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A BRIEF ANALYSIS OF METHODS FOR CALCULATING LIQUID TRANSPORT IN RIVERS

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The calculation of suspended solids transport flows can be divided into two groups.

The first group includes a large number of empirical formulas obtained on the basis of studying fluid hydraulics and its modes in laboratory conditions.

Most empirical formulas, after several substitutions, can be reduced to the following form:

$$S_{ўр} = K\frac{\vartheta_{ўр}^{m}}{H_{ўр}^{n}\cdot w^{a}} \qquad (1.1)$$

here $S_{ўр}$ **is** the average turbidity of the flow corresponding to the transport capacity; $u_{ўр}$ **is** the average flow velocity in the vertical direction; *w* is the hydraulic volume of the liquid; $H_{ўр}$ - average depth of the stream; m, n, a - constant values determined from empirical data. Compositions of this category often give satisfactory results for the conditions under study.

The second group of suspended liquid formulas includes relationships obtained as a result of complex theoretical and experimental work, revealing the physical meaning of liquid motion in finite dimensions. S.Kh.Abalyans, A.N.Gostunsky, I.I.Levi, Yu.A.Ibad-zade, A.G.Khachatryan, A.M.Latyshenkov, S.E.Mirshulava, B.I.Studenichnikov and others conducted research on this problem and substantiated the relationships they proposed . Despite the fact that many formulas have been proposed to determine the current carrying capacity, an ideal solution to this problem has not yet been found [1].

Let us dwell on the most frequently used formulas for the transport capacity of a flow.

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The formula of A. N. Gostunsky is based on the assessment of the work of the stabilizing force in the flow [2-5]:

$$S_{ўр} = 0,051\frac{\vartheta_{ўр}^{3}}{R^{3/2}w_0}, \qquad (1.2)$$

Here is $\vartheta_{ўр}$ the average flow rate; R – hydraulic radius; w_0 - hydraulic volume of liquid.

K.I. Rossinsky and I.A. Kuzmin proposed the following formula for the current state of saturation:

$$S_{ўр} = 0,024\frac{\vartheta_{ўр}^{3}}{Rw_0} \qquad (1.3)$$

Similar to this formula, S.H. Abalians proposed the following formula, including a coefficient of 0.018 for the saturation condition: [1-6]

$$S_{ўр} = 0,018\frac{\vartheta_{ўр}^{3}}{H_{ўр}w_0}. \qquad (1.4)$$

Based on the analysis of the results of the research conducted by E.A. Zamarin, he recommended the following relationship for determining the weighted flow rates:

$$\rho = 0,022\left(\frac{\vartheta_{ўр}}{\overline{w}}\right)^{3/2}\sqrt{RI} \qquad (1,5)$$

here $\vartheta_{ўр}$ is the average flow velocity *, m/s;*

The formula is valid within the limit of conditions *0.022≤0.008 m* $\overline{W}$*/sec.*

For lower costs, the following formula is recommended:

$$\rho = 11\upsilon\sqrt{\frac{RI\vartheta_{ўр}}{\overline{w}}} \qquad (1,6)$$

A.G. Khachatryan recommended the following formula for canals receiving water from the Amu Darya River: [4-6]

$$\rho_{kr} = 0,69\frac{\vartheta^{3/2}}{\left(R\overline{w}\right)^{1/3}} \qquad (1.7)$$

here: p_{cr} – maximum turbidity, kg/m3 ; R – hydraulic radius of the flow, m.

The formulas of the above-mentioned authors are presented in the table.

Calculation methods for solving this problem are also shown in the literature of foreign authors. Let us analyze the results of some research works on this issue.

L. Van **Rijn** used the following relationships representing the process in the method of calculating fluid transport: [4]

$$q_{вз} = FU_0H_0c_a \qquad (1.8)$$

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here c_a **is** the concentration of suspended solids; F **is** the parameter of suspended liquid transfer i .U_b, $б_b$, C_b, F And c_a characteristics are defined.

The work took into account the ability of the flow to transport suspended matter. At the same time, critical conditions suitable for initiating the sedimentation of suspended matter in a continuous wall flow were studied [7-8]

The energy concept was taken as a basis. Accordingly, the work spent on keeping particles in suspension per unit volume per unit time is considered proportional to the product of turbulent energy per unit volume per unit time:

$$\tau_0 \vartheta = (\rho_s - \rho) g H w_s C_T \qquad (1.9)$$

$$C_T = \frac{\tau_0 \vartheta}{(\rho_s - \rho) g H w_s} \qquad (1.10)$$

here is w_s **the hydraulic** particle size ; C_T **-** concentration limit (saturation) of suspended particles [9-12]

In order to verify the accuracy of the obtained data, large-scale experimental studies were conducted. The studies were conducted in cases with different fractional composition, flow depth and average velocities. During the study period, the maximum changes in the Froude and Reynolds numbers were respectively: $Fr = 0.2...0,4$ and $\mathrm{Re} = 7 \cdot 10^3 ... 9,5 \cdot 10^4$. The following relationship was obtained from the analysis of the obtained experimental data (Fig. 1.6):

$$C_T = 0,0018 \frac{\tau_0 \vartheta}{(\rho_s - \rho) g H w_s} \qquad (1.11)$$

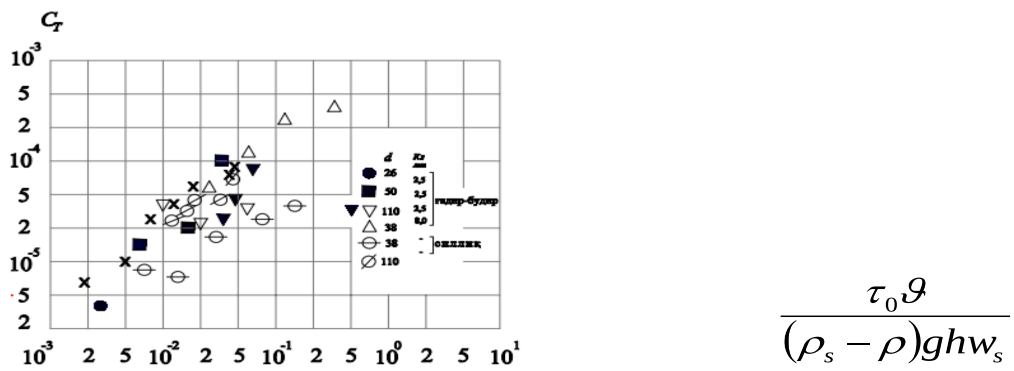

Figure 1.6. Threshold concentration of suspended matter for a turbulent boundary

The results of the experimental studies were compared with the data of other authors (Fig **. 1.7**). Conclusions were made about the influence of the boundaries of the runoff and underground depressions **on** leaching.

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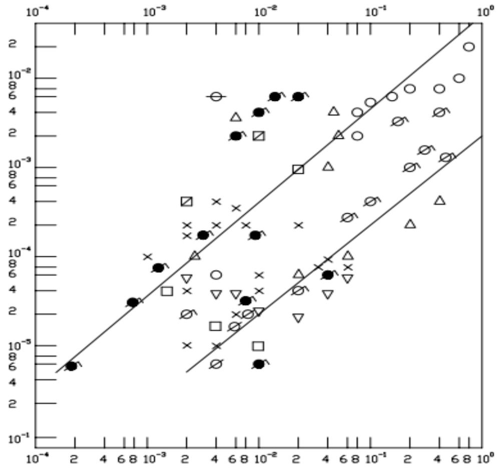

$$\left[1-\left(\frac{K_s}{h}\right)^{0,06}\right]\frac{\tau_0\vartheta}{(\rho_s-\rho)ghw_s}$$

△ Vanoni, Nomicos (1960)
□ Apman, Rumer (1967)
◇ Colemani (1981)

▽ Ashida,Okabe (1982)
◪ Ashida,Michiuse (1964)
● Gobson, Sayre (1970)
○ Halinsloe, Hsia (1945)
∅ van Rafn (1981)
△ Vanoni, Nomicos(1968)

× Bruk, Miloradov (1968)
◪ Harrson, Lidicker(1965)

Figure 1.7. Possibility of transporting suspended substances.

The following dependence correlates well with experimental data for solid boundaries with relative roughness **, high roughness and a flushed bottom:**

$$C_T = 0,034\left[1-\left(\frac{K_s}{h}\right)^{0,06}\right]\frac{\tau_0\vartheta}{(\rho_s-\rho)ghw_s} \qquad (1.12)$$

here K_s – gadir – the height of the building elements.

The authors draw the following general conclusions:

- sedimentation of suspended liquids in channels with solid boundaries is determined by turbulent energy and buoyancy of particles;

- underground gadir - relatively small scale $(K_s < H)$; does not affect the transport capacity of the current under its conditions;

- a hydraulically smooth boundary flow with a viscous layer thickness measured by the relative diameter of the particles leads to a decrease in transport capacity compared to a flow with hydraulically rough boundaries;

- mobility under a flat bottom without coatings compared to indelible boundaries leads to a higher maximum saturation concentration;

- if the shear stress tends to values corresponding to the inclusion of subsurface leaching, the transport capacity for suspended liquids approaches zero.

From the analysis of the existing literature, since the influence of the lateral slopes of the trapezoidal soil channel on the flow rate and movement of effluents has not been thoroughly studied, a positive approach to solving this problem is required in the future. Among the existing formulas for determining the flow rate and discharge, the formulas of S.E. Mirshulava and L. Van Rein are respectively based on theoretical and experimental aspects.

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