

Improved dam sealing working body for a mounted channel digger

M.S. Karimov*, T.U. Usmonov, Z.Sh. Sharipov, and N.K. Usmanov

Tashkent National Research University – «Tashkent Institute of Irrigation and Agricultural Mechanization Engineers (TNRU-TIAME), 39. Kary-Niyaziy str., Tashkent, the Republic of Uzbekistan

Abstract. Temporary irrigation canals for supplying irrigation water to irrigation furrows are cut by plow channels. However, existing channel diggers, when cutting temporary channels, form a dam that is not compacted, which often leads to erosion of the irrigator. Therefore, partial compaction is required. An improved channel digger with a compacting working body was developed and an author's certificate of the Republic of Uzbekistan №1895 was obtained. May 22, 1998. The working body of the improved channel digger consists of two symmetrical blades made of sheet steel in the form of developable surfaces. Also, the technological process of forming dams when cutting a temporary irrigator with an improved channel digger was studied, and the optimal operating speeds of the unit were determined when forming dams with a compactor. Experiments have shown that with an increase in the speed of movement of the unit, the width of the base of the dam increases, since at high speeds the throwing distance increases. The results are presented in table. 1.

1 Introduction

In this paper, the process of irrigation water filtration depending on the soil density in the dam was studied and the required minimum limit of soil density in the dam was established. The study of water filtration depending on the density of the soil in the dam led to the conclusion that with a dam height of up to 0.20 m and a base width of 0.76 ... 0.83 m. the dam sealing working body must provide a density of at least 1.5 g/cm³.

2 Materials and methods

At present, the main sowing method in Uzbekistan is furrow. Irrigation water supply from the head canal to irrigation furrows is carried out by temporary sprinklers that are cut using plow channel diggers, the design of which does not provide for a dam sealing device, and therefore there was an increase in water filtration, which increases the loss of irrigation water. The density of the soil in the dam increases the anti-filtration properties of the irrigator, and also reduces the risk of its erosion [1].

* Corresponding author: Karimovmaksud245@gmail.com

Observations show that dams formed by existing dredgers are often eroded by water. This is due to insufficient soil density in the dam, which naturally raises the question of the need to seal the dam [1]. Based on the results of the study, the Research Institute of Agricultural Mechanization (NIIMSH) developed an improved channel digger with a compacting working body and carried out research work to substantiate its parameters.

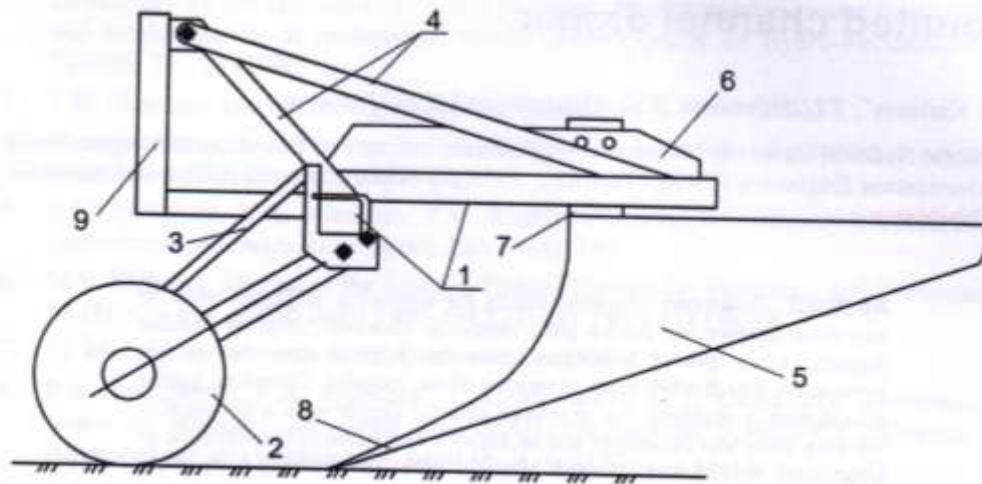


Fig. 1. Scheme of an improved version of the channel digger.
1 - frame; 2 - support wheels; 3 - screw mechanism; 4 - spacer rod; 5 - working body;
6 - parallel plates; 7 - rack; 8 - ploughshare; 9 - coupler.

An improved sample of the channel digger (Fig. 1) consists of a frame 1 made of a square beam, support wheels 2, a screw mechanism 3, with which you can adjust the depth of the channel digger, expansion rods 4, a passive (plow type) working body 5, two parallel plates 6, for attaching the working body to the frame [3, 7].

The working body of the improved channel digger consists of two symmetrical blades made in the form of developable surfaces made of sheet steel. Rack 7, the working body is a steel strip 25 mm thick, bent along the radius of the guide curve, a ploughshare 8 is fixed on the nose of the rack [4].

In order to study the operating conditions of the compacting working body in the field, the technological process of forming dams was studied when cutting a temporary sprinkler with a channel digger, which is aggregated rolled with the MTZ-80 tractor. In the experiments, the speed of movement of the unit was changed from 0.8 to 1.79 m/s. The research results are shown in table 1.

Experiments (table 1) show that when the speed of movement of the unit is within 0.8 ... 1.79 m/s, the width of the base of the dam increases, this is justified by the fact that, with an increase in the speed of movement of the unit, the distance of throwing the soil to the side increases.

Table 1. Parameters of the transverse profile of the dam at different speeds of the unit.

No	Unit movement speed, m/s.	Dam height, m.	Dam base width, m.	The angle of the internal slope of the dam, deg
1	0.82	0.243	0.664	45
2	1.26	0.200	0.767	41
3	1.48	0.180	0.835	37
4	1.79	0.140	0.953	32

A high-quality and higher dam is obtained when the speed of the unit is in the range of 1.26 ... 1.48 m / s. The height of the dam at these speeds reaches 20 cm, and the width of the dam base varies between 0.76 ... 0.83 m.

It can be noted that the main operating parameters of the compacting working body being developed must be oriented for compacting a dam with a height of at least 0.20 m and a base width of 0.75–0.85 m [5].

3 Results and discussion

To determine the minimum density limit of the dam soil, which prevents its erosion, the process of water filtration was studied depending on its density. The initial dimensional values of the dam were: height 0.22 m, width of the dam base - 0.783 m. The dam was compacted manually by tamping [9, 10].

Based on the results of the experiments, we determined that at a dam density of 1.5 g/cm³, erosion does not occur.

All these results were processed on a computer using a multiple regression analysis program. The test of the hypothesis about the homogeneity of the variance with the same non-repeating experiments was carried out using the Cochran test, and the significance of the regression coefficients was determined by the Student's test.

The adequacy of the process model was checked by the Fisher criterion. After processing the experimental data and evaluating the significance of the coefficients, the corresponding regression equations were obtained that describe the process of dam compaction.

4 Conclusions

1. The parameters of the working body of the developed ditcher should ensure the cutting of a temporary sprinkler with a height of 0.20 m, a base width of 0.76 ... 0.83 m, which provides a dam density of at least 1.5 g / cm³.
2. Based on the obtained optimal values of the main parameters, a dam compactor was manufactured, which was installed on an improved channel digger for cutting a temporary sprinkler and, when tested in the field, showed a significant increase in productivity relative to the existing ones and provides a degree of compaction up to agrotechnical requirements in one pass of an improved channel digger with a dam sealing working body.

References

1. P.N. Slobodyuk, Research and substantiation of the parameters of the working body for cutting irrigation furrows at different speeds, (Dissertation for Ph.D., Yangiyul, 1987) 155.
2. M.S. Karimov, On the issue of compaction of temporary irrigating canals' dams. Collection of articles of the scientific and production conference dedicated to the 50th anniversary of the specialties of water management construction, water management and mechanization of reclamation works of the Faculty of Hydro-Reclamation of TIAME. 71...73 (1996)
3. T.U. Usmonov and others, Agriculture of Uzbekistan, 4, 43-44 (2001)
4. M. Autambaev, A.Z. Ivanov, Yu.I. Terekhov, *Fundamentals of planning a research experiment*, (T., Ukituvchi, 1993) 22...36.
5. S.V. Malnikov, V.R. Aleshkin, P.V. Roshin, *Planning experiments in research of agricultural processes*, (Leningrad. Ear. 1980), 180.
6. M.S. Karimov, Journal of the Siberian Federal University, Technique and Technology, 13 (5), 626-631 (2020) ISSN 1999-494X (Print). ISSN 2313-6057
7. I.I. Mer, *Meliorative machines*, (Moscow. Ear 1980) 25 - 27.
8. F.A. Bekchanov, R.R. Ergashev, T.M. Mavlanov, O.Y. Glovatskiy, *Mathematical model of vibrating air pump unit*, XXII International Scientific Conference on Advanced in Civil Engineering, April 18-21, (2019)
9. N.I. Naumets, *On the theory of soil compaction by machines* (Proceedings of the Kharkov Road Institute, 1996) 6.
10. G.V. Vydenyapin, *General methodology of experimental research and processing of experimental data*, (M., Kolos. 1973) 184.