Assessment of Degmay Uranium Tailing and Remediation Concept

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1. Introduction

The mining industry is one of the basic sectors of the economy in Tajikistan. Uranium mining and milling was an intensive industry in most of the Central Asian countries of the former Soviet Union. Tajikistan has a number of uranium ore deposits and mining and milling facilities, which operated in the past. This country's own ores and imported raw materials were processed mainly at the former Leninabad Geochemical Combine facility (currently State Enterprise (SE) "Vostokredmet") and also at other hydro-metallurgical plants located in the vicinity of uranium ore extraction sites (Adrasman, Taboshar, Isphara, etc.). Presently the only operating enterprise in the Republic of Tajikistan, which still has the potential to process uranium ores using an acid leach extraction process, is State Enterprise "Vostokredmet". There are also 10 sites where uranium residues and waste rock piles are disposed which belongs to the current enterprise.

2. Degmay Uranium Tailing Site

Degmay tailings disposal was in operation during the period from 1963 to 1993. It is located in the Gafurov region on the Degmay hill, 1.5 km away from the nearest settlement (Guisyon) and approximately 10 km from the city of Khujand. This facility is the largest single uranium mill tailings site in Central Asia; it extends over 90 ha and holds about 36 million tons of wastes [1].

Fig.1. Scheme of Degmay tailings in the surroundings of Khudjand and Chkalovsk. Arrows 1 and 2 point place where aerosol samples were taken (Table 1).

3. Gamma Dose Rates and Radon Problem

The surface of tailings is not covered, thus allowing a significant and constant radon exhalation from the tailings. Exhalation of radon-222 into the atmosphere is sufficiently increased in parts of the tailings pond containing significant cracks, some reaching to a depth of over two meters and having a width of 20 to 40 cm. The outdoor radon concentration in the air over the tailings surface during the summer time (under windy conditions) was observed to be in the range from several hundred up to 1000 Bq m^{-3} [2]. In June 2006 exhalation of Rn-222 was found by direct measurements at different places to vary from 10 to 60 $Bqm^{-2}s^{-1}$, which is significantly higher that the recommended safety level in case of covered surface of the tailings in Tajikistan ($1Bqm^{-2}s^{-1}$) [1].

Depending on the meteorological conditions and different atmospheric parameters, the air containing high concentrations of radon and daughter decay products could spread over a distance of a few kilometers from Degmay tailings.

The surface of the tailings is completely dry and is covered with cracks and clefts. The tailings pond is only partially fenced and therefore freely accessible for the local population. The high gamma dose rates was measured [3] on the tailings surface (4.5-20 μSv/h) which are significantly higher than the reasonable safety levels allowed for an area accessible to the general public (table1)

Table1. Gamma-dose rate and Radon exhalation at the Degmay uranium tailing.

Locations (SeeFig.1)	Gamma-dose rate, $\mu Sv \cdot h^{-1}$	Outdoor Rn-222 $Bq \cdot m^{-3}$	*EEVA Rn-222 $Bq \cdot m^{-3}$	Rn-exhalation $Bq\ m^{2} \cdot s^{-1}$
1a	3.9-4.0	102±24	5.2	9.18±2.75
1б	18.0-20	321±68	8.15	65.5±19.7
2a	6.5-7.0	187±36	15.85	50.8±16
2б	4.5-5.0	207±57	12.75	31.4±9.4
Regional background	0,15-0,2	15-20		

* EEVA-Equivalent Equilibrium Volumetric Activity.

Also the minimum and maximum gamma dose rates measured in the two hazardous areas identified at the Degmay site are presented in table 2. In this study, a hazardous area is defined as an area with elevated radionuclide or radiation levels, as compare with the background levels. The values were estimated on the basis of regular measurements carrying out by the monitoring group of SE "Vostokredmet".

Table2. Gamma dose rate range (Sv/h) in hazardous areas identified at Degmay

Hazardous area	Min	Max
Settlement	2.0E-07	5.0E-07
Tailings	4.0E-06	2.0E-05

According to estimation [1] annual dose for population living in nearest settlement (Guisyon village) is from 0.4mSv/y to 2.8mSv/y which external pathway consist of 69%, radon contribution is 29% and 5% is others (Consumed that people do not visit the tailing site).

The generation of the airborne dust from the surface of the tailings is a major concern, as the average wind velocity in the area exceeds 10 m/s. There has been no appreciable groundwater monitoring carried out around Degmay during in more than 10 years (for hydraulics or chemistry). Most of the wells are unserviceable for observation of the contamination movement and will require reconstruction or replacement.

The nearest settlement is a village about 1500 meters away from the tailings dam. The drinking water supply used by the villagers comes from wells. Water from these wells is also used for irrigation purposes. Under these circumstances it would be prudent to evaluate and predict the possible contamination of the ground water in the vicinity of the Degmay tailings pond. The main dam of the tailings pond has no geotechnical monitoring installations and therefore neither data nor calculations of the stability conditions are available.

4. Recommendations for Degmay Uranium Tailing Site

Knowing the current situation of Degmay site, it is necessary to mention some activities which could help initiate remediation process for the site. Nowadays only 25% surroundings of the Degmay site has fence and there is a free access to public and cattle pasture on the surface of the tailing dump, where vegetation has been grown up.

Degmay tailing dump, which is located in 1.5 km distance from the nearest residential settlement, is not covered at all. Therefore, it is necessary to consider a new programme of observations with the focus on the contamination of ambient air (aerosols) and to assess dusting and the effect of wind dispersal on distribution of radionuclides from the tailings through the air.

The existing wells around the tailings pond are unsuitable for reliable monitoring of the spread of the contamination in the groundwater system beneath and around the tailings pond; most of the ground water observation wells are badly damaged and are ill-suited to the observation of contaminant migration; as a result, measurements of contaminated waters cannot be performed. Concerning above mentioned challenges for Degmay site we have some recommendations.

I. One immediate concern is to re-establish a secure fence around “Degmay” tailings.
II. The observation wells around Degmay tailings needed to be reinstated as well as creating new observational monitoring wells.
III. The equipment for further pumping of the observation wells is also required.
IV. The methods for maintenance of the groundwater monitoring network and new programmes for observation should be implemented.
V. In the surroundings of the tailings it is necessary to undertake monitoring of the chemical contamination of ground waters, because the crushed ores, which were disposed of here over a long period of time, have high contents of ionic sulphate (from 0.5 to 20 g/l) [1].
VI. It is suggested to carry out observations on the condition of covers over tailings quarterly.
VII. It is necessary to carry out specialized research and development, design and exploratory and other works on monitoring of social-ecological condition of this site, as well as on demographic public diseases, living in these regions. Until now, a remediation strategy has not been defined for the Degmay site. Therefore it is necessary to develop a project on remediation of Degmay tailings and rehabilitation of the adjacent territory.

One of the most popular decisions is to make cover system for tailings by using as natural as engineer barriers which can provide long term sustain operation and performance [4]. Since Degmay site area is over 90ha, first remediation action could be construction of drainage system. Then HELP (Hydrologic Evaluation of Landfill Performance) program, will be used to designing, evaluate and optimize cover system.

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6. References

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