Techniques and technology improvement of cleaning open drainage networks in Bukhara region

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Abstract. In Uzbekistan, including in the Bukhara region, the technical condition of the collector-drainage networks is unsatisfactory; the drainage systems are overgrown with weeds, and their cleaning remains one of the most pressing issues. As of December 2020, the total length of collector-drainage networks in the Bukhara region is 8851.6 km, of which the reclamation condition of 583.0 km is satisfactory and the reclamation condition of 160.2 km of collector-drainage networks is unsatisfactory, and performance enhancement is required. Finding solutions to these problems requires field and practical research to increase their efficiency by 50–55 percent. The article provides some scientifically based information on the development and implementation of production of technical means used in the implementation of these processes and advanced variants of technologies for their application.

1 Introduction

The main issues in the world are the development and introduction of energy-saving technologies and equipment for the cleaning of open collectors and sewers. There are a lot of studies and technologies to address this issue. This includes the information from different sources [1–5].

Nowadays there are many materials on the development and introduction of new energy-saving technologies and techniques for cleaning open collectors and drains [6–9].

The results of the research, recommendations and conclusions in the sphere of production do not take into account the specific climatic conditions of the Bukhara region, the problems of cleaning open collectors and ditches, which serve to improve the reclamation of saline soils. Taking into account some shortcomings in the technology, it is important to substantiate the parameters of the new resource-saving technologies and techniques in Bukhara region and also conduct scientific research.

Plants, which are grown in collectors of Zach drainage networks, are mainly divided into three groups.

Group I: aquatic plants whose stems, roots, and leaves are in water (black grass, lowland plants, weeds, herbaceous aquatic plants, etc.).

Group II: plants (reeds, algae, sugar cane, etc.) whose roots are in water and half of those which grow out of the water. They grow to a depth of less than 30 cm under water and can grow up to 45 cm in length per month.

Group III: weeds (which are plants) growing along and adjacent to the collector banks [14].

2 Materials and Methods

The technical specifications of the equipment are based on the recommendations and manual data on the use of the machine developed by the organization that tested and commissioned the machine, as well as the results of factory tests. In addition to the general indicators, due to technical requirements, improved and modernized sample indicators were installed for individual parts and general working bodies during the tests [13].

The slope of the collector sides is recommended as the slope of the sides of the collector where the open collector-drainage is built or repaired to be taken as the values given in Table 1, depending on the degree of salinity of the soil.

Table 1. The slope coefficient of the collector sides

Names of soil	The slope coefficient of the collector sides	
	In unsalted, low and medium saline soils	In strongly saline soil
clay and heavy sandy soil	1.0	1.0–1.25
medium sandy soil	1.25–1.5	1.5–1.75
sandy and light sandy soil	1.75–2.0	2.0–2.5
fine sands	2.5	2.5
barkhan and sand	2.5–3.0	3.0–3.5
stony and gravelly soil	1.0–1.25	1.0–1.25

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According to table 1, non-saline, low and medium salinity soils, as well as strongly saline soils, depend on the type of soil. In order to design collector reconstruction projects, we check them using water discharge calculations, irrigated surface area sizes, crop types, crop rotation schemes, and drainage modules.

The main reasons for the loss of stability of the collectors of berths and berms of drainage systems are as follows.

During the development in the construction of projects (in the process of construction or repair work), the values of the rock coefficients are close to the minimum marginal value.

There is an increase in external load on the collector berm, which has been working for a long time and the mechanical composition of the soil that has changed (sudden impact of the masses of excavators, bulldozers, old rods during the process of cleaning).

Changes in internal frictional forces (increase in specific gravity with increasing soil moisture or, conversely, the effect of water suspended pressure on the soil) are due to changes in the granulometric composition of the soil under the collector and hydraulic fracturing under prolonged operation filtration hydrodynamic pressure.

Incorrect assignment of the calculated values of soil strength in the collector shaft or a decrease in its resistance to slipping (changes in internal friction resistance), for example, is due to an increase in humidity.

Demonstration of hydrodynamic pressure, seismic forces, and various dynamic effects includes movement of agricultural machinery, vehicles in the vicinity, etc.

The bucket-reaper segment is made in the form of a bucket-basket with a finger-spinning apparatus mounted on it and is given as an indicator value in Table 2:

- hydro motor (axial-piston type 210.16);
- crew-shaft mechanism;
- two-tiered handle of the cutting device transmission;
- segment cutting apparatus;
- spring bracket that attaches the bucket to the main excavator.

The machines needed in the field of water management are changed depending on the work in its networks. For this purpose, the machines tested with the experience of the manufacturers and the technical characteristics assigned to them, the manufacturers' information about their work performance technology, areas of application, technological parameters, and technical tools are listed in Table 2.

All of the above-mentioned machines are important in carrying out certain technological processes, and the amount of seepage water flowing into the open collector and ditch networks is 0.5 m/day, giving the possibility to increase the existing ones by 20–25%.

Table 2. A technological complex of machines for harvesting plants in irrigation, open collector and ditch networks and dams.

Technology and areas of performed works application	Technological parameters	Technical tools
Loss of weeds in the cross section of the channel	Loss of green mass of plants to the base	Universal wheeled tractors traction class 0.9-5.0 Mowing device designed for the slope of the channel with a mowing capacity of 0.8 ha/s
Mowing the slopes of canals and dams below the drainage water level, the bottom of slopes	The cutting height of plants does not exceed 7 cm	Excavators with chain wheels from 0.45 to 0.6 m^3 Finger segment mower from 2.1 to 3 m
Removal of mowed plants and loading on vehicles 1,2,3.	No more than 10% of vegetation spilling onto the slopes, loss of green mass 0.5%	Excavators with chain wheels from 0.45 to 0.6 m^3 Finger segment mower from 2.1 to 3 m
Transportation of harvested plants 1,2,3.	Green mass is delivered to the place of destruction	Universal wheeled tractors traction class 0.9-5.0 A self-propelled truck with a capacity of 4 tons

Table 3. Technical and technological characteristics

№	Name of cars	Limitation of application
1	KK-2.1 brand mower with a segmented cutting finger	Carrying out repair and maintenance work on open collector and pressure and irrigation networks Cleaning depth up to 4 m, width 2,1 m.
2	KK-3.0 brand mower with a segmented cutting finger	Carrying out repair and maintenance work on open collector and pressure and irrigation networks Cleaning depth up to 4 m, width 3,0 m.
3	The machine for mowing the slope of open ditch networks	Mowing and simultaneous removal of vegetation from ditch slopes 2 m deep

The above parameters, the total collector area of the open collector and ditch networks are determined by the formula:

$$F_{ra} = F_{bottom} + F_{sloping},\ m^2 \quad (1)$$

The area of the open collector and the bottom of the drainage network (Ftubi) are calculated according to the formula:

$$F_{bottom} = b_k \cdot L_{can} \quad (2)$$

Here: b_k is the width of the bottom of the open collector and ditch networks, m.

Sloping of the reap area ($F_{sloping}$) is determined by the following formula:

$$F_{sloping} = 2 \cdot L_{sloping} \cdot L_{can} \quad (3)$$

The slope of the open collector and the slope of the drainage network, the length of the reap, ($L_{sloping}$) are calculated by the following formula:

$$L_{sloping} = 2 \cdot L = 2(h_{can}+1)\sqrt{1+m^2} = 2(2+1)\sqrt{1+2^2} = 13{,}38 \text{ m.} \quad (4)$$

Based on the experimental data, after weeding of the bottom and slopes of the open collector and ditch networks, the average value of the growth of coarse-grained plants was determined and their results are presented in Table 4.

Table 4. Classification of vegetation on open collector and ditch networks (D-1 collector)

Open collector ditch networks	Plot length	The number of stems per 1 m², pcs., $N_1, N_2 \dots N_i$.	The average number of stems per 1 m² area, units, $N_{av.}$
PK126+00 to PK130+50	450	94 97 90	90
PK126+00 to PK130+50	550	98 92 95	95
Total	**100**	**92**	**92**

From the above, it can be seen that the estimated volume of work on mowing open collector and ditch networks and the average value of the growth rate per 1 m² of the mowed area, a new classification of the growth rate, the parameters of the recommended technique and technology are technical regulations for mowing coarse-stemmed plants from open collector and ditch networks. serves as a basis for development [19].

By linear integration of differential equations, the externally stable form of the slope in dimensionless coefficients is obtained. According to picture 1, X and Z are determined to find the appearance of the actual stable slopes:

$$P = \frac{2c \cdot \cos\varphi}{1 - \sin\varphi} \quad (5)$$

$$X = \frac{X_c^-}{Y} \quad (6)$$

$$Z = \frac{Z_c^-}{Y} \quad (7)$$

$C \neq 0$ and $\varphi \neq 0$

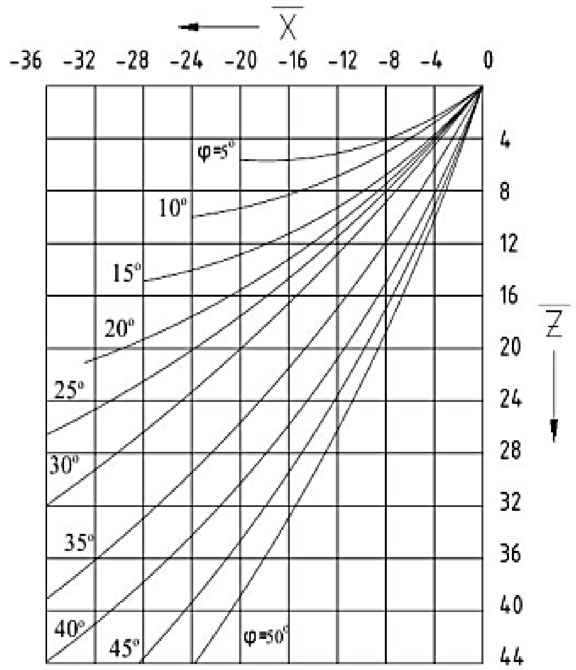

Figure 1. Graphs for plotting constant slopes in dimensionless coordinates.

A stable slope is built starting from the upper edge of the collector cross-section. When the soil internal friction angle is vh0, slope stability is determined by shear forces.

3 Conclusion

Thus, based on theoretical and experimental research, open collector, and determining the scope of work for mowing coarse weeds harvested from the side and bottom of drainage networks, as well as the average value of the growth rate per 1 m² of cut area, there were 90–95 pieces [12–16].

As we mentioned, the scientific research is carried out in the following areas: harvesting rough-stemmed plants from the collector-drainage networks with the help of buckets with fingerpicking equipment; improving the performance of collector-drainage systems; optimizing the flow of drainage water. As a result, the reclamation of irrigated lands will be improved, soil salinity will be reduced, and crop yields will be increased. This is the main result of this research work. In order to do this, we will solve the following problems [17–21]:

- cleaning issues in the Bukhara region's existing open collector and drainage networks, as well as issues aimed at resolving them;
- identifying defects and shortcomings (problems) in the working parts of the hydraulic excavator, which are currently used to clean these open collectors and ditches from weeds;

- detecting and eliminating deficiencies in the working part of the bucket-reaper, i.e., the presence of poor quality and incomplete mowing of coarse weeds;
- substantiating the parameters and work process technology of a new bucket-mower developed for the organization of quality mowing of rough grasses to prove not only its superiority over existing ones, but also high economic performance.

Based on the above, taking into account the problems in the process of cleaning the existing collector drainage networks in the Bukhara region, scientific research is being carried out to improve the techniques and technologies used in this process, some positive results have been achieved, and the research will be continued [22].

Analysis of the literature and conducted studies show that after salinization of groundwater (up to 5–7 g/l), the percentage of leaching regime is in the range of 1.05–1.1, and in desalinated groundwater (3–5 g/l) and even It can be reduced to 1.0–1.05, thereby allowing to reduce the annual limit of water consumption of irrigated land by 10–15% [23].

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