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EVAPORATION TOXIC WATER AND INFLUENCE OF MAN-MADE OBJECTS ON COASTAL CASPIAN ZONE

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Key words: tailing Koshkar-Ata; evaporation; Waste liquid phase; waste production; phosphogypsum; phosphochalk; inorganic dust; PC "ERA"; radiation risk, the coastal zone of the Caspian Sea.

Abstract. Koshkar Ata tailpiece reservoir is located 5-6 km north-east of the city of Aktau in Kazakhstan and 7-8 km to the east coast of the Caspian Sea. Tailpiece reservoir was formed by dumping production of Caspian Mining and Metallurgical Combine (PGMK) processing complex of uranophosphorus ore, waste water sulfuric acid plant (CPS) and untreated domestic sewage of upper districts of Aktau. The article presents the results of studies of evaporation from the surface of the aqueous phase of the tailpiece reservoir "Koshkar-Ata." Water balance equation counting the absence of entering sewage to the toxic waste pond is compiled. A map of the stray fields of inorganic dust has the effect of summation of exposure.

Introduction. Koshkar Ata tailpiece reservoir is formed by dumping production of Caspian Mining and Metallurgical Combine (PGMK) processing complex of uranophosphorus ore, waste water sulfuric acid plant (CPS) and untreated domestic sewage of upper districts of Aktau. Processing waste dumped in form of pulp into natural drainage basins of Koshkar-Ata. The volume of accumulated waste is 105 million with a total activity of 11242 Ci. During the operation of the tailpiece reservoir discharge of sludge and wastewater exceeded the volume of evaporation. In this connection, the aqueous tailpiece reservoir area increased steadily and in 1992 reached a maximum value of 77, 18 sq. km. In subsequent years, the amount of evaporation exceeds the volume coming into the tailpiece reservoir dumps and water area by 2005 decreased to 33,76 km^2 (Figure 1) [1].

At the same time, revealing a significant part of the dried pulpwaste, forms a "dusty beaches", representing a potential risk to public health of nearby communities. Area polluted beaches, which are a source of toxic dust, more than 20 square meters. km, settle mainly in the southern part of the tailpiece reservoir.

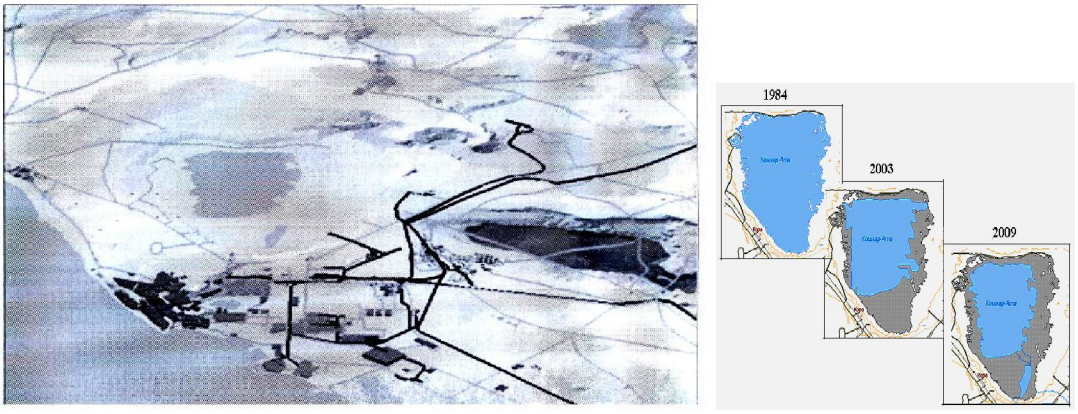

Figure 1 – Overview map of tailing Koshkar Ata overlooking bare in different years, the surface of the aqueous phase

Materials and methods. The liquid phase of waste placed in the pond represents the brine formed for all time as a result of operation of the tailpiece reservoir concentration of mineral salts at constant surface evaporation of accumulated industrial waste. Total mineralization of aqueous phase in 2003 was 168,0 – 200,8 g /dm^3, at the beginning of 2009 amounted to 234,4 – 248,0 g /dm^3.

Production waste reprocessing of uranium-bearing ores – phosphogypsum phosphochalk, granulometric composition is classified as silty suglinok. Chemical waste composition: Phosphogypsum – $CaSO_4$ – 84-92% by weight; Total P_2O_5 – 1,5%; R_2O_5 – insoluble in water - 1,7%, F – 0,3-0,4%, SiO_2 – 2.0%, Fe_2O_3 – 0,5%, Al_2O_3 – 0,5%, MgO – 1,0%, Wednesday – weak acid solutions, Fosfomel – $SaSO_3$ – 80-90%, $CaSO_4$ – 7-13%, the medium – slightly alkaline solution.

The content of ^{226}Ra in the sands – $(2\text{-}3)\cdot10^{-10}$, in sludge – $(10\text{-}13)\cdot10^{-11}$ g/g, waste characterized by elevated levels of radioactivity, caused mainly by the presence of a radioactive isotope ^{226}Ra. Along with the relatively higher content in the liquid portion of the slurry ^{226}Ra mineralization of it is pretty high. While decaying isotope ^{226}Ra formed radon ^{222}Rn, which is released into the atmosphere, forming a short-lived decay products of several subsidiaries. Inhalation of radon ^{226}Ra may contribute to cancer. Radon release rate depends on many factors such as concentration, humidity and waste air and other.

Polluted beaches area which are a source of toxic dust, is more than 20 square meters. km, settling mainly in the southern part of the tailpiece reservoir [2]. Evaluation of Hazard RAO Koshkar Ata tailpiece reservoir health of inhabitants of nearby settlements of Aktau was carried out by the Institute of Nuclear Physics of the National Nuclear Center of Kazakhstan in 2008. In 2009, executed rehabilitation activities of the two radiation hazardous tailpiece reservoir sites located in the southern part of the basin Koshkar-Ata, which ensured the elimination of the current emergency – isolation of radioactive waste at the tailpiece reservoir tamper reduces the area of radioactive contamination of the tailpiece reservoir [3].

The results of a study. To assess the health impact of the dust factor, is important conditions of Mangistau region dry hot climate determine the degree of loss of moisture toxic.

In this regard, in 2012, a research team led by professor Kenzhetaev G.Zh, the budget program "Grant funding for research" of the Ministry of Education and Science of the Republic of Kazakhstan on "Scientific substantiation of research components of the environment of the coastal zone of the Caspian Sea" and man-made objects were work carried out to monitor the evaporation of moisture from the surface waters and soils in the vicinity of the tailpiece reservoir. The object of research is to study the possibility of reducing the loss of water from the remaining tailpiece reservoir settling pond. Water body – the tailpiece reservoir within the cavity Koshkar-Ata with water surface area of about 18 km^2.

The energy potential of the territory, defined by the advent of solar radiation and turbulent heat transfer is very significant – annual values of total solar radiation reaching 6500-7000 MJ/m^2 with a clear sky. From April to September, the total radiation per day varies from 20.4 to 29.7 MJ/m^2. In the area of the weather station of Fort-Shevchenko occasionally were observed evaporation from the water surface by the water-evaporation ponds area of 20 m^2.

The data were used in the analysis of regional values of evaporation from water surface [4]. Annual normal amount of evaporation from natural water bodies for the district is 1200 mm, long-term variability of the annual amounts of evaporation is very low and is Cv = 0,1-0,12.

In the calculations of the water balance depression Koshkar-Ata, on the assumption that the evaporation from the water surface and the land is not limited energy capabilities of the territory, and its moisturizing, to the calculation of the water balance annual precipitation and their distribution within the year are taken.

The transition rate from the rate of evaporation of the annual evaporation of 1% probability of being exceeded is – 1.23 to 95 % - noah – 0.85. Accordingly, the annual values of evaporation from natural water bodies made: P = 50% - 1250 mm, P = 1% - 1538 mm, P = 95% - 1065 mm. Distribution of evaporation by month is shown in Table 1, Figure 2.

Table 1 – Monthly Evaporation from water surface tailpiece reservoir

Monthly Evaporation from water surface tailpiece reservoir (mm), P=50%														
Months												Year	Season	
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		XII-III	IV-XII
25	37	62	100	150	188	200	187	138	88	38	37	1250	100	1150

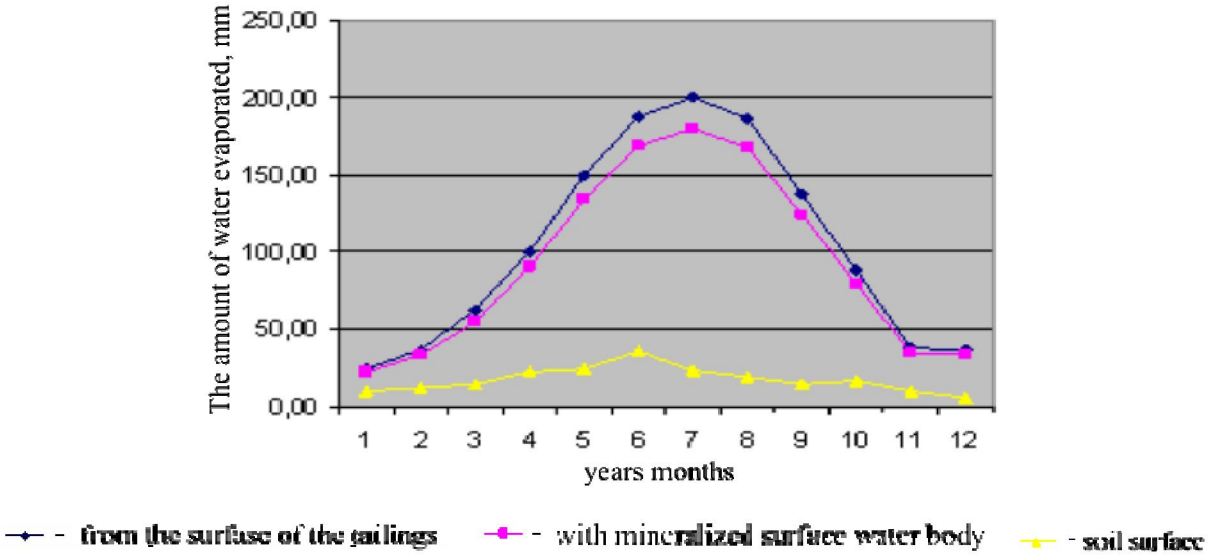

Figure 2 – Number of evaporated moisture from water and soil

For natural reservoirs of the district and, of course, for the tailpiece reservoir high salinity is characterized, which reduces evaporation (table 2, Figure 2).

Table 2 – Evaporation from the surface of the mineralized body of water

Evaporation from the surface of the mineralized body of water P=50%														
Months												Year	Seasons	
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		XII-III	IV-XII
22	33,3	55	90	135	169	180	168	124	79	34	33	1125	90	1035

Because of the lack of information about the magnitude of salinity and water chemistry of the reservoir introduced amendments to the indicative annual amount of evaporation – all years K = 0,9. Accordingly, the annual amount of evaporation of the calculated probability is: P = 50% - 1125 mm, P = 1% - 1384 mm, P = 95% - 959 mm. For rough estimates can be taken in the allocation year for P = 1% and P = 95% for the year, close to the average (P = 50%).

Compared with the evaporation from the water surface evaporation from the soil slightly, as determined not energy potential, and only in the presence of available moisture in the soil surface. Evaporation assessed by actual observations by GGI 500-50 and 500-100 GGR weather stations Fort Shevchenko (field) and Tuschibek. The duration of observations is small, so only defined term average values of evaporation from the soil surface (Table 3, Figure 2).

Table 3 – Evaporation from the soil surface tailpiece reservoir

Evaporation moisture from soil														
Months												Year	Season	
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		XII-III	IV-XII
10	12	15	22	25	36	23	19	15	17	10	6	210	43	167

The calculation of the distribution of evaporation within the year on regional factors reliably made for years of high humidity (P = 50%). Because of the short duration and heterogeneous series of observations of evaporation reliably estimate the distribution of evaporation during the 1% and 95% probability of being exceeded is not possible. In the calculations of the water balance of the depression Koshkar Ata must be based on historical averages of its components.

Regarding the amount of evaporation loss, according to the calculations for the last 15 years, it is – 1,201 m / year. We can assume that the share of seepage water accounts for about 9-10% of the total, while the losses amount to 0,106 height meters, ie 8,8% of the total [4, 5]. Changes in water levels in the reservoirs can be regarded as some of the manifestations global scale.

Based on these studies, we obtained the following expression below. Thus, for the considered settling pond may be true of the water balance equation [5]:

$$\frac{dV}{dt} = \left(\frac{U_b(t)}{S(H)} - E_b(t) \right) \cdot S(t), \quad (1)$$

where V – volume of the reservoir at time t; Ub (t) – the flow of water per unit time; Eb (t) – the visible layer evaporation (Eb = E-P) is lost in a time unit; E – evaporation; P – precipitation; S(t) – the surface area of the pond.

Along with this, given the lack of incoming sewage, water balance equation can be written as follows [6]:

$$\frac{dH}{dt} = \frac{U_b(t)}{S(H)} - E_b(t), \quad (2)$$

where H – the water level in the reservoir at time t; S (H) – the surface area of the water body in determining the value of N.

The success of the study will depend on the accuracy (methotodology) determination of the water balance components, and from asking the change reasons. Not enough study of evaporation determines uncertainty using the water balance equation.

To study the elemental composition of the dust from tailpiece reservoir analyzed samples deposited atmospheric pollutants, selected near the tailpiece reservoir and the background area.

It is found from the surface of the tailpiece reservoir is blown dust, which includes 13 names of pollutants and one group of substances having deleterious effect summation steps: inorganic dust with SiO_2 < 20% + inorganic dust with SiO_2 74,5% (Figure 3). This is obviously due to weather conditions (relatively high air humidity and low wind speed in the observation period) is not conducive to dusting.

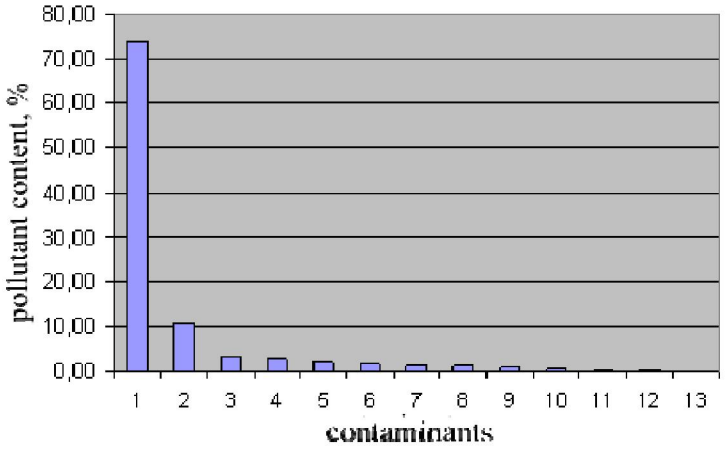

Figure 3 – Composition of fugitive dust from the beach area of the tailpiece reservoir:
1 – inorganic dust with SiO_2 74,05%; 2 – also with a 20% SiO_2; 3 – potassium chloride; 4 – zinc; 5 – iron; 6 – barium sulfate; 7 – manganese; 8 – sodium chloride; 9 – aluminum; 10 – cobalt; 11 – copper; 12 – Nickel; 13 – chrome.

With the interpretation of remote sensing data and contour depiction of the water basin of Lake Koshkar Ata device using GPS satellite positioning status is set to loop the water basin of the lake in August 2012 [7]. To study the long-term propagation of dusting and pollution of tailpiece reservoir with using PC "ERA" a map of the fields of inorganic dust dispersion indicating the contours of MPC was built (Figure 4).

It is established that the dry surface in most parts covered with phospho-gypsum crust that prevents dusting.

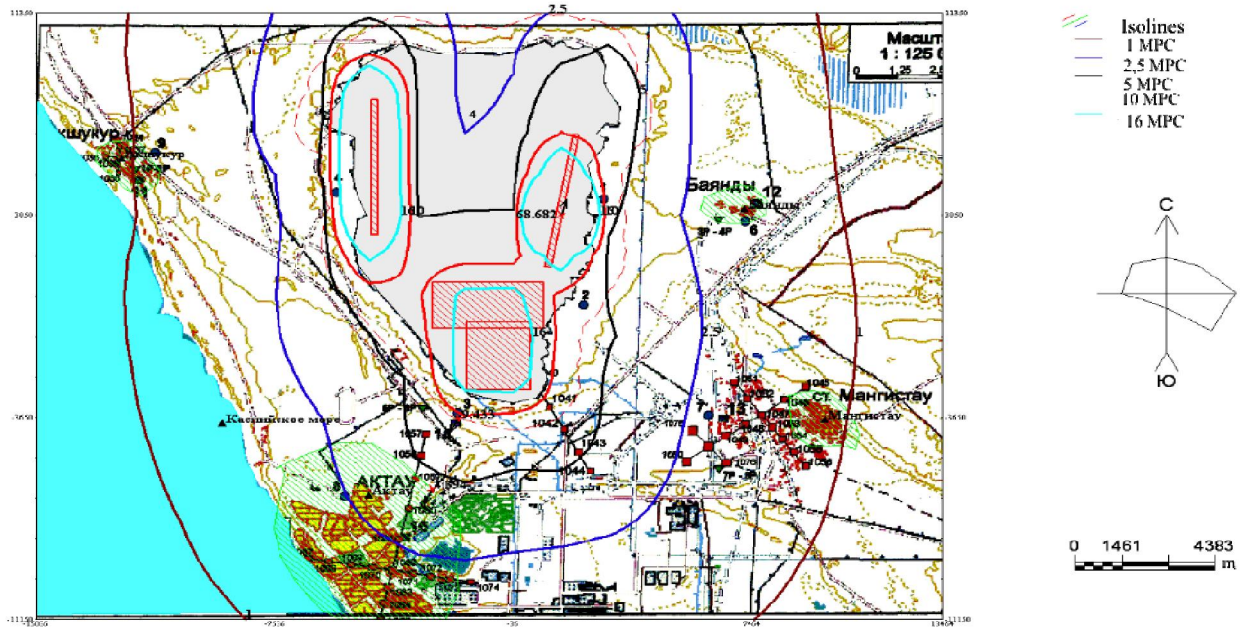

Figure 4 – The fields of inorganic dust dispersion

Conclusion. In any case, there is evaporation of water from the surface of the tailpiece reservoir into the atmosphere, shallowing of the coastal zone, and the exposure of sand to form a fine dust, which adversely affects the human body. With the real possibility of contamination of the coastal zone of the Caspian Sea by shifting wind inorganic dust, since the area of "dusting" of beaches all over increases. In this regard, it is necessary to implement the project for remediation of the tailpiece reservoir area and reduce dusting areas of beaches that will reduce the potential for release of toxic substances and air, respectively, reduce to the lowest possible negative impacts on air, soil, flora of the coastal zone of the Caspian Sea. In addition, the project will reduce the radiation risk factor for the population.

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УЛЫ СУДЫҢ БУЛАНУЫ ЖӘНЕ КАСПИЙ ЖАҒАЛАУЫНА ТЕХНОГЕНДІ ОБЪЕКТІЛЕРДІҢ ӘСЕРІ

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Тірек сөздер: Қошқар-Ата қалдық қоймасын; булану; сұйық фаза қалдықтар; қалдықтарды өндіру; фосфо гипс; фосфо бор; бейорганикалық шаң; РС «ЭРА»; радиациялық тәуекел, Каспий теңізінің жағалау аймағы.

Аннотация. Мақалада «Қошқар-Ата» қалдық сақтау қоймасының сулы фазасы бетінің булануының зерттеу нәтижелері көрсетілген. Улы суайдынына түсетін ағынды есептемей су балансының теңдеуі жасақталды. Зиянды әсердің суммация эфектісіне ие анорганикалық шаңның шашырау өрісінің картасы жасалды.

ИСПАРЕНИЕ ТОКСИЧНЫХ ВОД И ВЛИЯНИЕ ТЕХНОГЕННОГО ОБЪЕКТА НА СОСТОЯНИЕ ПРИБРЕЖНОЙ ЗОНЫ КАСПИЯ

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Ключевые слова: хвостохранилище Кошкар-Ата; испарения; отходы жидкой фазы; отходы производства; фосфо гипс; фосфо мел; неорганическая пыль; РС "ЭРА"; радиационный риск, прибрежная зона Каспийского моря.

Аннотация. В статье представлены результаты исследований испарения с поверхности водной фазы хвостохранилища «Кошкар-Ата». Составлено уравнение водного баланса с учетом отсутствия поступающих в токсичный водоем стоков. Построена карта полей рассеивания пыли неорганической обладающей эффектом суммации вредного воздействия.

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