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Processes of Turbid Flow Velocity in Pressure Pipes During Field Studies

A.R. Babaev[1], D.A. Maxkamov[2]

[1]Doctor of Philosophy in Technology, Phd Tashkent State Transport University

[2]Master's degree Tashkent State Transport University

ABSTRACT: In this research paper, we consider the motion of particles in flows, taking into account the attached mass. When the concentration of dispersed particles is insignificant, the mutual influence of the particles is negligible, the movement of each particle in the liquid can be considered as occurring regardless of the presence of other particles. Therefore, the results that will be obtained for the case of movement of a single particle in a liquid are applicable. This makes it possible to study the laws of particle behavior based only on the equation for particles. Here, the behavior of particles is studied taking into account the influence of the added mass effect and the Safman forces. According to the results of the study in the conditions. particle motion in an upward flow, the effect of the attached mass effect is comparable to the Stokes hydrodynamic force at moderate. It is established that the separation of the Safman force to the Stokes force depends on the dimensionless parameter. The results show that for currents, the effect of the attached mass significantly affects the regime of particle flow in the water stream.

KEYWORDS: Density, hydrodynamics, flow, flow regime, Reynolds number, mass, particles, trajectory, velocity, viscosity.

INTRODUCTION

When the concentration of dispersed particles is insignificant, the mutual influence of the particles is negligible, the movement of each particle in the liquid can be considered as occurring regardless of the presence of other particles. Therefore, the results that will be obtained for the case of movement of a single particle in a liquid are applicable. This makes it possible to study the laws of particle behavior based only on the equation for particles. Here, the behavior of particles is studied taking into account the influence of the added mass effect and the Safman forces.

In the construction industry, mining industry, chemistry in the world, pressure pipes are used to move turbid currents. One of the important issues in increasing their efficiency is the creation of computational methods depending on the composition, viscosity of turbid flows, the physical, chemical and mechanical properties of the phases in the system. At present, the Republic is achieving theoretical and practical results in the cleaning of water bodies, hydraulic structures with the help of pressure pipes, raising the turbidity in construction, management of the systemic movement of viscous systems in the chemical industry.

In the case of turbid fluid hydraulic transport through pressure pipes, pressure losses and critical flow velocity are the main hydraulic parameters. One of the main disadvantages of hydraulic systems used in production today, especially in the mining industry, is their high energy demand and low efficiency. We can list a number of reasons for this situation, which, according to experts, include the pressure of the water pump system, the characteristics, parameters of the flow and the composition of the turbid flow [1,2,3].

The properties of turbid flow hydraulic mixtures in mining and processing enterprises are determined primarily by the granulometric composition of solid particles and their volumetric concentration. The interaction of liquids and solids during the joint motion determines the specific pressure loss and the carrying capacity of the flow [3,4,5].

Gravity plays an important role in the movement of turbid water along the pipe. The solid particles brought in by the flow are generally not uniformly distributed over the cross-sectional surface of the stream, and their bulk mass moves at the bottom of the pipe.

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Such a motion results in an axial asymmetry of the velocity field, which is expressed in the kinematic axis of the flow shifting upward relative to the geometric axis of the pipe corresponding to the state of the greatest average velocity in its high-concentration substrates.

In the Republic of Uzbekistan, about 1,600 pumping stations are used in the system of irrigation water supply to consumers in agriculture and water management. Research in this area has shown that a large amount of river sediment is transported along with water in the pumping stations of pumping stations [6,7].

From the analysis of the data collected in the studies conducted at a number of pumping stations, it is known that the mechanical and chemical composition of river sediments is variable and the fractional composition can vary from 0.01 mm to 0.25 mm. The distribution of river sediments along the flow cross-section is of particular importance in assessing the impact of river sediments along with water on the pressure pipes of pumping stations, ie the kinematic and dynamic parameters of hydraulic flow [6,7].

It is important to determine the flow turbidity (water + river sediments) transmission capacity in the hydrotransport of river sediments in pressure pipes. One of the main tasks of hydraulic transport is to take into account the distribution of the concentration of sludge formed along the cross section of the pressure pipes under the influence of gravitational forces in expressing the essence of two-phase flow [5,6,7].

Suspended motion of solid particles in canals, trays, pipes - is undoubtedly of engineering interest in the calculation and operation of hydraulic structures for various water management purposes, as well as hydraulic structures used in industrial production, energy, construction and utilities. Solids in a suspended state and moving with a liquid or gas form a two-phase current [3,4,5,6].

As a result of experimental work on the study of turbid fluid motion in the pipe, the following types of turbid flow motion were observed:

• in the form of sliding layers, solid particles move (slide) along the flow length at the bottom of the pipe;

• In the form of waves, the particles sink in a wavy state at the bottom of the pipe.

Particles close to the surface of the layer move along the surface of the waves, while the waves move at a very small speed in the direction of the turbid current flow.

If the flow rate decreases further, sediments, a turbid layer, will form at the bottom of the pipe. This layer consists of solid bodies lying motionless at the bottom of the pipe. On such a layer, the particles can move in the form of sliding layers or waves, while the fine particles are in a suspended state. The hydraulic losses of the napor in turbid fluid movement are different from the losses in water movement, and depend on the type of turbid flow. The transition from one type of motion to another corresponds to a certain average velocity of the flow.

Figure 1 shows a graph of the change in specific hydraulic resistanceI in a pipe according to the average velocity and particle cross-sectional concentration C_0 ($I = \frac{h_w}{l}$ =, where i h_w s the hydraulic losses, l is the pipe length).

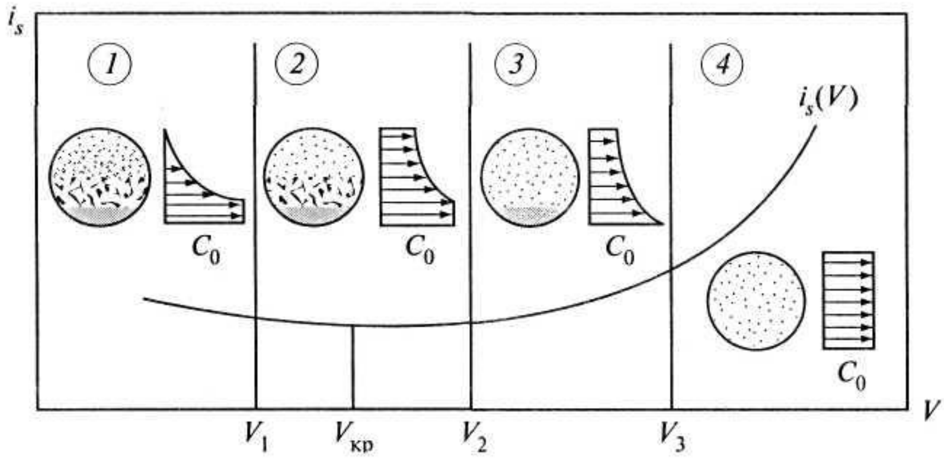

Figure 1. The change in specific hydraulic resistance in the distribution of turbid flow concentration across the pipe section

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The four distinct zones of the flow motion types carrying suspended solids are shown in the graph.

The first zone (1) is the type of leakage in a non-uniform flow in a pipe with a continuous turbid layer, $\vartheta < \vartheta_1$.

Учинчи зона (3) – $\vartheta_3 > \vartheta > \vartheta_2$.

Velocity ϑ_1 is the velocity at which a layer of turbidity begins to accumulate in the pipe walls. When $\vartheta < \vartheta_1$, a continuous turbid layer is formed.

The second zone is located at the boundaries of (2) - $\vartheta_2 > \vartheta > \vartheta_1$.

At $\vartheta > \vartheta_1$, solids begin to roll and bounce, creating a sliding layer or wave at the bottom of the pipe. As the velocity increases to ϑ_2, the sliding layer of the particles and the waves disappear.

The third zone (3) is $\vartheta_3 > \vartheta > \vartheta_2$.

This composition depends on the type of leakage of the non-uniform flow.

Fourth zone (4) - $\vartheta > \vartheta_3$. In such cases, when the concentration is sufficiently evenly distributed over the pipe section due to the pulsation of velocity and pressure at high velocities, the same flows are formed in the composition.

The mechanical composition of the turbidity was analyzed in natural field studies to assess the effect of the multi-fractionation of the turbidity composition on the hydraulic parameters of the flow. The analysis was carried out in the laboratory of JSC "GIDROPROEKT".

Research Syrdarya-Sokh Irrigation Basin Department, Fergana Pumping Stations Energy Department Rishtan N.S.E.B. The Sarikurgan pumping station is one of the hydraulic structures on the Sokh River water distribution facility. Sokh River Water Distribution Facility The Sokh River Water Distribution Facility, built in 1947, has a capacity of 398 m3 / second. The total length of the river control is 84.9 km.

The total length of the discharge stream of the Sokh River is 9 km, the water capacity is 260 m3 / sec, the irrigation area is 46,985 ha, the year of commissioning is 1947.

Sarikurgan pumping station was put into operation in 1983. At the pump station, 4 pumps of 300D90 brand are used for water supply. The water pipeline is 1000 mm in diameter and 880 m long. Pump electric motor power 250 kW. The water consumption is 900 / h

Table 1. 300D90 pump specifications

O/n	Naming	Unit of measurement	Symptoms
1	Brand		300D90
2	Water consumption	m^3/ hour	1080
3	Water transfer height	m	70
4	Frequency	cir/min	1500
5	Power	kvt	250
6	Pump weight	kg	1034
7	Aggregate weight	kg	2035
8	Overall dimensions of the pump	mm	1392x1120x1070
9	Overall dimensions of the unit	mm	2440x1120x1070

Studies in systems with high turbidity concentrations were conducted in mining enterprises and studies in streams with low turbidity concentrations were conducted at irrigation pumping stations.

Table 2.The amount of turbidity at the Sary-Kurgan pumping station (June 2020)

№	**For example**	**Sediment volume, g/l**
2.	Advanced camera access	1,95
3.	Channel access to the camera	1,25
4.	The Sokh River became a hydroelectric dam	1,25
5.	The place where the discharge pipe from the	1,18

	lifting pipe falls into the pool	
6.	Sokhdarya hydroelectric power station	1,25
7.	Sokhdarya	1,15

Studies show that in hydraulic calculations of pipes of pump and compressor stations, heat and power plants, hydropower plants and various hydraulic and gas-air systems and in determining the most optimal parameters of hydraulic transport should take into account the variability of concentration in turbid flow, uneven distribution along pipe radius. [3,5,7].

When the mechanical composition of the turbid flow is multi-fraction, it is possible to determine the calculated diameter in the calculation as follows:

$$d_s = \left(\frac{\sum_i d_i p_i}{100} \right) \qquad (1)$$

Where is d_i the particle diameter; $p_i$is the percentage of the $_I$- fractional particle.

The coefficient taking into account the different sizes of the solid particles is determined as follows. As mentioned above, the amount of 0.01 mm small particles in the turbidity content is on average 20-35%. The following conditions were adopted to take into account the effect of fine particles in the turbidity:

If $d_0 > d_{10}$:

$$\beta = \frac{3d_0}{d_{90}} \qquad (2)$$

If $d_{10} > d_0$:

$$\beta = \frac{3d_{10}}{d_{90}} \qquad (3)$$

Where $d_{10}$and d_{90} are the percentage of the solid particle, respectively. It is determined by the granulometric composition of the turbidity.

A simple example representing the difference in velocities is that it is characterized by the density of the turbid flow at the outlet of the pipe and its cross-section along its length.

The values obtained for different turbid currents differ from each other. The measuring devices are adapted to the amount of mass of the solid phases, not to the transport velocity of the individual phases. Based on this, the total mass of the solid material and the liquid will be the same as the flow continuity, but the composition composition of the mixture by volume will be different [3,5,6,7].

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