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NEW CONSTRUCTIONS OF SEDIMENT EXCLUSION WORKS

Abstract. Presents regulating ways of transporting ability and new constructions of sediment exclusion works. For comparison, it has been considered the works of leading experts in this field of science. Methodological and theoretical basis of the study were scientific works of native and CIS scientists on the problems of improving the construction and researches in sediment exclusion works. To achieve the objectives, there were used general scientific methods to study the improvement of construction and transportation ability of sediment exclusion works with longitudinal slotted holes. The results given of experimental research of construction of sediment exclusion works with longitudinal slotted holes. Theory, methods, results of research and new construction of sediment exclusion works, which derived from the results of field research in Tasmuryn, the main channel of the river of Ily Almaty region. Taking into account the experimental research of construction considered, given recommendations to make an experimental research of sand trap structures with longitudinal sediment exclusion slots. Research results application area. Key findings and practical recommendations can be used as a methodological basis for the further deepening research of sand traps with longitudinal sediment exclusion slots.

Keywords: construction of sand traps, sediment exclusion works, longitudinal slotted holes, bottom sediments, transportation ability, helical motion, slurry pipeline.

Introduction. A wide-spread, sufficiently effective sediment exclusion (works) structure is considered to be a bottom transverse slurry pipeline of cylindrical type, to which sediments are supplied by parallel tubes, located along the stream at certain distances. Pairing of the tube to a slurry pipeline performed tangentially to the upper part so that biphasic bottom stream moves in the slurry pipeline helically Sustainable economic development of Kazakhstan and the socio-ecological situation of the population of the country depend on the conditions of water supply and ecological well-being throughout the country. Ensuring the water security of the state has always been at the center of attention of the Government, and first of all, the Head of State is giving this vital problem President of Kazakhstan N.A. Nazarbayev [1, 2].

According to A.I. Arykova [1], helical motion of the flow occurs as a result of translational motion and transverse circulation connection, formed by the water entering through the lateral openings, represented either in the form of a longitudinal slit or separate apertures located at certain distances from each other.

Due to this water flow nature, the intensity of the flow rotation along the length varies and mostly depends on the input speed of the water flow into openings. Due to the variability of the water divergence along the length of the slurry pipeline, its movement is uneven. All this complicates the kinematic picture of the flow motion and therefore the conditions which determine the movement of uniformly-screw flow, as well as longitudinal-screw flow, which are not suitable for our problem. It should also be noted that the results for screw-flow models are based on the Euler's differential equations, without taking into account terms representing the resistance forces, which may not display the actual picture of the real flow movement.

If, in addition, we take into account the fact that we are confronted with the motion of a stream of increased turbulence due to the addition of the liquid with normal components to the flow axis along the length of the fluid, it is obvious that to describe the motion of the entire flow, one must take into account the energy losses due to turbulent mixing.

However, as is known, the system of differential equations for the steady motion of a viscous incompressible fluid under turbulent conditions is not closed.

Methods of the research. "The longitudinal helical motion is a special case of a vortex flow circulation, and, speaking closely, not a screw" writes O. F. Vasiliev [3] in his work. In general the movement with transverse circulation and in the case of screw motion, the current function f (Ψ) is to be expressed through the longitudinal elements and the transverse velocity of the water flow which depends on the nature of the distribution of the latter over the cross section. The paper [3] presents the results of theoretical studies of an inviscid fluid in screw and circulation flows, which continues theory founded by I. S. Gromeko [4] in this field.

Much of the work [3] is devoted to the study of the general case of two-parameter inhomogeneous motion flow screw ($\lambda \neq$ const) as a special case of a two-parameter vortex motion. By definition, the two-parameter flow is a flow whose components, velocity depends only on two coordinates. The two-parameter screw flow in the cylindrical coordinate system, when the motion does not depend on the coordinate φ, is given in system of equations as follows:

$$V_r r = \frac{\partial \psi}{\partial z}, \quad V_z r = -\frac{\partial \psi}{\partial z}; \tag{1}$$

$$V_\varphi r = F(\psi); \tag{2}$$

$$\frac{\partial^2 \varphi}{\partial z^2} + r\frac{\partial}{\partial r}\left(\frac{1}{r} * \frac{\partial \psi}{\partial r}\right) + F(\psi) \cdot F'(\psi) = 0, \tag{3}$$

where r is the radius; V - peripheral velocity; ψ - stream function.

Here $-F'(\psi) = \lambda$.

Following equation describes a one-parameter axisymmetric screw flow

$$\frac{V_\varphi}{r}\frac{d(V_\varphi r)}{dr} + V_z \frac{dV_z}{dr} = 0. \tag{4}$$

In this case

$$\lambda = -\frac{1}{V\varphi}\frac{dV_z}{dr}. \tag{5}$$

Equations (4) and (5) describe motion of uniform screw of inviscid fluid flow in a straight circular tube.

The coupling of pipes to the slurry pipeline with respect to the lower part of the pipe is very relevant, but in this version the pipes are arranged with reverse bias against the stream [5].

It is known that the conveying capacity of a screw-twisted flow is several times greater than the conveying capacity of a ramjet (straight flow) [6]. The degree of twist as well as the conveying capacity of the flow can be regulated by:

1) axial feed of ramjet (straight flow) into slurry pipeline;

2) feeding additional tangential flow of the upper clarified part of the flow channel into the slurry pipeline;

3) establishing of cone valve at the end of slurry pipeline with the mouth of the cone inside the tube (slurry pipeline);

4) setting nozzle at the end of the slurry pipeline in the form of a truncated cone.

In the first case, the ramjet (straight flow) is superimposed on a swirling external flow, the movement process of which is studied in laboratory conditions [7].

Two designs of hydraulic elevators have been investigated: with direct flow and with tangential feeds of the intake medium. The performed studies of the characteristics of the hydraulic elevator at different

distances of the working nozzle from the upper mixing chamber showed that there is an optimum distance at which the efficiency of hydraulic elevator operation is highest.

In the second case, imposition of internal and external swirling flows occurs [6].

In the third case, three axial flow formed in the slurry pipeline: peripheral sediment transporting stream, air cord in the nucleus, and between them the reverse current [6].

In the fourth case, the slurry pipeline formed four streams: an air cord (axial), peripheral (trim) and near the axial air cord flows directed towards the exit of the slurry pipeline and in the middle of the radius between zones of equal axial direction - annular zone of recurrent fluid flow [6].

Results and discussion. Based on the design of the obtained prepatent [2], field studies were conducted at 63 picket of the Tasmuryn main canal in the Almaty region. 5 series of experiments were conducted where the length of the longitudinal slits varied from 0,50m to 2,66m (0.5 m, 1.0 m, 1.5 m, 2.0 m; 2,66 m). Below are the main hydraulic characteristics in the alignment of the sand trap.

Main hydraulic characteristics in the alignment of the sand trap

Picket	Date dd.mm.yyyy	Length of longitudinal slit, m	The average depth, m	The average velocity, m/s	Channel consumption, m^3/s
63		0,50	1,88	0,37	49,35
63+40		0,50	1,94	0,363	55,87
63+46		0,50	1,98	0,362	54,55
63		1,0	1,92	0,364	57,48
63+40		1,0	1,92	0,380	59,34
63+46		1,0	2,10	0,412	58,043
63		1,50	1,98	0,40	55,763
63+40	15.08.2012	1,50	1,96	0,42	54,55
63+46		1,50	2,54	0,41	54,92
63		2,0	2,00	0,369	54,98
63+40		2,0	2,01	0,375	53,86
63,46		2,0	2,01	0,368	54,76
63		2,66	1,94	0,373	49,68
63+40		2,66	1,95	0,378	57,065
63+46		2,66	1,91	0,373	57,010

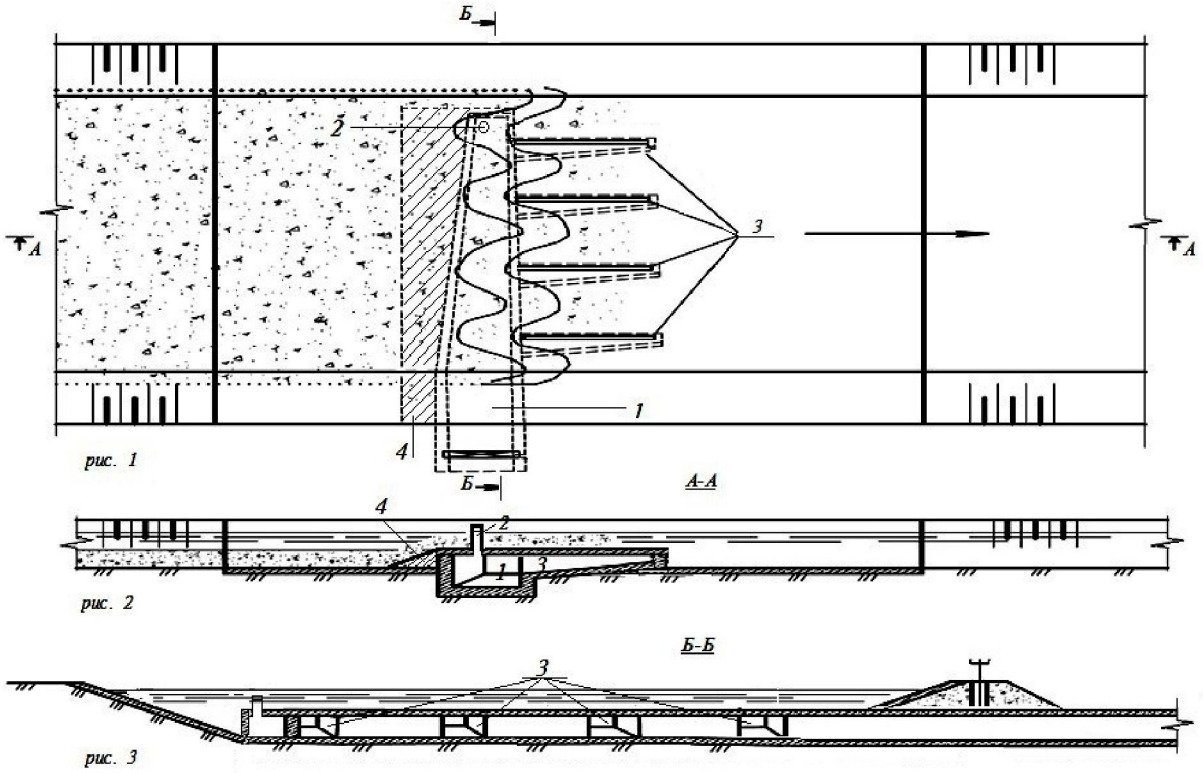
In general, a new sand trap design with longitudinal sediment transporting(ation) slots worked well. Water consumption for washing sediment was approximately 5-7% of the total flow channel. This is a good result, but still, there were some shortcomings, such as, longitudinal slots of the upstream side were quickly filled with larger deposits. And also, under slurry pipeline from the upper side sand hillocks accumulate and reduce the effectiveness of the device.

We were given the task - improving the reliability of the peskogravielovki and hydrological transport model in the slurry pipeline. Filed application for the invention was obtained and prepatents [8]. Offered peskogravielovka includes slurry pipeline and a device for capturing a picture sediment with longitudinal receiving slot openings arranged parallel to the channel axis for slurry pipeline, i.e. downstream and adjacent to the slurry pipeline to the downstream side.

The desired result is achieved by a device for the slurry pipeline sediment capturing a picture with longitudinal slotted holes arranged in the downstream of and adjacent to the downstream side with a slurry pipeline and a slurry pipeline installation about a vertical supply pipe in it additional expense.

Into account, the accumulation of sand hills under slurry pipeline from the upstream side, we proposed a new design sand trap [9], comprising a slurry pipeline and a device for capturing a picture sediment with longitudinal receiving slot openings arranged parallel to the channel axis for slurry pipeline, i.e. downstream and adjacent to the slurry pipeline to the downstream side, and also took into account the types of laboratory research and regulation of the conveying capacity of irrigation channels [10, 11].

The desired result is achieved by a device for gripping sediment in the form of a slurry pipeline galleries with longitudinal slotted holes arranged in the downstream of and adjacent to a slurry pipeline from the downstream side and the setting before slurry pipeline from the ground to the top of the pipe reinforced concrete slab as a slope to prevent entry of sediment various kinds under slurry pipeline pipe. Figure 1 shows the plan of the sand trap, figure 2 shows the section A-A in figure 1, figure 3 shows the section B-B in figure 1.



Figures 1–3 – Sand trap with longitudinal slotted holes

Sand trap with longitudinal slotted holes consists of slurry pipeline 1, a vertical tube 2 of circular or rectangular cross section, welded at the initial part of slurry pipeline tangentially thereto and tube 3 with longitudinal receiving slot openings arranged parallel to the channel axis by the downstream and adjacent to a slurry pipeline with downstream side and a reinforced concrete slab 4 placed in front slope slurry pipeline from the ground to the top of the pipe (on the axis of the tube).

The apparatus operates as follows. Apparatus of sediment exclusion works tube 3 with longitudinal slotted holes from bottom water in earthen channels allow to skip larger drifts not pulling on the longitudinal slit, and setting a slurry pipeline 1 tangential vertical pipe 2, allows due tangential Incoming additionally twists the main stream coming from sediment exclusion picture in one direction. Addition to the construction of reinforced concrete slabs 4 in the form of a slope in front of the installed slurry pipeline from the ground to the top of the pipe (on the pipe axis) and prevents ingress of bottom sediments and sediment before tractional slurry pipeline pipe, which is important in the operation of the sand trap for a long time. The initial portion and the entire length of slurry pipeline sedimentation does not occur and the whole pulp goes into relief channel and further discharged back into the river or natural depressions terrain.

For comparison and analysis of the results of the works of native and foreign scientists engaged in the problems of deposits were studied and clean sediments in earthen canals and sediment exclusion devices [12-22].

Conclusions. Estimated invention relate to the field of hydraulic engineering, in particular to the construction sediment exclusion galleries, and can be used to prevent deposition of sediment in the slurry pipeline galleries and enhance their transporting capacity. The article presents the theory, methods, and results of research and new designs of sediment exclusion works construction derived from the results of field research in Tasmuryn's main channel of the river Ily of Almaty region. The data structure of the devices it is possible, using available technology on the basis of the current level of technology and knowledge, as its design is fairly simple, but the implementation of these devices has long been well mastered the relevant enterprises of different levels.

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ТАСЫНДЫТҰТҚЫШ ҚҰРЫЛЫМДАРДЫҢ ЖАҢА КОНСТРУКЦИЯЛАРЫ

Аннотация. Жұмыста тасындытұтқыш құрылымдардың жаңа конструкциялары мен олардың тасымалдау қабілетін реттеу жолдары келтірілген. Салыстыру үшін ғылымның осы саласындағы жетекші мамандардың еңбектері қарастырылған.

Зерттеудің әдістемелік және теориялық негізі отандық және ТМД елдері ғалымдарының, тасындытұтқыш құрылымдардың конструкцияларын жетілдіру және зерттеу сұрақтарына қатысты ғылыми еңбектері болып табылады. Зерттеу мәселелерін шешу үшін бойлық саңылаулы тесігі бар тасындытұтқыш құрылымдардың өткізу қабілеті мен конструкцияларын жетілдіруді жақсартуды болмыстық зерттеудің жалпы ғылыми әдістері қолданылды. Бойлық саңылаулы тесігі бар тасындытұтқыш құрылымдардың конструкцияларын эксперименталдық зерттеудің нәтижелері. Алматы облысы Іле өзені Тасмұрын магистрал каналындағы болмыстық зерттеулер нәтижесі негізінде алынған тасындытұтқыш құрылымдардың жаңа конструкцияларын зерттеу нәтижелері, зерттеу әдістемесі, теориясы келтірілген. Қарастырылатын конструкцуияны эксперименталдық зерттеулер ескеріліп, бойлық саңылаулы құмтұтқыштардың конструкцияларын эксперименталдық зерттеулерді жүргізуге нұсқаулықтар ұсынылған. Негізгі қорытындылар мен тәжірибелік ұсыныстар бойлық саңылаулы тасындытұтқыш құмтұтқыштарды зерттеуді одан ары тереңдету үшін әдістемелік негіз ретінде пайдаланылуы мүмкін.

Түйін сөздер: құмқиыршықтастұтқыштардың конструкциялары, тасындытұтқыш құрылымдар, бойлық саңылаулы тесіктер, түпкі тасындылар, өткізу қабілеті, бұрандалы қозғалыс, құмқойыртпақ құбыры.

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НОВЫЕ КОНСТРУКЦИИ НАНОСОПЕРЕХВАТЫВАЮЩИХ СООРУЖЕНИЙ

Аннотация. В работе приведены пути регулирования транспортирующей способности и новые конструкции наносоперехватывающих сооружений. Для сравнения рассмотрены работы ведущих специалистов в этой области науки.

Методической и теоретической основой исследования явились научные труды отечественных и ученых СНГ по проблемам совершенствования конструкций и исследованиий наносоперехватывающих сооружений. Для решения поставленных задач были использованы общенаучные методы исследования улучшения конструкции и пропускной способности наносоперехватывающих сооружений с продольными щелевыми отверстиями. Даны результаты экспериментальных исследований конструкций наносоперехватывающих сооружений с продольными щелевыми отверстиями; теория, методы, результаты исследовании и новые конструкции наносоперехватывающих сооружений, полученных на основе результатов натурных исследований в Тасмурынском магистральном канале реки Или Алматинской области.

С учетом экспериментальных обследовании рассматриваемой конструкции, предложены рекомендации проведения экспериментальных исследовании конструкций песколовок с продольными наносозахватными щелями. Основные выводы и практические рекомендации могут быть использованы в качестве методической основы для дальнейшего углубления исследований песколовок с продольными наносозахватными щелями.

Ключевые слова: конструкции пескогравиеловок; наносоперехватывающие сооружения; продольные щелевые отверстия; донные наносы; пропускная способность; винтообразное движение; пульповод.

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