Increasing flow turbidity in pressure systems

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Increasing flow turbidity in pressure systems

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Abstract. Clearing the water reservoirs from sediments is one of the most pressing problems. There are several ways to deal with this problem, and in most cases, they require enormous amounts of money and energy. Studying the motion of a muddy flow in pressure pipelines is one of the important works for solving this problem. Designed by the Department of Hydraulics and Hydroinformatics (TIIAME), the the inkjet apparatus is considered to be an energy-saving device and uses the potential of the flow itself to remove the muddy sediment from the water structures to the bottom. Typically, the flow carrying capacity depends on several hydraulic flow elements. The article discusses that fuzzy transporting ability depends on relative depth. Relative depth is the ratio of the suction height to the water head in front of the water outlet. The studies were conducted in laboratory conditions. Theoretical work is justified by the law of energy conservation. As a result, a new expression is obtained showing the relationship between the transporting ability of the flow and relative depth.

1. Introduction

Filling of water structures with sediments leads to a reduction of their useful volume, and in some of the hydrological constructions because of sedimentation seen, the destruction of water constructions and water giving systems [1,2]. At the same time, one of the disadvantages is the lack of access of mineral deposits in the sediment to the agricultural crops as a result of accumulation bottom of the structure [3,4]. In addition to the aforementioned reasons, there are a number of other reasons to justify the fact that the structures are one of the most important jobs in preventing mudslides and erosion.

When discussion provides about movement of sediment particles from one place to another, the ability of sediment transportation of the flow is plays an important role [4,5]. In this article describes movement of sediment flow in pressured system.

Much work has been done on the transfer of sediment flow in pressured systems: V.M. Karasik on the transport of particulate material in pressured pipes (1965), M.Aementev on the movement of solid particles in pressured pipes (1975), O.Y.Glovatsky on pumping stations researches can be example for this. (1992). X.Rahmatulin's theory of interconnected environments (1956) and continuation of this theory can be considered the works of K. Latipov, A.Umarov, A. Shakirov, A. Arifjanov and H. Ilhomov. A. Arifjanov in his scientific works introduces the concept of "optimal diameter" to determine the dispersion of turbid particles across the surface of the cross-section and thereby the flow [3,6,7]. The scientific researches which mentioned above is the scientific works with a strong theoretical basis. As a result of the research which provided in this field, sediment transportation can be written totally as follows [8–11]:

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$$s = \eta \frac{\vartheta^{\alpha}}{R^{\beta} W^{\xi}} \tag{1}$$

there: ϑ - *avarage velocity of flow*

R - *hydraulic mean radius*

W - *avarage hydraulic dimensions of hard particles*

η, β, ξ - *are constant values which wil find in experiments.*

At the core of provided scientific researches sediment transportation of the flow is related with the specific physical parameters. The main disadvantage of such relations is that their usage possibility. Therefore, in our research suggests that the sediment transportationof the flow is associated with the dimensionless unit size.

2. Methods and materials

Scientific research was provided through laboratory experiments. The pilot analysis was conducted in a laboratory at the Tashkent Institute of Irrigation and Agricultural Mechanization Engineers (FAP 20130001). The sediment transportation possibility of investigated jet device depends on the kinematic parameters of the turbid flow and the height of the discharge openings from the bottom of the facility.

The experiments provided at different levels and heights, and determined the turbidity of the flow. For increasing the reliability of the experimental results, it was found that the sediment transportation of flow is the connection with deviation without the unit of measurement which approximately pressure. (Figure 1).

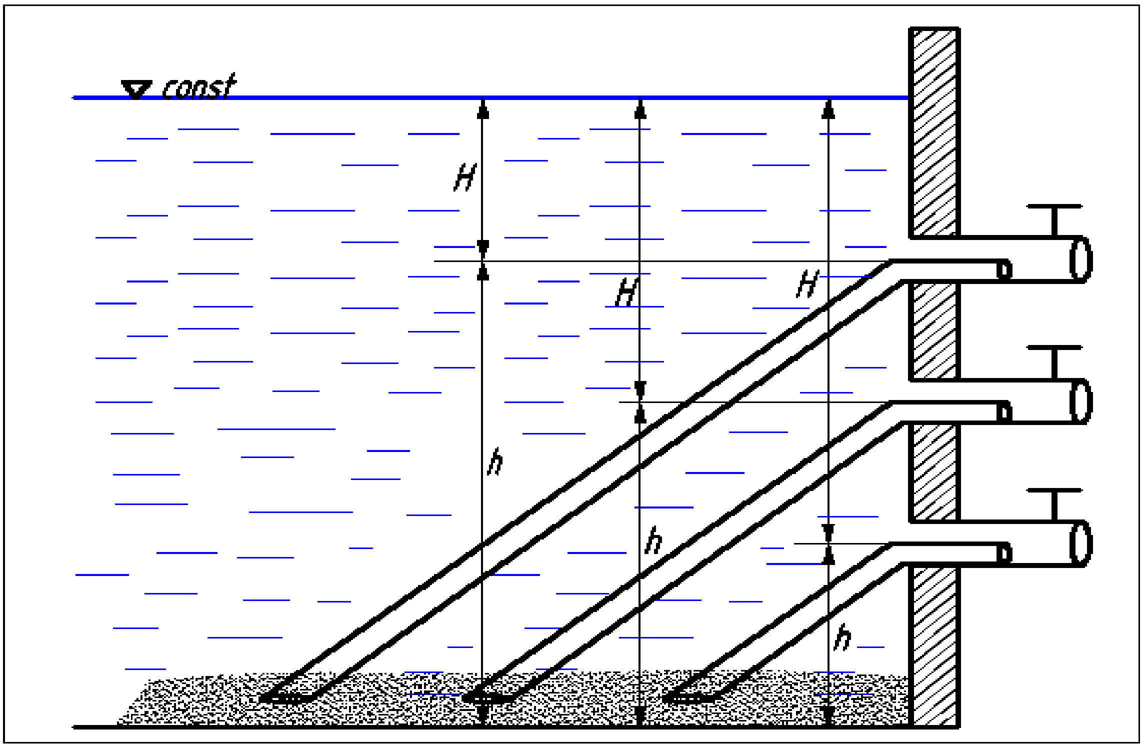

Figure 1. Jet device for removal of sediments to lower beams

The experiments were provided basis of commonly used hydraulic methods.

- the suction height and water discharge in front of the cracks were adjusted;
- the water intake and suction height were measured using a line mounted on the side wall of the reservoir;
- the volume of water discharged from the openings is determined by volume (currently the most accurate method);

- volume of water flowing through the outflow hole VST-mark
- two-button SOS PR-2B-2000 "Agat" stopwatch was used to measure time;
- the amount of turbidity was determined by weighing the muddy water and weighing the resulting turbidity;
- the internal diameter of the hole and suction pipe was determined by using the ShS-125 stencils;

The experiments were conducted several times at different pressure and suction heights. Determined the flow rate, the amount of sediments in flow, the average flow rate, the flow rate for the ideal fluid (without ideal resistance), discharge coefficient, the Reynolds number, and others.
As mentioned above, the sediment transportation rate of the flow depends on the average flow rate, the hydraulic size of the fuzzy particles, and the geometric size of the flow. Given that the transverse dimensions of the pipe and the hydraulic size of the fuzzy particles in the matter considered are constant, the flow rate of the turbidity depends on the average flow rate. Further research will focus on determining the average flow rate in both theoretical and laboratory settings. The basis for theoretical research is the law of energy conservation [12–14]. Taking a few cross sections, one can write the D. Bernoulli equation

$$\frac{\gamma_1}{\gamma}(h+H)-h=\frac{P_{c_1}}{\gamma}+\frac{\vartheta_2^2}{2g}+\left(\frac{\lambda_{cм}\cdot l}{d}+\xi_2\right)\frac{\vartheta_2^2}{2g} \tag{2}$$

and after performing certain mathematical operations on the equations, we obtain the following relation for the average flow rate:

$$\vartheta_2=\frac{1}{\sqrt{\beta_1}}\sqrt{2g\left(H_2-\frac{P_{c_1}}{\gamma}\right)} \tag{3}$$

there: β_1 - *total resistances of the suction pipe of the jet device*

H_2 - *preassure in front of water giving hole*

$$H_2=\beta H+h(\beta-1) \tag{4}$$

$\beta=\frac{\gamma_1}{\gamma_0}$

γ_1 - *Comparison weight of fresh water*

γ_0 - *Comparison weight of sediment flow*

3. Results

From the expression (3) and (4) aboves, the average flow speed depends on the water discharge and suction height in front of the outflow hole. In other words, the average velocity of the flow in the suction pipe is inversely proportional to the suction height (h), and the water in front of the hole is directly connected to H. As a result of the experiments, at a certain value of the comparison pressure $\frac{h}{H}$ before water giving device, the movement of the sediment particles in the suction pipe is completely stopped and only the clean water movement can be observed. In the discussion of experimental results seen dependence of sediment transportation property of flow to current pressure (figure 2):

$$S=A\rho(0{,}75-h/H)^{0{,}5}$$

there: ρ - *density of sediment flow* $[\frac{kg}{m^3}]$
A - coefficient which takes into account structure and is determined by experiments
h - suction height [m]
H - pressure of water in front of wate giving hole [m]

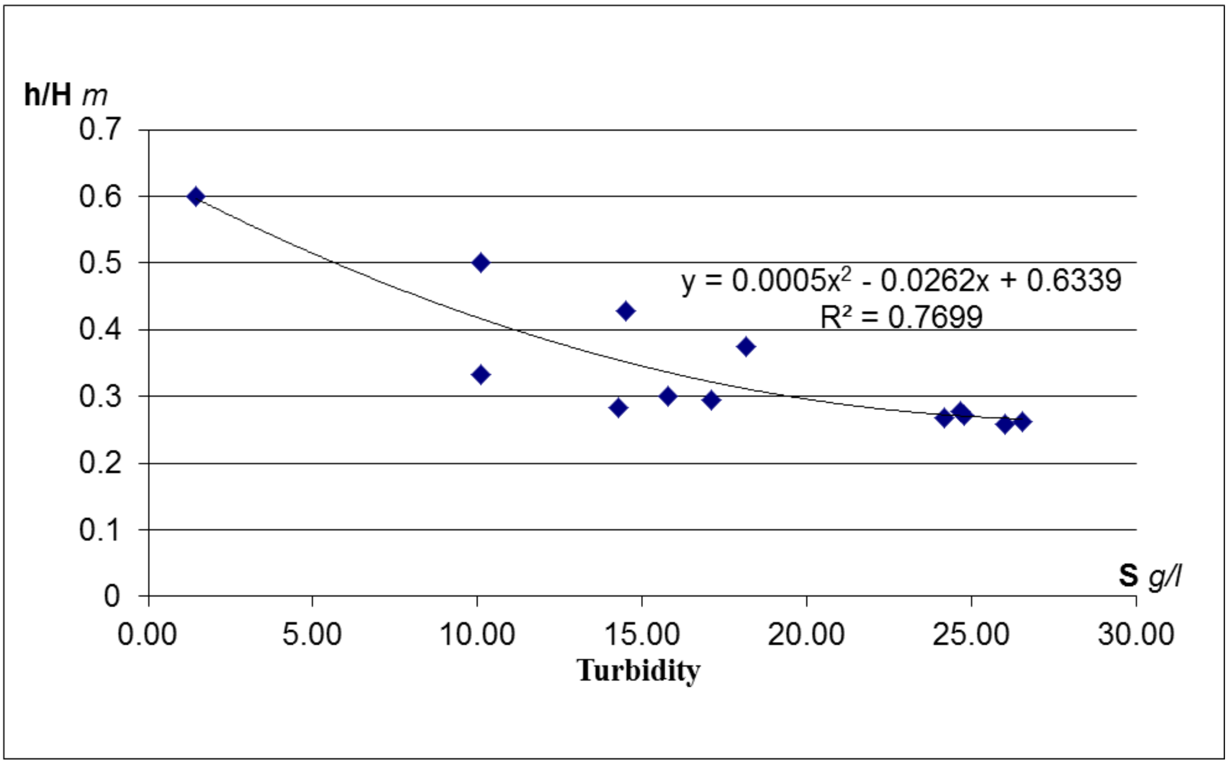

Figure 2. Graph which shows the relative dependence of sedimentation to relative pressure

4. Conclusion

In summary, the dependency used to determine the turbidity of a stream in a closed system indicates that in most cases the flow depends on several hydraulic elements. As a result, the range of dependencies received is reduced. Thus, as a result of research invited new connection for sediment transportation of the flow for intake precipitated sediments to lower beams. The advantage of this dependence than other formulas is that the sediment transportation property of the flow connected with relative pressure which without the measurement unit. Depending on the amount of water in front of the hole, it is possible to determine the suction height for jet device, or vice versa, according to suction height one can determine the minimum value of pressure in front of suction hole for sediment suction.

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