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Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

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ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
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Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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RESEARCHES OF HYDRODYNAMICS OF INFILTRATION AND COLMATATIONS PROCESSES IN BASINS OF DAILY REGULATION UNDER ARTIFICIAL REPLACEMENT OF GROUND WATER RESERVES

Abstract. The article presents the organization, methods and results of field studies of the water-physical properties of rocks of top sediments in the foundations of infiltration basins, as well as an assessment of their influence on clogging processes. Studies were conducted on a physical model of the mini-pool with water infrastructure and captained structures on the real object and the real conditions of Southeast Kazakhstan. At the same time, the natural conditions of water seepage to the full saturation of the tested power of the rocks of cover sediments were simulated taking into account the spreading of the infiltration flow at the close occurrence of the groundwater level. The obtained full-scale characteristics can be recommended and accepted as the calculated indicators both at the stage of feasibility study and detailed design of the WIP systems without additional labor-intensive and costly survey and research works.

Keywords: artificial replenishment of groundwater reserves, infiltration pool, physical model, pit, volume humidity, maximum molecular moisture capacity, pumping, colmatation.

In the study of the processes of artificial replenishment of groundwater (hereinafter IVZPV), a detailed description of the water-physical, hydrodynamic and filtration properties of cover sediments and upper layers of water-bearing rocks of the aquifer plays a very important and decisive role, especially in the design of open infiltration facilities.

On the territory of South-East Kazakhstan for replenishing the groundwater reserves of the aquifer first from the surface of the earth with low thickness of covering low-permeable sediments, infiltration structures of open-type artificial replenishment systems are most effective [1]. In our case, it may be the most expedient if there is a large regulating capacity in the aquifer.

Performance prediction of such pools may be provided by analogy with the structures of the existing systems of artificial recharge or calculations.

The first method requires the use of long-term data on the operated installation, similar to the factors affecting the value of the performance of the pool with the newly designed. This way can be the most rational only when the newly designed installation is located in the area of the operating system or the extension of the already operated system is projected [2].

In the conditions of South-East Kazakhstan, where there are no built and operated systems of the ERW, the only and acceptable can be the use of the calculation method, for which it is necessary to have data on the composition and permeability of the soils of the base of infiltration basins and the specified mode of their operation [3].

For this purpose, a mini - basin system was constructed with the infrastructure of water intakes and captive structures, imitating the IVZPV system that is optimal for this region in miniature. It carried out a full range of field work in engineering geology and soil mechanics with the drilling of holes and the sampling of rocks of the aeration zone, as well as hydrological and laboratory studies of surface water as a source of replenishment of operational reserves.

In this work, the following main and defining criteria were used:

- the presence of a potential consumer of accumulated water in the areas of IVPP. Such a consumer is rural settlements with the number from 500 and taking into account the prospect of growth up to 2000 inhabitants. These are primarily those in which residents use either imported water or existing surface sources for drinking water supply do not meet sanitary and epidemiological requirements;
- the presence of water-bearing layers (horizons) with sufficient potential for making the appropriate volume of accumulated groundwater reserves, the required quality and quantity;
- the possibility of using the selected section of the IPPW as a model for the dissemination of the data to similar areas for further implementation and use of research results;
- the possibility of organizing experimental work on the site;
- cost and other technical and economic indicators.

As a result, as the most acceptable alternative object of scientific research processes USPV elected land located on the territory adjacent to the village Ishitobi, a potential consumer of water due to ground-water artificial replenishment of their stocks[4].

The location of the research site on the territory of the Republic of Kazakhstan in Almaty region is shown in figure 1.

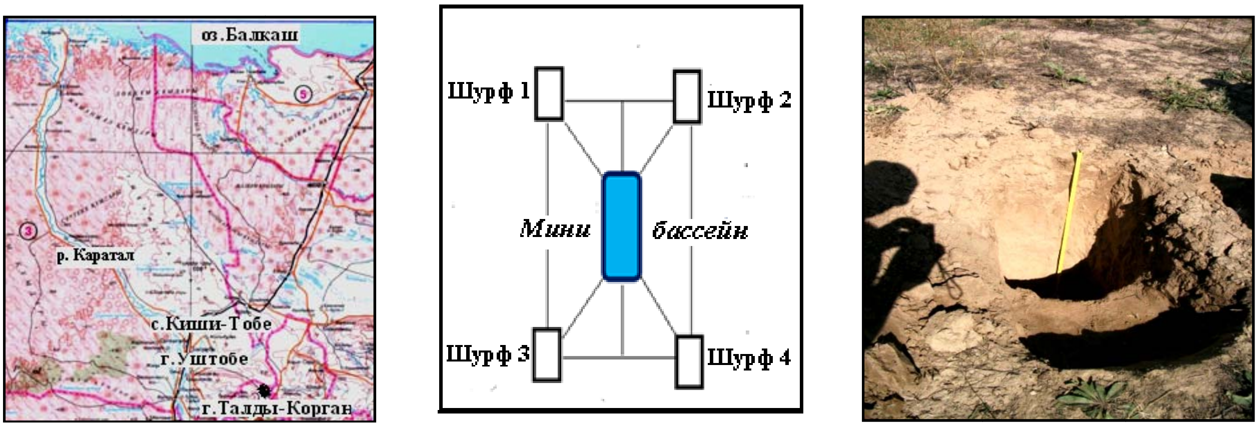


Figure 1 – Scheme of location and general view of made bore pits

Organization of the research area. For the study of water-physical, hydrodynamic and filtration properties along the perimeter in the corners of the conditional envelope of the projected infiltration basin, 4 holes were drilled.

The studies were carried out separately for each opened genetic layer of alluvial-proluvial cover sediments and the upper section of water-bearing rocks of the aquifer.

In the center of the experimental site was passed and equipped with a pit, simulating on a reduced scale projected infiltration pool of daily regulation with the following parameters: Depth - 4,0 m with natural slopes and the size of the top - 2x5 m.

Methods of conducting experimental studies. Studies of the lithological composition and characteristics of the water-physical properties of rocks of top sediments in the grounds of infiltration basins, as well as the assessment of their influence on clogging processes are an integral part of both the feasibility study and the detailed design of the IVZPV systems [5].

Volumetric weight, natural moisture (weight), maximum molecular moisture capacity and other water-physical and filtration properties of rocks were determined using the Litvinov field laboratory (PPL-9).

To determine the granulometric composition of fine gravelly and grainy sandy soils, as well as coarse-grained part of silty - clay soils, the sieve method was used [6] - one of the main in the practice of soil research, which occupies an intermediate position between direct and indirect methods and is widely used in practice independently or in combination with other methods. To separate the soil into fractions by the sieve method without washing with water, sieves with holes with a diameter of 10; 5; 2; 1; 0.5 mm;

with washing with water - sieve with hole size 10; 5; 2; 1; 0.5; 0.25; 0.1 mm. Sieve method with water washing was used to determine the granulometric composition of fine and silty Sands.

To determine the content in the soil of particles with a diameter less than 0.1 mm, an areometric method was used, based on the sequential determination of the density of the soil suspension at certain intervals using a hydrometer. The results of the determinations were calculated diameter and number of particles to be determined.

To determine the granulometric composition of clay soils, a pipetting method was used in combination with a sieve. This method is based on the separation of soil particles by the speed of their fall in calm water. At certain time intervals, samples were taken from a suspension of soil from different depths with a pipette, which were then dried and weighed.

For sands with the inclusion of pebbles, experimental filling was carried out according to the method of A.K Boldyrev. The Boldyrev method is based on the assumption that the pressure gradient in the conditions of the described solution of the problem is close to one (J=1). It should be noted that the results of experiments to determine the filtration coefficient by this method are, as a rule, approximate, depending on the size of the hole section and the duration of the experiment.

The filtration coefficient was determined using the method of pumping water from wells in the experimental area, for which we used the wells of the regime network of RSU Zonal Hydrogeological Reclamation Center of the Ministry of Agriculture of the Republic of Kazakhstan [7]. - № № 153,261 as central and № № 127, 129, 152, 10 (figure 2) as observation wells. The latter were needed to observe changes in the water level at some distance from the Central production during pumping.

Figure 2 – Pictures of central and observation wells No. 261, 10

If the pump capacity (or, what is the same, q flow rate) is constant, then the degree of water level decrease in generation at a constant aquifer power and all other equal conditions depends on the value of the rock filtration coefficient [8].

The smaller the coefficient k, the greater the reduction can be achieved with a certain pump capacity. This dependence is quite natural.

Consequently, it is possible to determine the water permeability of the rock by determining its filtration coefficient k by experimentally determining the dependence of the decrease s of water in the hydrogeological development on a particular flow rate q during pumping (figure 3).

To carry out studies to determine the permeability and volume humidity of cover deposits filling each of the passed pits with water from the river Karatal was carried out from a $2m^3$ volumetric tank equipped with a float system and a flow meter, and constantly replenished with a car-water carrier with a tank capacity of 8 m^3.

To obtain a reliable characteristic of water-physical, water-chemical, hydrodynamic and filtration properties of rocks in the aeration zone, studies were carried out separately for each genetic horizon of the cover deposits at full capacity. At the same time, all existing methods, devices and equipment were previously analyzed, used for these purposes [8, 12].

To create a model of the process of water infiltration from the pool in the zone of incomplete saturation, field studies were conducted by filling the prepared physical model with water-mini-pool with an initial water column of 200 cm and its subsequent operation [9].

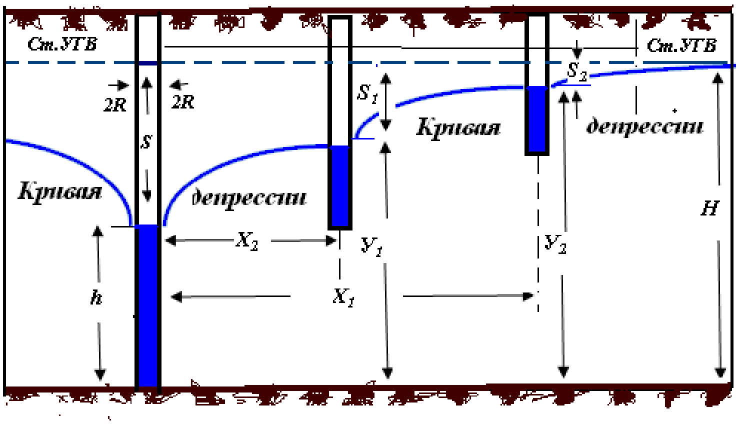


Figure 3 – Filtration coefficient calculation model in the field when dewatering well

Observations were carried out for 78 hours with the following intervals of water flow measurements and the value of water column decrease in the pool per unit of time: during the first 6 hours - after 1 hour, later during the day after 2 hours - and then until the end of the experiment - every 4 hours. At the same time, interval sampling of a water-saturated soil with undisturbed structure was carried out to determine the bulk moisture.

Sampling for the measurement of volumetric humidity was made by layers located at depths: 10, 20, 60, 75 и 90 cm from the bottom of the infiltration mini-pool. Moisture samples were taken immediately after the opening of the next layer to avoid loss of moisture[10].

As a result, to obtain the necessary parameters characterizing these properties when conducting research, a unified approach was chosen, in which a metal frame with a height of 20 cm of rectangular shape with dimensions that follow the dimensions of the slopes of the pit, which was crushed to a depth of 5 cm, was used as a buzzer. In this case, the natural conditions of water infiltration were simulated until complete saturation of the tested thickness of the sedimentary rocks took into account all factors, such as the spreading of the infiltration flow, trapped air, water temperature, close groundwater level, etc. [11, 13].

Field studies of the processes of soaking the base of the mini pool were carried out by measuring the magnitude of the dirt capacity or turbidity of the river water pumped into the infiltration mini-pool. Studies of clogging were carried out simultaneously with the implementation of the experience in studying the permeability, i.e. within 78 hours. A device was used - Turb 355 T/IR Mutnomer, as well as a photometric method of comparing samples of the test water with standard suspensions.

Measuring the turbidity of the river water and the estimation of errors of measurements were performed with the use of latest edition RD 52.08.104-2002 "water Turbidity. Methods of measurement ", developed by the State Institution" State Hydrological Institute "Roshydromet, authors: D.A. Konovalov, N.N. Bobrovitskaya, K.M. Zubkova, L.G. Tkacheva, M.E. Vychezhzhanina. Certified by GU GGI, certificate No. 03-2000 of 11/15/2000.

The portable turbometer works in a wide range from 0 to 1000 FTU (NTU), for greater accuracy, the measuring range is divided into two sub-ranges: from 0 to 50 NTU with a resolution of 0.01 FTU and from 50 to 1000 FTU with a resolution of 1 FTU.

Conversion to mg/l depends on the material and varies greatly, from 1 NTU = 0.13 mg/liter (silica in the form of diatomite) to 1 mg/l (kaolin) [11].

In this regard, the performed calibration of the instrument recommends the use of Russian GOST 3351-74, which establishes the ratio of 1 EM / liter = 0.58 mg / liter for kaolin.

It should be noted that the Mutnomer Turb 350 IR WTW with kaolin suspension and calibration was used for the first time as a scientific experiment to quickly obtain instantaneous turbidity values.

Results of experimental studies. In order to verify the obtained results on the permeability of those rocks, the coefficients of which were determined according to the data of loading, calculations were carried out using empirical formula of Hazen. From which it follows that the greatest difference between the calculated filtration coefficients, determined as a result of the pilot filling, in sandy, well filtering rocks reaches -20.7% and the smallest in sandy beds -1.8%.

The coefficient of water loss (in fractions of a unit) was calculated by the formula P.A. Belinsky according to the values of the filtration coefficient, determined according to the data of pilot fillings.

The coefficient of water loss (in fractions of a unit) was calculated by the formula P.A. Belinsky according to the values of the filtration coefficient, determined according to the data of pilot fillings.

Table 1

Rock names	Water loss coefficient (in fractions of a unit)
Pebble gravel with sandy aggregate	0.171
Medium-grained sand	0.097
Fine-grained sand	0.072
Sandy bean	0.068
Loam	0.078
Loam heavy	0.067
Loam light	0.081

From the lithological composition of rocks depends not only the value of the coefficient of water yield, but also the height of the capillary rise.

Table 2

Rock names	Capillary lift height
Fine-grained sand	0,15-0,25
Clay sand	1.0
Sandy bean	1,05-1,60
Heavy loam	1,35-2,50
Loam light	2,50-3,35

The granulometric composition of the rocks, depending on their genetic connection, is given in the table below the corresponding percentage of fractions.

Table 3 – Grain composition of rocks of covering quaternary deposits

Lithological composition of rocks	Granulometric composition (%) of fractions						
	7,0-5,0	5,0-2,0	2,0-1,0	1,0-0,5	0,5-0,05	0,05-0,005	Less than 0.005
Gravel sand	–	15.2	21.7	–	34.4	14.8	14.8
Coarse sand	9.5	5.3	21.1	1.7	29.9	1.6	0.8
Medium-grained sand	-	43.0	43.0	0.1	5.6	4.9	3.4
Fine-grained sand	–	–	–	–	97.1	0.8	2.1
Sandy loam	–	–	–	–	45.1	33.6	21.6
Sandy loam	–	–	–	–	6.1	51.2	42.7
Clay loam	–	–	–	–	43.6	36.3	20.1

The results of experimental studies to determine the permeability and volume moisture of top sediments with a brief explanation and conclusions are presented in figures 4–7.

Figure 4 shows the constructed diagram of the dynamics of changes in the flow rate of the filtered water to the zone of incomplete saturation and depth of wetting for different stages of saturation of the upper lithological layer of cover sandy loams in pit A-1. The research interval is 100-140 cm. The experiment lasted 26 hours under the given volume of water 1,147 m^3 the magnitude of the drenching 400 mm. Sustained water flow came after 20 hours from the start of the experiment; relatively stable infiltration after 6 hours. Soil density-1.32 g/cm^3, the initial volume humidity-36.7 % of the field capacity and volume or 0.22; at full saturation-73.1% or 0.44 at full capacity. The porosity is 0.6. The difference is due to the presence of trapped air in the pores of the soil [12].

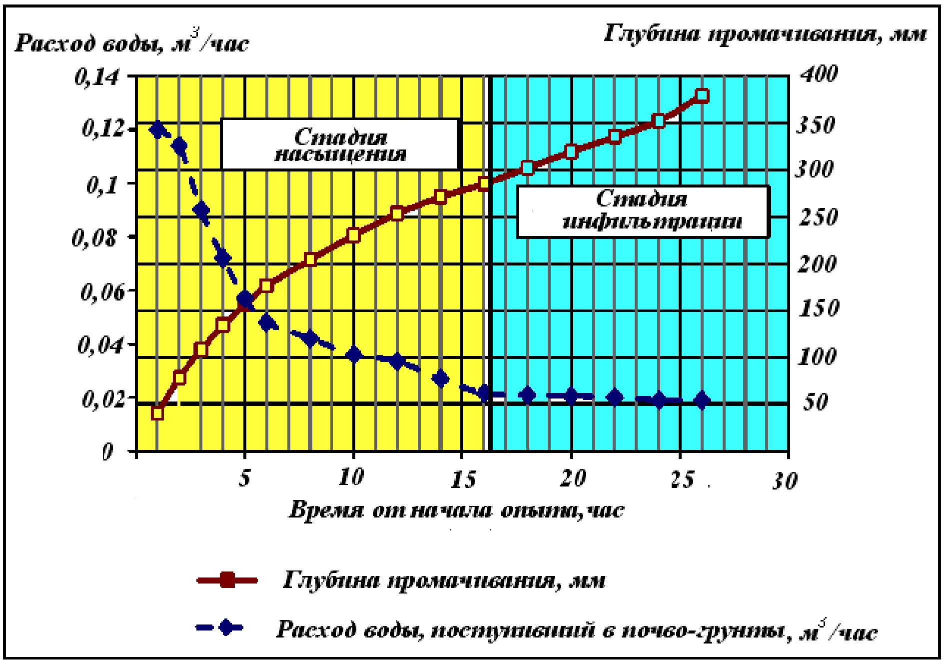


Figure 4 – Changes in filtrated water rate to the zone of subsaturation and depth of wetting for different saturation stages of cover sandy loams. Bore pit A-1 characterizing the upper lithological layer in the section of the subsaturation zone at the pilot site of AGWSP. The weighted average filtration coefficient was 0.3 m/day

The following lithological layer of sediments of the unsaturated zone at the experimental site USPV, research has been carried out in pit B-2, is light loam, grey, medium density summation (figure 5). Research interval-140-200 cm. The experiment lasted 60 hours under the given volume of water 1,240 m^3 the magnitude of the drenching 600 mm. Sustained flow of water came after 40 hours from the start of the experiment; relatively stable infiltration after 16 hours. The density of the soil is 1.29 g/cm^3, the initial volume humidity of sandy loams is 32.5% of the field capacity and volume, or 0.23; at full saturation, 80.87% or 0.57 at full water capacity. The sediment porosity is 0.7 [14].

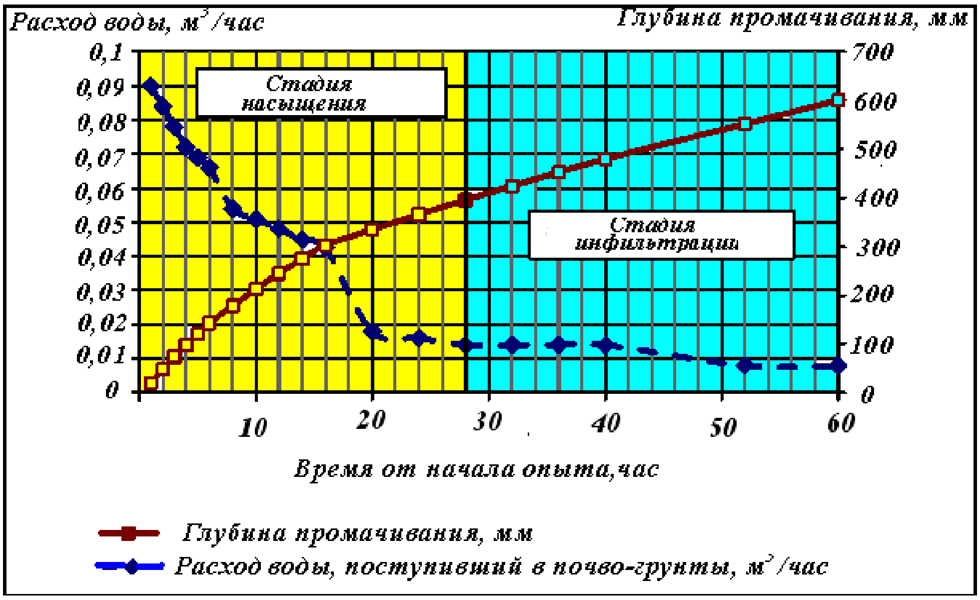


Figure 5 – Changes in filtrated water rate to the zone of subsaturation and depth of wetting for different saturation stages of loam soil. Bore pit B-2 characterizing the second lithological layer in the section of the subsaturation zone at the pilot site of AGWSP

Figure 6 shows the dynamics of changes in the flow rate of filtered water to the zone of incomplete saturation and depth of wetting for various stages of sandy loam saturation in the B-3 hole, characterizing the third lithological layer in the section of the incomplete saturation zone in the experimental section of the IVZPV. In the B-3 pit, studies were conducted on water-physical and filtration properties f surface sediments represented by light gray, fine sand, mica sandy loam in the range of 230-300 cm. The experience lasted for 85 hours under the given volume of water 1,384 m^3 the magnitude of the drenching 700 mm.

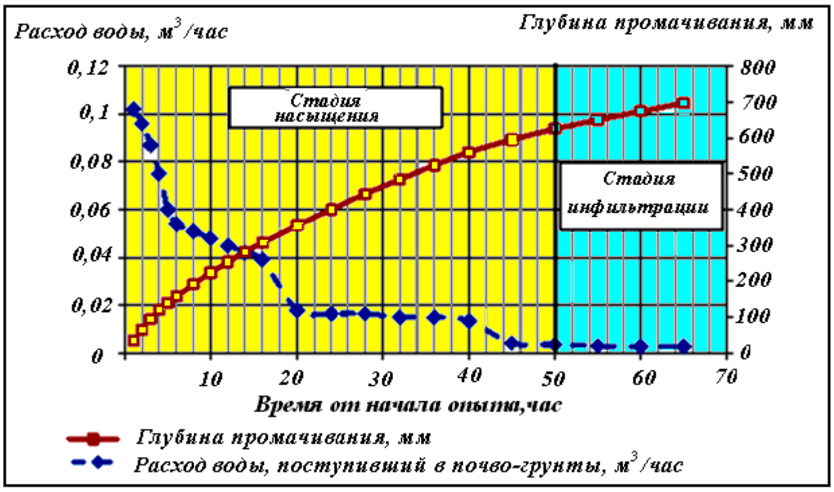


Figure 6 – Changes in filtrated water rate to the zone of subsaturation and depth of wetting for different saturation stages of sandy loam. The bore pit V3 characterizing the third lithological layer in the section of the subsaturation zone at the pilot site of AGWSP

A steady transition from full saturation to infiltration occurred after 75 hours from the start of the experiment; relatively stable infiltration after 8 hours. The density of the soil is 1.39 g/cm^3, the initial volume humidity is 36.7% of the field capacity and volume, or 0.22; at full saturation - 91.38% or 0.55, the porosity of the soil is equal to 0.60. The weighted average filtration coefficient was 0.56 m/day.

The fourth lithological layer in the section of the incomplete saturation zone in the experimental area of the IVZPV, represented by fine-grained gray sand, mica was tested in the G-4 pit in the interval of 310-420 cm (figure 7), from the mark of 390 cm aquifer. The duration of the experiment was 95 hours with a supplied volume of water of 0.971 m^3. Sustained flow of water came after 82 hours from the start of

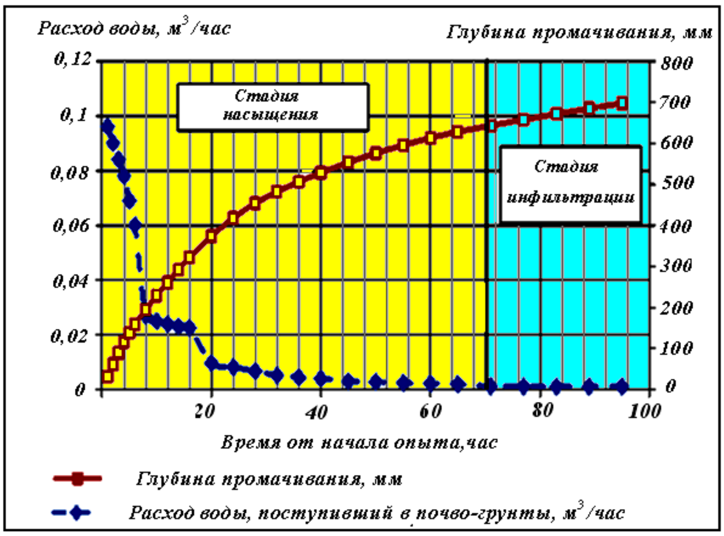


Figure 7 – Changes in filtrated water rate to the zone of subsaturation and depth of wetting for different saturation stages of finely grained loamy sand. The bore pit G-4 characterizing the fourth lithological layer in the section of the subsaturation zone at the pilot site of AGWSP

the experiment; relatively stable infiltration after 8 hours. The density of the soil is 1.34 g/cm^3, the initial volume humidity is 56.7% of the field capacity and volume, or 0.31; at full saturation, 52.1% or 0.53. The porosity is 0.55. The weighted average estimated filtration coefficient was 2.8 m/day at the beginning of the research and 3.4 m/day with full saturation.

To assess the dynamics of the infiltration process through the zone of incomplete saturation to groundwater levels at the experimental site, the following parameters were obtained:

- the initial profile of volumetric humidity (before the pool is flooded);
- the value of the height of the water column in the pool above its bottom and its change in time;
- the value of the total volume of water applied for infiltration and the time of infiltration (from beginning to completion);
- the depth of soaking at the end of the experience;
- profile of volume humidity at the end of the experiment and intermediate time profile of volume humidity.

The resulting material is the constructed profiles and chronoisoplets of one-dimensional volumetric moisture of the cover soils underlying the aquifer of modern and Upper Quaternary alluvial-proluvial undifferentiated sediments with natural composition in conditions of insufficient and complete saturation in the mini-pool in the experimental experimental section of the IVRIZV deposits presented in the figure below.

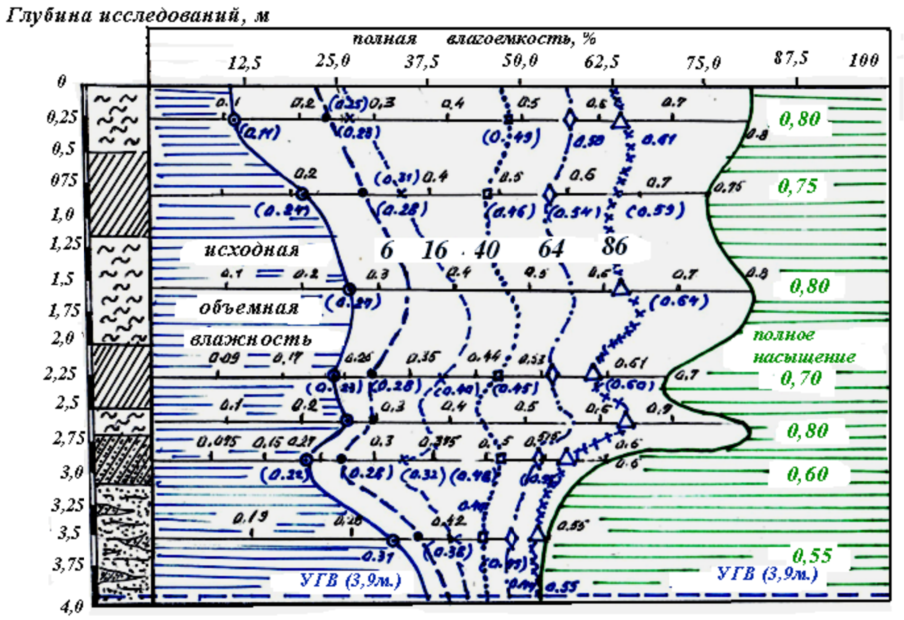
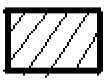
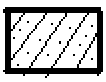
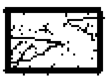


Figure 8 – Profiles and chronoisopleths of one-dimension volume humidity of cover grounds underlying the water bed of modern and upper quarternary alluvial-proluvial poorly defined formations in the context of natural stratification under conditions of insufficient and full saturation in the mini basin at the experimental area of AGWSP - Chronoisopleths of volume humidity,numbers – observation interval in hours . - loam soil - sandy loam - fine sand with sandy loams lenses – loam

 – Chronoisoplets of volume humidity, numbers - the period of observations in hours

 - loam  - sandy loam  - fine-grained sand with loam lenses  - clay

To confirm the normal functioning of the applied device Motomura Turb 350 IR, WTW and the suspension of kaolin and performed calibration,was carried out additional measurements of optical density of the suspension on a spectrophotometer and the concentration of kaolin in 0,5; 1,0; 1,5; 2,0; 3,0; 4,0; 5,0 mg/l. In each standard solution, the analytical signal was measured by a spectrophotometer at a wavelength of 530 nm, which was used in this type of analysis.

Next, measurements were made in the analyzed solution, which should know the concentration of the substance to be determined. Having obtained the value of the analytical signal, with the help of a calibration graph, a concentration was found that corresponds to this signal. According to the results of measurements of the optical density of standard working suspensions, a calibration graph of the dependence of the optical density on turbidity was constructed.

As is clearly seen in the figure, the calibration graph is expressed as a straight line coming from almost zero, which gives us grounds for asserting that the results of measurements of the turbidity of river water are quite reliable, verified by modern spectrophotometry methods and comparable to traditional gravitational weights with high correlation coefficient.

Table 4 – Results of river water turbidity determination
at the site of field studies of AGWSP

Period and duration research			Water volume per unit of time on saturation of the studied layer, m^3	The value of the water layer in the unit of time, mm	Height of the water column in the mini-pool, mm	Turbidity, mg/dm^3
Research date	Research interval, hour	The duration of research, hour				
10.08	1	1	0.440	110	2000	35
	1	2	0.42	105	1890	36
	1	3	0.38	96	1785	37
	1	4	0.36	90	1689	38
	1	5	0.35	87	1602	37
	1	6	0.32	80	1522	36
		6	0.183	568	1522	37
	2	8	0.60	150	1372	35
	2	10	0.576	144	1228	35
	2	12	0.560	140	1088	35
	2	14	0.544	136	952	35
	2	16	0.512	128	824	35
	2	18	0.480	120	704	34
	2	20	0.40	100	604	34
	2	22	0.32	80	524	34
	2	24	0.24	60	464	34
11.08	2	26	0.192	48	416	34
	2	28	0.144	36	380	32
	2	30	0.128	32	348	31
		30	4.696	1174	348	30
	4	34	0.216	54	294	29
	4	38	0.216	54	240	27
	4	42	0.208	52	188	26
	4	46	0.208	52	136	25
12.08	4	50	0.200	50	86	25
	4	54	0.200	50	36	24
		54	1.248	312	36	24
	4	58	0.1936	48.4	-12.4	24
	4	62	0.1936	48.4	-	23
	4	64	0.1936	48.4	-	22
	4	68	0.192	48.0	-	21
	4	72	0.192	48.0	-	22
	4	76	0.192	48.0	-	21
		78	1.1568	2000	0	22
		78	7.284	2000	0	29

Conclusion. In order to obtain the necessary parameters characterizing these properties, a unified approach was chosen in the course of research, in which the natural conditions of water seepage were simulated to the full saturation of the tested power of the rocks of cover sediments, taking into account the spreading of the infiltration flow at the close occurrence of the groundwater level.

The studies were carried out separately for each opened genetic layer of alluvial-proluvial cover sediments and the upper section of water-bearing rocks of the aquifer.

The specific characteristics obtained are: volumetric weight, natural humidity, the level of molecular moisture capacity and other water-physical and filtration properties of rocks in real conditions of artificial supplementary feeding of groundwater for drinking water supply of the population of the settlement.

The site of experimental studies is composed of heterogeneous in the area of distribution and lithological composition, low-power weakly and waterproof cover deposits, the average density of addition.

Surface water river. Karatal are characterized by a low content of suspended mechanical particles: from 12-15 to 25-30 mg/l in the mid-summer and autumn-winter periods, except for periods of flood runoff, when their turbidity reaches up to 120-150 mg/l.

In the process of conducting pilot studies in the infiltration mini-basin, as the water level in it decreased, natural clarification of water occurred and its turbidity decreased to the minimum values: 20-23 mg/l.

The thickness of the formed clay film at the bottom of the mini pool was only 0.09 mm with a volume of filtered water through a mesh of 7.284 m^3 and so small that it could be concluded that there is no danger to the colmatage of pores of aquiferous rocks of fine-grained sands.

In general, the experimental studies carried out at the Karatal experimental site allowed to evaluate the infiltration processes from the infiltration mini-basin, study the process of clogging and silting of infiltration structures, characterize the water-physical, hydrodynamic and filtration properties of the main lithological differences of the sediments at the site of the proposed construction of the artificial replenishment of the underground waters [15].

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ЖЕР АСТЫ СУЛАРЫНЫҢ РЕЗЕРВУАРЛАРЫН СУРЕТТЕРМЕН АЛМАСТЫРУҒА БАЙЛАНЫСТЫ КҮНДЕЛІКТІ РЕТТЕУДІҢ БАСТАМАЛАРЫНДЫ ИНФИЛЬТРАЦИЯ ЖӘНЕ КОЛЬМОТАЦИЯ ПРОЦЕСТЕРІНІҢ ГИДРОДИНАМИКАСЫ ЗЕРТТЕЛДІ

Аннотация. Мақалада инфильтрациялық бассейндердің негізіндегі жоғарғы шөгінділердің су-физикалық қасиетерінің далалық зерттеулерін ұйымдастыру, әдістері мен нәтижелері, сондай-ақ олардың бітелу процестеріне әсерін бағалау қарастырылған. Зерттеулер шынайы объектіде және Оңтүстік-Шығыс Қазақстанның нақты жағдайында су қабылдайтын инфрақұрылымы мен тұтқыр құрылымдары бар шағын бассейннің физикалық моделі бойынша жүргізілді. Сонымен қатар жер асты суларының деңгейіне жақын болған кезде инфильтрация ағынын таратуды ескере отырып, ашылатын шөгінділердің жыныстарының сыналған қалыңдығын толығымен қаныққанға дейін судың инфильтрациясының табиғи жағдайлары модельденді.

Түйін сөздер: жер асты суларын жасанды толтыру, инфильтрация бассейні, физикалық модель, тесік, көлемдік ылғалдылық, максималды молекулалық ылғалдылық қабілеті, сорғы, бітеу.

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ИССЛЕДОВАНИЯ ГИДРОДИНАМИКИ ПРОЦЕССОВ ИНФИЛЬТРАЦИИ И КОЛЬМАТАЦИИ В БАССЕЙНАХ СУТОЧНОГО РЕГУЛИРОВАНИЯ ПРИ ИСКУССТВЕННОМ ВОСПОЛНЕНИИ ЗАПАСОВ ПОДЗЕМНЫХ ВОД

Аннотация. В статье приводятся организация, методика и результаты проведенных натурных исследований водно-физических свойств пород покровных отложений в основаниях инфильтрационных бассейнов, а также оценка их влияния на процессы кольматации. Исследования проводились на физической модели минибассейна с инфраструктурой водозаборных и каптажных сооружений на реальном объекте и для реальных условий Юго-Восточного Казахстана. При этом были смоделированы естественные условия просачивания воды до полного насыщения испытываемой мощности пород покровных отложений с учетом растекания инфильтрационного потока при близком залегании уровня грунтовых вод. Полученные натурные характеристики могут быть рекомендованы и приняты в качестве расчетных показателей как на стадии технико-экономического обоснования, так и рабочего проектирования систем ИВЗПВ без проведения дополнительных трудоемких и затратных изыскательских и исследовательских работ.

Ключевые слова: искусственное восполнение запасов подземных вод, инфильтрационный бассейн, физическая модель, шурф, объемная влажность, максимальная молекулярная влагоемкость, откачка, кольматация.

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