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Article

Analysis of Machines Used in Digging and Cleaning Canals

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Abstract: Further improvement of the land reclamation condition is of great importance, as a result of which the yield from the land will increase. In cotton fields with a layer of haydov (0…..30 cm), moisture and hardness are 11…19% and 2…3 MPa, under the haydov layer (30….50 cm) – 8…18% and 3….6 MPa. During the pre-sowing cultivation period, soil moisture and hardness do not differ significantly depending on the type and area of the soil. Only saline fields differ somewhat from washed fields.

Keywords: Plunger trenchers , Plug-rotor trenchers , Trench levelers , Milling trenchers.

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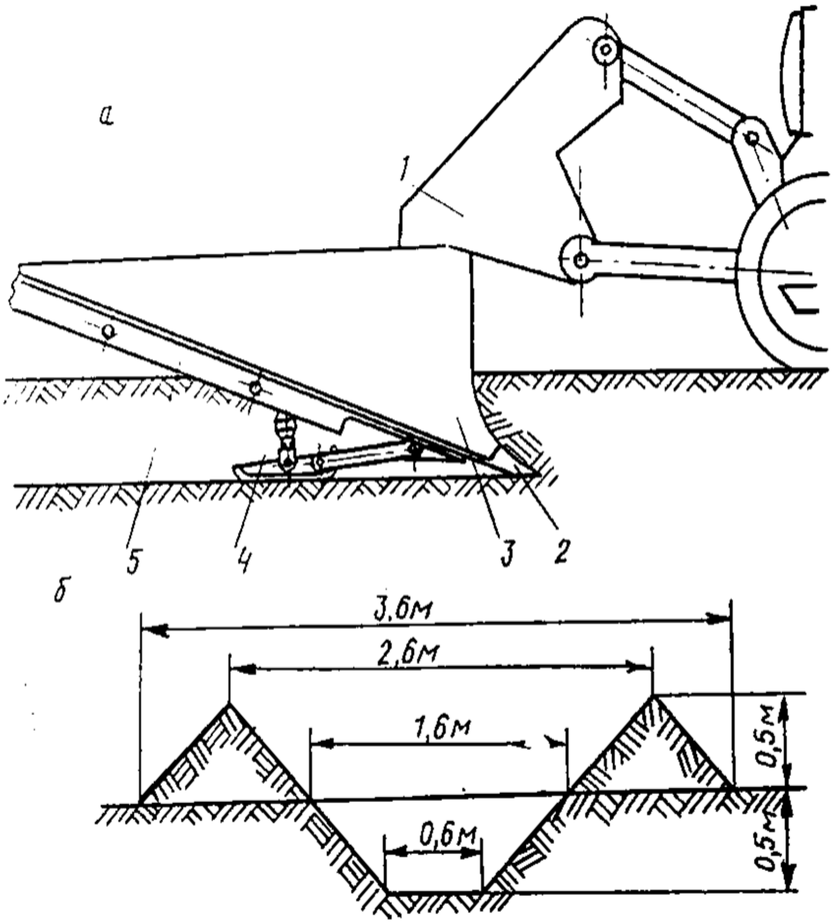
1. Introduction

In our republic, as in many other sectors, extensive work is being carried out in agricultural production to develop machines with high productivity, energy and resource efficiency, high-quality processing, and working bodies based on advanced technologies.

The main direction of mechanization of open-pit construction and the main reserve for increasing labor productivity is the wider use of continuously operating universal meloration machines [1] . Channel diggers are mainly produced in two types: plow channel diggers in the form of a large plow with two overturning blades, and milling channel diggers with two disks and milling cutters. The disks are located at an angle of 90 ^{0} to each other and at an angle of 45 ^{0} to the horizontal surface . The MK-16 plunger canal digger (Figure 1) is designed for digging temporary irrigation canals with a bottom width of 0.6 m and a depth of 0.5-0.6 m. It can also be used for cleaning canals.

The MK-16 trencher consists of a stand 1 with interchangeable plowshares 2, turnbuckles 3, support skis 4, and slope compactors 5.

The cross-section of the stand is box-shaped. A plate for the lemex is welded to its lower part, and a finely ground lemex is fastened to it using four bolts with concealed heads [2].



operating canal digger: profile of the 6th canal section ; 1-stand; 2-plough; 3-turnover; 4-snow ; 5-slope compactor

Fig. 1. 2. Fig. 1. MK-16 trencher with plug:

The left and right turners are attached to the rack with the help of brackets, ribs and brackets. The lower part of the rack is attached to the ski with a hinge, and the ski supports the trench digger on the bottom of the excavated trench. The lower edges of the turners are attached with hinges to the tilting clamps, which are tightened with screw clamps when necessary. The results of the experiments are presented in Figures 2 and 3 and in the table.

Technical characteristics of trenchers

Indicator	MK-13	MK-16	MK-17	MK-23
Work unit:	1.4-2.5	2.5	__	__
km /h	___	__	80-200	100-240
km3 / hour				
Overall dimensions, mm : length				
width	5800	360	6000	__
height	3200	3830	2240	__
Mass of the working equipment kg	3600	2195	2300	__
Channel depth, m	4500	1016	8770	2500
Width of the channel bottom, m	0.6-0.8	0.5-0.6	0.5	0.5
	0.5	0.5	0.3	0.35

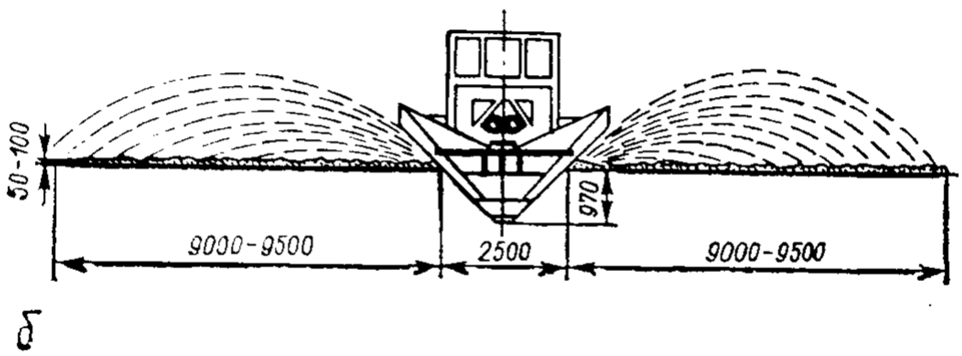
2.4 -§ Channel digger- levelers

The KZU-0.3 channel digger-leveler and the PR-0.5 floor leveler-leveler are used to dig and level temporary irrigation canals , ditches , and floors .

The KZU-0.3 canal digger-leveler (Fig. 3) is a unified machine. It is designed to dig temporary irrigation canals with a depth of 0.3 m and a bottom width of 0.5 m , and ditches with a bottom width of 0.3 m with a slope of 1:1, It is also designed for leveling and leveling [3]. The machine operates on all categories of soils, except for stony soils . The trencher is mounted on a DT-75 tractor.

2. Fig . 4. Milling unit KFN-1200A channel boring machine

For leveling the channels, the leveling rollers are attached to the frame extensions - the cross beam at an angle. A roller is attached to the rollers. The wheels are set to the specified cutting depth of the embankment. After the specified adjustments are made, the tractor leveling enters the channel together with [4]. When the unit is moved with the leveler lowered, the blades of the augers cut and the cut soil falls into the channel along the augers and fills it . The leveling board flattens and levels the soil, and the roller compacts it.



a,b - when the aggregate speed is 6 and 8 km/h, respectively

Figure 4.Continued

b- working view; 1- hydraulic cylinder; 2, - cardan shafts; 3- distribution box; 5- semi-axle inside the casing; 6, 12- conical and planetary reducers; 7- frame; 8- milling cutter; 9- slope adjustment mechanism; 10- blades; 11- reversible plow; 13- tractor mounting mechanism; 14- hydraulic cylinders of the tractor mounting mechanism

Figure 3. 2.5 -§ Milling channel diggers

The KFN-1200A double-milling active working installation (Fig. 4, a) is designed for digging irrigation canals up to 1.2 m deep in one pass on peat and mineral soils. The working body of the canal digger consists of a two-bladed plow , two disk-shaped cutters, the cutters rotate at a frequency of 65 or 95 rpm. The disk-shaped cutters have blades , and on the surface of the blades are mounted buckets [5]. The blades cut the soil, and the buckets remove it to the top. The soil is spread evenly on both sides of the canal. The canal is trapezoidal, with a flat bottom and slopes.

2. Methodology

This study employs a comparative analytical approach to evaluate the technical characteristics and operational performance of canal digging and cleaning machines used in land reclamation. The primary machines analyzed include the MK-13, MK-16, MK-17, and MK-23 plunger-type trenchers, the KZU-0.3 canal digger-leveler, and the KFN-1200A double-milling canal boring machine [6].

Data were collected through field observations and technical documentation review conducted at irrigation canal construction sites in Andijan region, Uzbekistan [7]. Technical parameters including working speed (km/h), channel depth (m), bottom width (m), machine mass (kg), and overall dimensions were systematically recorded and compared. Field measurements of soil moisture content and soil hardness (MPa) were taken at depths of 0–30 cm (plow layer) and 30–50 cm (sub-plow layer) to assess working conditions [8].

Performance indicators were analyzed using standard agronomic and mechanical engineering evaluation criteria. The efficiency of each machine was assessed based on its capacity to maintain canal geometry (depth, bottom width, and slope angle), the quality of embankment compaction, and fuel and energy consumption per unit of work [9]. The study also considered the adaptability of each machine to varying soil conditions, including saline, washed, and standard agricultural soils typical of Central Asian irrigated farmlands [10].

3. Results

The comparative analysis of the four plunger-type trenchers reveals notable differences in their technical performance. The MK-16 demonstrated the most consistent results for small-scale temporary irrigation canal construction, achieving a working speed of 2.5 km/h with a channel depth of 0.5–0.6 m and a bottom width of 0.5 m, while maintaining a relatively compact equipment mass of 360 kg [11]. The MK-13, in contrast, operates at lower speeds (1.4–2.5 km/h) but handles greater depths (0.6–0.8 m), making it more suitable for primary drainage canals [12].

The MK-17 and MK-23 machines showed higher volumetric capacity (80–200 m^3/h and 100–240 m^3/h, respectively), which is better suited for large-scale reclamation projects. However, their heavier mass (8,770 kg for MK-17 and 2,500 kg for MK-23) limits their deployment in areas with soft or waterlogged soils [13]. Field observations confirmed that soil moisture in the cotton field plow layer (0–30 cm) ranged from 11% to 19%, with hardness between 2 and 3 MPa, while sub-plow layers (30–50 cm) exhibited moisture of 8–18% and hardness of 3–6 MPa, consistent with the operating ranges of these machines. The KZU-0.3 canal digger-leveler performed well in combined digging and leveling operations for temporary irrigation canals and ditches. Its capacity to operate on all soil categories except stony soils, combined with its DT-75 tractor compatibility, makes it suitable for widespread application in Central Asian farmlands [14]. The leveling rollers and auger-based soil redistribution system produced canal floors of consistent quality with minimal manual finishing required.

The KFN-1200A milling canal boring machine demonstrated the highest depth capacity, reaching up to 1.2 m in a single pass on both peat and mineral soils [15]. Its dual disk-shaped cutters rotating at 65 or 95 rpm, combined with bucket-equipped blades, enabled efficient soil removal and even distribution along canal banks. The resulting trapezoidal canal profile with a flat bottom satisfied standard irrigation canal design requirements.

4. Discussion

The results confirm that no single machine type is universally optimal for all canal digging and cleaning operations in Uzbekistan's irrigated agricultural zones. The selection of appropriate equipment must account for canal dimensions, soil type, required working speed, and available tractor fleet . Plunger-type trenchers such as the MK-16 are best suited for shallow temporary irrigation channels, while milling machines like the KFN-1200A are more appropriate for deep, wide drainage canals.

The observed variation in soil hardness between saline and washed fields has practical implications for machine selection and adjustment. Saline soils exhibited higher resistance values in the sub-plow layer, which can increase the load on the working body and reduce operational speed. This finding is consistent with previous studies on soil-machine interaction in Central Asian irrigated agriculture. Operators should adjust slope compactor positions and working depth settings accordingly to maintain consistent canal quality.

From a broader mechanization perspective, the introduction of high-performance machines significantly reduces the time required to commission reclaimed areas and improves overall labor productivity. The continuous-operation design principle common to all analyzed machines represents a key advantage over traditional intermittent excavation methods. Wider adoption of these technologies across Uzbekistan's irrigation infrastructure maintenance programs could yield measurable improvements in canal hydraulic efficiency and water delivery reliability.

5. Conclusion

The use of high-performance machines at construction sites in the areas of drainage and irrigation will reduce the time for commissioning the reclaimed areas, improve the quality of the work performed, and increase the level of mechanization of work . When digging a channel with a MK-16 plunger, the depth of the channel to be dug depends on the condition of the base rock and the density of the soil in which the channel is being dug. The position of the slope compactors is adjusted depending on the depth of the channel to be dug and the density of the soil.

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