, as already noted, often has to be carried out in cramped conditions, where the use of the drilling and blasting method is limited by the complexity of measures to ensure safety and environmental protection, and in some cases the production of explosions is generally impossible.

The development of high-strength soils by mounted tractor cultivators of static action is distinguished by the lowest cost and a sufficiently high productivity. However, the use of machines of static action, implementing layer-by-layer loosening, is limited by the traction capabilities of the basic equipment, and, consequently, by the strength of the developed soil, economically justifying itself when working on large areas.

In order to increase the efficiency of developing strong as well as frozen soils, a device [3] is proposed for softening soils during trenching by a rotary working body with cutting tools working in conjunction with machines for preparatory work, earthmoving and planning machines, aggregated with bulldozers. However, this design did not find wide application due to the limited ability to use it in cramped conditions.

Despite the fact that the level of mechanization of excavation work carried out in construction and in open cast mining has reached a high level, the development of soils of increased strength in cramped conditions is often still performed manually, which is 10-15 times higher than the cost of developing them with machines and mechanisms. The complexity of manual development of soils of increased strength in such conditions is 20-25 times higher than mechanized. In transport construction, for example, 0,3% of the volume of manual excavation is 42% of the total labor [4].

In this regard, the mechanization of the development of soils of increased strength in cramped conditions and on small in volume, dispersed objects are a problem of national economic importance.

One of the most promising areas in the creation of mechanization of this kind of work is equipping shovels with removable working bodies, active action. Such interchangeable working bodies of single-bucket excavators are mounted cultivators with pneumatic or hydraulic hammers and buckets of active action. The use of an excavator as the base machine in the latter case allows for the full development (cultivation and excavation) of soil in cramped conditions without the use of additional means of mechanization.

Replaceable working bodies of dynamic action, due to the large magnitude of the efforts created, are capable of destroying soils of relatively high strength and, in addition to having a relatively low weight, make it possible to use them as replaceable working equipment of shovels. The use of single-bucket excavators as basic machines, especially wheeled excavators, will create a number of additional advantages for mechanization tools such as mobility, the ability to manipulate working equipment in wide ranges and destroy both horizontal and vertical surfaces, which makes it possible to effectively use dynamic machines for work in cramped conditions and on small, dispersed objects.

Replaceable dynamic action cultivators are usually hung either on the handle of a hydraulic excavator or on an arrow instead of a handle. Such active cultivators economically justify itself with a significant amount of work on loosening high-strength soils, when re-equipment of an excavator for excavation of destroyed soil or material is extremely rare, and also when crushing oversized pieces of rock in stone quarries, when an excavator with a mounted cultivator turns into specialized car. In cases where it is necessary to periodically carry out work on loosening and excavating the destroyed soil, and such work is much more common in construction practice, the productivity of the full development (loosening and excavation) of the soil is significantly reduced, since it takes a considerable time to replace one working body with another (up to 40 minutes or more).

Quick-action active cultivators mounted on the excavator bucket using a special gripping device [6], for which the installation and dismantling times are about two minutes, respectively, have a relatively low productivity of full soil development, which varies from 4 m^3 depending on the group of difficulty in developing the soil h in soils of group VIII up to 20 m^3 / h and soils in group V, and they economically justify themselves only with insignificant amounts of earthwork at the facility.

Active excavator buckets [7, 8], unlike mounted cultivators, simultaneously produce loosening and excavating the soil, which greatly simplifies the excavation technology in some cases. The combination of loosening and excavation allows you to work in hard-to-reach places, as well as to develop slopes, the bottom of trenches, pits and wells to the design level. The combination of operations of cultivation and excavation leads to a significant increase in the productivity of the excavator in the development of soils of increased strength in cramped conditions.

In this regard, the improvement of active excavator buckets continues to be a promising direction in the creation of mechanization tools for the development of soils of increased strength in cramped conditions. It should also be noted that mounted dynamic cultivators are interchangeable working bodies of single bucket hydraulic excavators.

Considerable attention paid by researchers to the creation of new interchangeable working bodies for single-bucket excavators is also explained by the relatively low cost of this, which does not require modernization of the base machine. The creation of replaceable working bodies for single-bucket excavators with straight shovels helps to increase the productivity of these machines in certain types of work. The use of a special replaceable working body for each type of work makes it possible to better use the energy resources and weight parameters of the machine, to more fully mechanize the execution of a number of works on which manual labor is still used.

The specialization of machines and equipment, the whitening of the full compliance of the equipment used with the specifics of the conditions of the construction site are important factors in the intensification of construction production, which characterize one of the features of the development of earth moving machines at the present stage.

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