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# METHOD OF DETERMINING THE UNWASHING VELOCITY OF OPEN DRAINAGE SYSTEMS

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## ANNOTATION

*In the history of mankind, the development of systems of escape goes back to the distant past. In ancient times, in the countries of Rome, Greece, Egypt, and later in the European regions, the large-scale use of collector-drainage systems was established. The article presents hydrodynamic processes occurring in open drainages. The problems that arise in the design and construction of open drainages are highlighted. The non-wash rate table given in the building codes and regulations was analyzed. The formulas given by the authors for determining the rate of non-washing were studied. Scientific research on the design of open bed collector systems based on the rate of non-washout has been carried out and the results are presented.*

**KEY WORDS:** *Reclamation, ditch, hydrodynamics, non-wash speed, flow rate, flow depth.*

## INTRODUCTION

The field of reclamation, in particular, drainage systems, is particularly important in the development of agriculture [1,2]. Drainage systems are a reclamation facility that serves to turn excess underground water into runoff and divert it away from cultivated areas in irrigated areas. Exhaust systems may vary depending on existing conditions. These consist of open bed collector systems, closed bed collector systems, vertical collector systems, composite collector systems, etc. In irrigated areas, open-bed and closed-bed collector systems are mainly used [3,4]. The advantage of open-bed and closed-bed collector systems is that their use does not require excessive energy resources. In this type of collector systems, the flow is formed and moves based on the laws of hydrodynamics. Ceramic, concrete, asbestos-cement and PVC pipes are mainly used in the construction of closed trenches [5,6]. Open collector systems are built by digging deep collector systems in cultivated fields. Due to the material stability of closed trenches, washing processes do not occur. Only fuzzy printing processes are observed. Due to the fact that the open colllectors have a soil bed, washing processes are observed in some cases.

## STATEMENT OF ISSUE

One of the important tasks in the process of designing open collector systems is to fulfill the condition of non-washing. Because if washing processes take place in the bed of an open ditch, there is a risk of the ground of the bed moving to the lower parts and muddying the next sections. In addition, as a result of the downward washing of the bottom of the open ditch, the side walls and banks collapse. It is known that several scientific studies have been conducted on the design of irrigation canals based on the non-flush rate [1,8]. As a result of the conducted scientific research, some recommendations have been developed. Recommendations were developed by V.N. Goncharov, G.I.Shamov, A.M.Latyshenkov, B.I.Studenichnikov, Ts.E. Mirtskhulava and others to justify the rate of non-flushing flow in irrigation canals [9,10]. Based on the developed recommendations, a special table for determining the non-washable speed for bonded and non-bonded soils was developed and included in the Construction Rules and Regulations. In these presented tables, it is possible to determine the non-flush velocity at values above the flow depth of 0.5 m. But in most cases in open collector systems, the flow depth is less than 0.5 m, so it is not possible to use this table. It can be seen that the problem of determining the rate of leaching in open collector systems remains relevant.

## SOLUTION METHOD

A number of scientific studies have been conducted to determine the non-flush rate in open collector systems. Data from the table used to determine the non-flush rate given in the building codes and regulations were statistically analyzed.

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**Table 1**
**Table for determination of non-leaching rate by CN and L**

| Average size of soil particles | Permissible flow velocities m/s and flow depth, m for homogeneous smooth soil with clay content of 0.1 kg/m3, | | | |
|---|---|---|---|---|
| | 0,5 | 1 | 3 | 5 |
| 0,05 | 0,52 | 0,55 | 0,6 | 0,62 |
| 0,15 | 0,36 | 0,38 | 0,42 | 0,44 |
| 0,25 | 0,37 | 0,39 | 0,41 | 0,45 |
| 0,37 | 0,38 | 0,41 | 0,46 | 0,48 |
| 0,5 | 0,41 | 0,44 | 0,5 | 0,52 |
| 0,75 | 0,47 | 0,51 | 0,57 | 0,59 |
| 1 | 0,51 | 0,55 | 0,62 | 0,65 |
| 2 | 0,64 | 0,7 | 0,79 | 0,83 |
| 2,5 | 0,69 | 0,75 | 0,86 | 0,9 |
| 3 | 0,73 | 0,8 | 0,91 | 0,96 |
| 5 | 0,87 | 0,96 | 1,1 | 1,17 |
| 10 | 1,1 | 1,23 | 1,42 | 1,51 |
| 15 | 1,26 | 1,42 | 1,65 | 1,76 |
| 20 | 1,37 | 1,55 | 1,84 | 1,96 |
| 25 | 1,46 | 1,65 | 1,93 | 2,12 |
| 30 | 1,56 | 1,76 | 2,1 | 2,26 |
| 40 | 1,68 | 1,93 | 2,32 | 2,5 |
| 75 | 2,01 | 2,35 | 2,89 | 3,14 |
| 100 | 2,15 | 2,54 | 3,14 | 3,46 |
| 150 | 2,35 | 2,84 | 3,62 | 3,96 |
| 200 | 2,47 | 3,03 | 3,92 | 4,31 |
| 300 | 2,9 | 3,32 | 4,4 | 4,94 |

According to the results of the analysis, in the table used in CN and L, the values for determining the no-wash velocity are not given in cases where the flow depth is less than 0.5 m. It is known that this table was compiled based on the formulas proposed by Ts. E. Mirtskhulava [19,20]. This table is mainly used in the design of channels. Ts. E. Mirtskhulava proposed the following for determining the rate of leaching in open waterbeds for unbound soils:

$$\vartheta_{ner} = \lg \frac{8.8h}{d} \sqrt{\frac{2m}{0,44\rho n}[g(\rho_{gr} - \rho)d + 2C_{yn}^{n} \cdot K]} \tag{1}$$

there: ϑner — average flow velocity over the cross section, permissible non-erosive, m/s; m is the coefficient of working conditions, which takes into account (for channels arranged in non-cohesive soils) the influence of sediments in the colloidal state on the erosive capacity of the flow; when the content of clay particles in water is less than 0.1 kg/m3 m=1, if these particles are present in water 0.1 kg/m3 or more, m > 1; gr ρ, ρgr – density of water and soil, kg/m3; n is the overload factor, which takes into account the change in the erosive capacity of the flow under the influence of the pulsating nature of the speeds and other cases of the likely excess of loads on soil particles over the calculated values; d is the average diameter of soil particles, mm; Cyn is the fatigue tensile strength of non-cohesive soil, Pa; this parameter takes into account the appearance of appreciable adhesion forces with fine-grained soil (at d < 0.15 mm); k - coefficient characterizing the probability of deviation of adhesion forces from the average value, it can be taken k = 0.5

## RESULTS

For unbound soils, the rate of leaching was determined for values of flow depth of 0.1-0.5 m. The formula proposed by Ts.E. Mirtskhulava was used to determine the rate of non-washing. Calculations were carried out for particles with an average size of 0.05-2.00 mm. The results were tabulated.

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**Table 2**
**Table for determining the speed of washing**

| h, m | 0,05 mm | 0,15 mm | 0,25 mm | 0,30 mm | 0,50 mm | 0,75 mm |
|---|---|---|---|---|---|---|
| 0,1 | 0,46 | 0,31 | 0,33 | 0,32 | 0,35 | 0,40 |
| 0,2 | 0,49 | 0,33 | 0,34 | 0,35 | 0,37 | 0,43 |
| 0,3 | 0,50 | 0,34 | 0,35 | 0,36 | 0,39 | 0,45 |
| 0,4 | 0,51 | 0,35 | 0,36 | 0,37 | 0,40 | 0,46 |
| 0,5 | 0,52 | 0,36 | 0,37 | 0,38 | 0,41 | 0,47 |
| 1 | 0,55 | 0,38 | 0,39 | 0,41 | 0,44 | 0,51 |
| 3 | 0,6 | 0,42 | 0,43 | 0,46 | 0,5 | 0,57 |
| 5 | 0,62 | 0,44 | 0,45 | 0,48 | 0,52 | 0,59 |

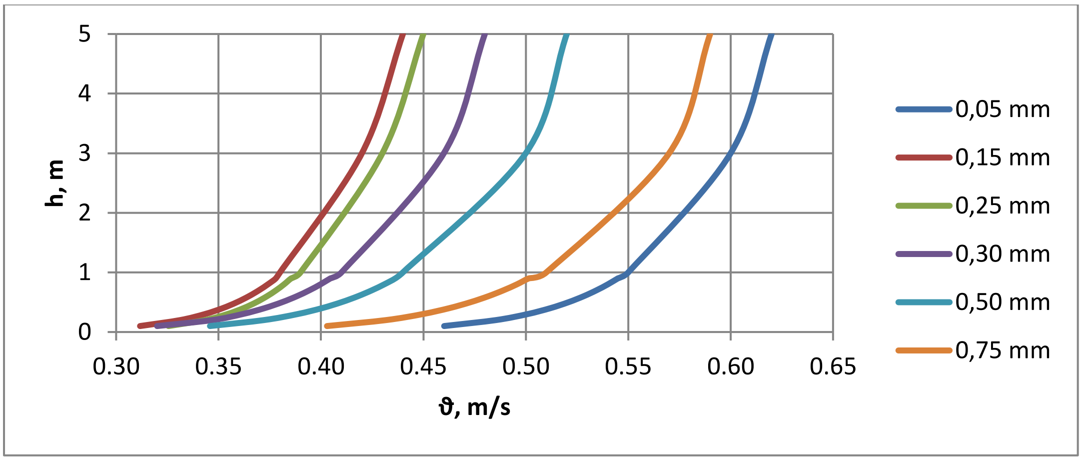


**Figure 1. A graph for determining the rate of leaching**

**Table 3**
**Table for Determining the rate of washing**

| h, m | 1 mm | 2 mm | 2,5 mm | 3,0 mm | 5 mm | 10 mm |
|---|---|---|---|---|---|---|
| 0,1 | 0,43 | 0,54 | 0,57 | 0,61 | 0,71 | 0,89 |
| 0,2 | 0,46 | 0,58 | 0,62 | 0,66 | 0,78 | 0,98 |
| 0,3 | 0,48 | 0,61 | 0,65 | 0,69 | 0,82 | 1,03 |
| 0,4 | 0,50 | 0,63 | 0,67 | 0,71 | 0,85 | 1,07 |
| 0,5 | 0,51 | 0,64 | 0,69 | 0,73 | 0,87 | 1,11 |
| 1 | 0,52 | 0,66 | 0,71 | 0,75 | 0,89 | 1,14 |
| 3 | 0,53 | 0,67 | 0,72 | 0,76 | 0,91 | 1,16 |
| 5 | 0,54 | 0,68 | 0,73 | 0,78 | 0,93 | 1,18 |

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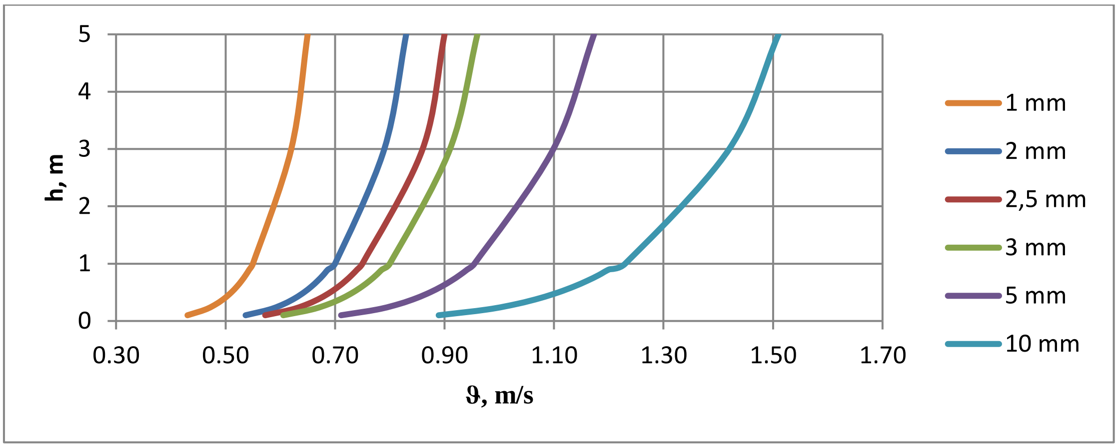


**Figure 2. A graph for determining the rate of leaching**

## CONCLUSION

The rate of leaching was determined for open bed trenches with unbound soil cores. The formula proposed by S.E. Mirtskhulava was used to determine the rate of non-washing. Specific tables and graphs were developed for each primer based on the determined non-leaching rate. With the help of the given table, it is possible to use values of 0.1-0.5 m of flow depth in the design of open collector systems based on the conditions of non-washing.

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