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TMF WATERPROOFING COURSE FILTRATION TEST

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The analysis of TMF waterproofing layer filtration properties is carried out. As a result of implementation of underground water sampling and survey, it is found that filtration waters of TMF flow into the underground waters. To find out the cause of contamination and for the detailed survey of the waterproofing course sampling from TMF dam and bottom was carried out, using a rotary drilling machine. Samples were checked in the laboratory, the result of the analysis of the obtained data was investigated, and the main reason of discharge was found.

Keywords: underground waters, filtration waters, piezometer, waterproofing course, particle-size study, clay.

Introduction. During the mining process, the main damage to the environment is made by TMF/ hydraulilc structures designed for keeping mineral particles (concentration tailings). For that reason, the filtration properties of TMF contaminated waters were studied and the reasons were evaluated.

TMF-s in RA are mainly located in fault zones of hillside or combs and are used by one-sided or two-sided dams. According to the type of the building and operation TMF-s can be of three types- operated by a central method, with upstream and downstream [1]. A continuous raise of a TMF dam is carried out by waste rock or in some cases by tails, which are faced outside and in the middle filled by waterproofing course/clay. The waterproofing course of the dam prevents any infiltration from TMF to outside. By the same principles, at the early stage of the project, filling and compaction of the waterproofing course on the bottom of TMF is made.

Conducting experiments and discussion of results. The waterproofing clay course is designed to prevent any filtration of contaminated water from TMF to the underground water basin. To determine its reliabililty a research was carried out in one of the acting TMF in RA – the Geganush TMF. The TMF is operated by the method of upstream water and water-cycling system [2]. From the east and west, the TMF is surrounded by natural slopes, from the north and the south -by artificially erected dams. To study the qualitative and quantitative properties of underground waters at different heights of TMF, different depth piezometers are installed. Studies were made

for 4 (four) piezometers, two for each dam [3]. As a result of the study, the sampling of the piezometer water and a lake, that potentially wasn`t affected by the TMF and is located in the back part of it, was done. In practice, the lake is fed from the same surface water stream as the piezometers. Sampling from piezometers was made by the SOLINST 425 sampling device

Table 1

Results of sampling and chemical analysis of underground waters

N	Determined component	NP_1 Borehole h=30 *m*, *mg/ml*	NP_2 Borehole h=30 *m*, *mg/ml*	NP_3 Borehole h=10 *m*, *mg/ml*	NP_4 Borehole h=10 *m*, *mg/ml*	$N_{L,}$ *mg/ml*
1	NH_4^+	4,9	2,9	13,7	0,30	0,20
2	Na^+	73,03	82,40	113,39	58,55	8,9
3	K^+	36,03	21,03	16,23	0,67	0,95
4	Ca^{2+}	500,9	553,44	396,43	392,50	33,09
5	Mg^{2+}	340,15	251,62	25,92	71,22	9,24
6	Cl^-	11,01	12,01	16,8	13,38	1,75
7	SO_4^{2-}	2611,84	2406,15	1250,66	1104.01	16,16
8	HCO_3^-	271,20	170,50	121,7	274.2	152,20
9	NO_3^-	Not determined	Not determined	Not determined	0,20	0,9
10	Total mineralization	3895,16	3517,15	1966,93	1927,43	221,79
11	pH	6,65	6,56	6,95	6,61	8,36

After studying the data in table 1, it becomes apparent that the impact of the TMF on the underground waters is quite significant and dangerous.We can also notice that the chemical structure of the samples is quite different for the samples of the same area, not influenced by the TMF. Studying the discharge way, it is clear that the main reason for the underground water chemical structure change is the TMF filtration water flow, which, in practice, is treated, but dangerous for penetration into the surface or underground environment. Studying the TMF structure, it is clear that the main ways for discharge are bottom and artificially built dams. But it is also necessary to study, as the TMF's and the dam's construction is carried out at the same time as a waterproofing course filling. Before the construction of TMF, waterproofing clay is filled and compacted on the bottom of TMF, and for the dam –the waterproofing course is filled in the middle of the dam. After finding the filtration water flow into the underground water basin, we can suppose that in this case, the waterproofing course/clay doesn`t fulfil its role, which leads to an underground water pollution. For a more detailed study, and to find the causes of this, sampling of the TMF bottom and dam recultivating clay layer was made. Also, clay sampling of the area, from where

clay as a waterproofing course was taken for the TMF construction, was made. It was possible to take clay sampling from the TMF bottom by the hydraulic rotary drilling method, by drilling about 25 *m* [4]. The obtained results were sent to a statutory licensed laboratory in RA for laboratory analysis. During the laboratory studies, particle-size and pipette analysis of samples were made and particle-size composition of samples was found, and based on that, the soil type was determined [5].

As a result of the particle-size study, the number of particles of up to 0.5 *mm* in diameter was found (according to classifications), and as a result of the pipette study, the percentage and weight of particles of less than 0.5 in diameter in the sample were found (table 2).

The obtained results were compared to the GOST 25100-2011 soil standards, and the class of the sample soil was found.

Table 2

Sampled soil particle-sized and pipette study results

CJSC «Institute of Mining and Metallurgy»			SOIL PHYSICAL PROPERTY TABLE																				
Object					TMF main clay																		
NeNe	Laboratory sample Ne	Working name Ne	Sampling, depth , sl	Sample composition	GRANULOMETRIC COMPOSITION (particle composition), %																GRAIN-SIZE BULK COMPOSITION , %				
					Noddle and gravel				Grit and gravel		Sand					Dust		Clay	Noddle and gravel	Grit and riprap stone	Sand	Dust	Clay
					Particle size , d, mm								0.5÷	0.25÷	0.1÷	0.05÷	0.01÷					0.05÷	
					>80	80÷40	40÷20	20÷10	10÷5	5÷2	2÷1	1÷0.5	0.25	0.1	0.05	0.01	0.005	<0.05	200÷10mm	10÷2mm	2÷0.05mm	0.005mm	<0.005mm
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	1	-	From floor of the TMF (12m)	Ne 1	-	-	-	-	-	-	0.02	1.58	1.84	31.59	42.01	1.64	3.28	18.04	-	-	77.04	4.92	18.04
2	2	-	Native clay	Ne 2	-	-	-	-	-	0.08	0.23	2.23	1.04	3.8	0.03	30.87	14.62	47.1	-	0.08	7.33	45.49	47.1
3	3	-	Surface clay	Ne 3	-	-	-	-	-	-	0.27	7.65	27.17	29.77	2.91	4.6	3.07	24.56	-	-	67.77	7.67	24.56

NeNe	Laboratory sample Ne	Natural moisture	PLASTICITY DESCRIPTION				DENSITY, g/sm^3			Openness %	Openness factor	Full water saturation moisture	Moisture degree				Soil type based on GOST 25100-2011
			Limit of liquidity	Rolling out limit	Plasticity and number	Liquidity factor	Native	Soil particle	Dry soil								
		W	W_L	W_P	I_P	I_L	ρ	ρ_s	ρ_d	n	e	W_{sat}	S_r				
1	2	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	1	18.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Sand-clay
2	2	9.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Clay
3	3	7.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Sand-clay

After the detailed study of the results, it becomes clear that the clay mass used as a waterproofing course, after a long stay under the TMF mass, underwent a physical structure change.

The plausible reason can be a geochemical migration, as a result of which minerals in the TMF mass penetrate through migration into the waterproofing clay

layer and have an impact on the particle-size and chemical structure of the waterproofing course *(fig.)*. It is also shown in the laboratory test results. As a result of the physical structure change, the soil type is also changed, from clay into sand-clay, which means it is not possible to use that soil as a waterproofing course.

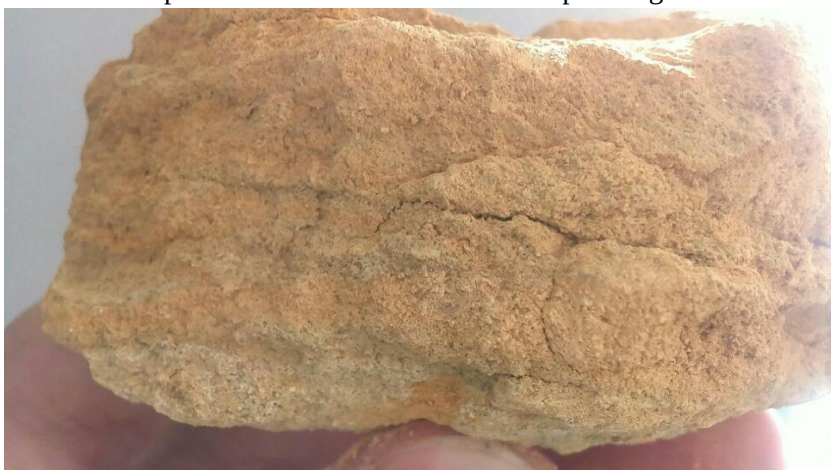

Fig. Waterprofing layer change as a result of geochemical migration

As for the 3rd soil sample in table 2, we can say that it also lost its waterproofing property and it is not efficient to be used as a surface waterproofing course.

Conclusion. The underground water and waterproofing material sampling laboratory test shows that when used as a waterproofing material, the clay on the bottom and dams of TMF during the operation of TMF becomes useless to prevent the filtration process that takes place from the TMF to the underground water basin. That is the reason for the discharge presented in table 1.

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ՊՈՉԱՄԲԱՐԻ ՋՐԱՄԵԿՈՒՍԻՉ ՇԵՐՏԻ ՖԻԼՏՐԱՑԻՈՆ ՀԱՏԿՈՒԹՅՈՒՆՆԵՐԻ ՀԵՏԱԶՈՏՈՒՄԸ

Տ.Ս. Նավասարդյան

Կատարվել է պոչամբարի ջրամեկուսիչ շերտի ֆիլտրացիոն հատկությունների հետազոտություն: Ստորգետնյա ջրերի նմուշառման և հետազոտության արդյունքում պարզվել է պոչամբարից տեղի ունեցող ֆիլտրացիոն ջրերի ներհոսքը դեպի ստորգետնյա ջրեր: Խնդիրն ավելի լայնորեն ուսումնասիրելու և աղտոտման ուղին պարզելու համար կատարվել է նմուշառում պոչամբարի պատնեշի և հատակի հատվածի ջրամեկուսիչ շերտից: Նմուշառումն իրականացվել է՝ կիրառելով ռոտորային հորատման մեխանիզմ: Նմուշները ենթարկվել են լաբորատոր վերլուծության, որի արդյունքում ձեռք բերված տվյալների ուսումնասիրությամբ պարզվել է արտահոսքի հիմնական պատճառը:

Առանցքային բառեր. ստորգետնյա ջրեր, ֆիլտրացիոն ջրեր, պյեզոմետր, ջրամեկուսիչ շերտ, հատիկաչափական վերլուծություն, կավ:

ИССЛЕДОВАНИЕ СВОЙСТВ ФИЛЬТРАЦИИ ГИДРОИЗОЛЯЦИОННОГО СЛОЯ ХВОСТОХРАНИЛИЩА

Т.С. Навасардян

Проведено исследование свойств фильтрации гидроизоляционного слоя хвостохранилища. В результате отбора проб и анализа подземных вод выявлен приток фильтрационной воды хвостохранилища в грунтовые воды. Для более расширенного исследования проблемы и выяснения путей загрязнения осуществлен отбор проб с водонепроницаемого слоя дамбы хвостохранилища и участка дна. Отбор проб осуществлялся с помощью роторного сверлильного механизма. Образцы были подвергнуты лабораторному анализу. В результате анализа полученных данных выявлена основная причина утечки.

Ключевые слова: грунтовые воды, фильтрационные воды, пьезометр, водонепроницаемый слой, гранулометрический анализ, глина.