**Salomov J.A., Mirsaidov I.U., Barotov A.M.**

Nuclear and Radiation Safety Agency, Tajikistan Academy of Sciences, Dushanbe, Republic of Tajikistan

## About necessity of remediation and recultivation of Taboshar districts' tailings.

Taboshar uranium deposit is one of the oldest sites of uranium industry and reprocessing in former USSR. During geological survey in 1926 close to Istiklol city (former Taboshar), relatively high radioactivity was revealed on present territory and in 1927 the physical exploration of uranium-containing zones was completed.

Active extraction of ore was carried out here from 1945 till 1965 yy. Nowadays it is a huge territory with total area of more than 400 hectares covered by surface wastes tailings of hydrometallurgical reprocessing of uranium ores. Disposal complex consists from non-preserved open pit («Factory of barren ores» (FBO)), destroyed industrial buildings and four tailings (Tailing I-II, Tailing III, Tailing IV and tailing of industrial workshop №3), containing approximately **55 million tons** of wastes, from which approximately **12 million tons** are uranium ore's wastes. Total area of four tailing and «Factory of barren ores» is 63 hectares. Besides, balanced-off ores and overburden rocks i.e. ores and rocks unprofitable for reprocessing should be included here as well.

Sarim-Sakhli-Say creek, mine, technical and open pits also belong to contaminated territories.

During many years, wastes materials are distributed along the whole site and square of contaminated territories around these sites are expanding step by step due to atmospheric precipitation, windy and water erosion [1-5].

Istiklol city with population about 12 thousands inhabitants located only in 0.5-4.0 kilometers from tailings' locations places.

Carried out measurements are indicating that average background value of exposure dose rate (EDR) in Istiklol city is about 33 - 35 microR/h, and limits of background fluctuations doesn't exceeds ±0.042 microSv/h (±4.2 microR/h). Drainages of residual acid solutions which fraying out as springs from under disposal sites are representing special problem of disposal complex in Istiklol city. Particularly, springs with extremely high content of ion-sulphates 9200-9600 mg/l and carbonate base ($HCO_3$ - 1800 mg/l) as well as dissolved uranium and other radionuclides of uranium-thorium chain were revealed under tailing I-II.

FBO storage represents a two-million cone-shaped tailing, - waste bank with 40 m with open surface till present and already during 45 years being a subject for windy and water erosion. Dusty overrunning by winds and water carrying-out (by mud streams) of radioactive materials is revealed in 20 km distance downwards by relief of location. Gamma-background dose rate on the surface of FBO tailing is fluctuating from 0.8-1.0 microSv/h on periphery and till 2,2 -3,7 microSv/h in central part.

Tailings 1, 2, 3 and 4 were operated from 1945 till 1965 years and were preserved in 1969. Tailing of workshop №3 operated from 1949 till 1965 years and was preserved in 1975. Dumps of «Factory of barren ores» were operated from 1950 till 1965 years and till the present moment are not preserved.

Staff of NRSA AS RT, SE "Vostokredmet" and IAEA experts carried out radiation monitoring of soil, air, mine and drainage waters of Istiklol city for determination of negative effect of all tailings and dumps on environment and public health. Particularly, samples were taken from three water reservoirs located in industrial site district and from spring located at entrance to the cit and which is used for household water supply. Inside the industrial site, samples were taken from open-pits, drainage waters from gallery №1 and creeks, flowing out under dam of tailing I and II.

Multiple increases over maximum permissible concentration (MPC) is registered practically in all basic parameters of creek's waters coming out to the surface downstream of tailing I-II dam. Besides, these waters are used by local population for household use. Waters of the source used for household use increases MPC by total hardness for 17%, by manganese in 6.6 times. Increase by these indicators connected to chemical and mineralogical composition of rocks drainable by spring till going out to the surface. Manganese as polianite ($MnO_2$) is a good oxidant which facilitates in uranium oxidation till hexavalent condition. In such condition uranium possesses with high migration properties and for this reason is migrated together with drainage waters, it more intensively contaminates the environment [6-7].

Drainage of acid solutions residues which are fraying out as springs from under the disposal sites is urgent specific problem of disposal complex in Istiklol city.

Data analysis shows that waters in Istiklol city district are differ with high content $^{234}U$, $^{238}U$ and $^{226}Ra$. Additionally, open pit waters, gallery drainage and tailings I-II contains uranium isotopes in the amounts considerably increasing **interference levels** which excludes their use for drinking water supply.

It was measured that summary annual radon release is assessed as 24,72x1012 Bq which is considerable value. Ideally it is necessary to stud the impact of radiation doses to public which is unfortunately currently is not done. Currently staff of SE «Vostokredmet» by financial support of the Government of the Republic of Tajikistan and IAEa technical assistance installed 140 track detectors of RadoSys company in residential houses and separate radiation dangerous sites of Istiklol. The purpose of this project is determination of radon isotopes and their decay products impact on public health.

Radon migration with air flow and its radioactive decay inevitably brings to contamination of sites near to tailings by long-life decay products – $^{210}Po$ and $^{210}Pb$. These territories are used by local population for cattle pasture and carrying out the lawn-and-garden sector and by this through the foodstuff chain it brings to additional exposure doses. For reduction of negative factors it is necessary to undertake additional preservation of radiation dangerous sites and remediation of contamination territories.

The results of field and laboratory measurements received during the last years during implementation of international projects (NATO, IAEA, ISTC) with application of modern equipment is evident of the factor that uranium concentration (U) in tailings materials is fluctuating on different depth from 0,01 till 0,03 %. Since tailings were formed by phased placing of spent products of reprocessed ores,

and also due to the primitive technology of uranium reprocessing on initial phase, variations of uranium concentrations are possible depending on rocks bedding depth in tailings.

Radium concentrations ($Ra^{226}$) is fluctuates from 1.4 till 27.5 Bq/g, and average alpha activity - $1{,}4x10^2$ Bq/g. Total alpha activity of «residues», placed in tailings in Istiklol city is assessed as $1.67x10^{15}$ Bq.

Potential radiological risks can become stronger due to possible mud stream on the territory of tailings location. Thus in period from 1998 till 2000 in result of high rains and formation of mud stream, considerable part of materials for HMP tailing № 3 disposal were washed out to the valley of Sarim-Sakhli-Sai creek.

The consequences of material wash out from places of their initial localization in tailings are observed on shores and riverbed of Sarim-Sakhli-Sai creek. Tailings' material is differentiates by specific relatively homogeneous fraction size of reddish color and places of present material accumulation has increased levels of gamma-emission dose rates. In dry riverbed and on re-deposition flood parts of creek, gamma dose rate is till 2.5 microSv/h. Re-deposition are distributed within the whole riverbed of Archi-Sai creek and till mouth and by its inflow to Utken-Suu river.

Condition of other tailings' coverage also causes specific concern. Thus, in accordance with passport data of workshop №3 tailing, located in 1 km distance from residential sector, has a coverage of 0.7-1,0 m of neutral soil.

Factor analysis of radiation danger carried out by IAEA expert mission [1] in Istiklol city revealed that radon content in air and aerosol contamination is not a factor of considerable radiation risk for city residents, besides cases of their visit to tailings and living of people directly within zones of their location since territory is well aired out. However, due to bad coverage of tailing, drainage waters draining from zones of their location are highly contaminated by radionuclides and contain high concentrations of manganese, sodium, lead and iron. Drainage waters of former flooded uranium mines and open pits are also considerably contaminated. Such contaminated waters are used all over by local population for cattle watering, watering of garden territories and even for drinking.

Thus, the use of drainage and mine waters with high contamination level for drinking and household needs in Istiklol city by local population in general with high radionuclide contamination content on the surface of uranium tailings, in zones of dumps location and former uranium open pits where local population has a free access for cattle pasture and other needs can lead to increase of limit dose for public which is 1 mSv/year [1].

That's why, an approach is necessary for finding sustainable solution of Taboshar district's tailings remediation and its water resources which involves tailings remediation taking into account social and medical aspects of public life who are living in these territories. For this purpose during almost 2 years the UNDP project "Strengthening of coordination on projects development and resources mobilization for sustainable management of radioactive wastes in Central Asia" carries out work on ordering ideas and resources, using program approach for problem assessment and elaboration of necessary solutions. Currently the current project seeks donors for feasibility study funding on carrying out the remediation

and recultivation works on complex restoration of Taboshar district. Feasibility study will allow assessing the problem scale in Istiklol city including determination of zones which are subject to contamination, restoration criteria establishment on the basis of dose rates and determination of their impact on public health, equals to, either to ecology or economics of district as well as degree establishment of contaminated substances distribution by means of such critical conductors such as water and wind.

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