



## General review of the state of uranium milling tailings in Ukraine

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The mining and milling of uranium ore are produced in Ukraine since 1948. During this time eleven tailings were formed at the large territory in the region of cities Zhovty Vody and Dnepropetrovsk. One tailing is now in operation. Other ten tailings are under conservation and are producing environmental impact of different extent. Any of tailings was not subjected to recovery. By means of the enterprises, which have on their territory tailings, the monitoring is carried out for radionuclides coming in underground waters. The samples of underground water are taken from wells that are located at the tailing perimeter. The list of tailings, quantity of stored material, and radionuclides activity are submitted in the table

Following table shows the list of tailings, quantity of stored material and radionuclides activity.

TAILINGS NAME	OPERATION PERIOD	OCCUPIED AREA, $\cdot 10^3 \text{ m}^2$	SLUDGE MASS, $\cdot 10^6 \text{ t}$	GENERAL ACTIVITY, TBq	DOSE RATE, mGy/h
West	1951–1954	60	0.7	181	21.8
Tzentralny Yar	1949–1954	24	0.2	103.6	38.4
Southeast	1956–1980	18	0.3	66.7	20
D	1954–1968	73	12	629	11.3
Lanthanum fraction	1965–1988	0.6	0.0066	133.2	26.2
DP-6	1982–1982	2.0	0.04	333	23.5
C-first section	1968–1983	160	15.4	684.5	13.9
C-second section	1983–1993	390	7.4	296	4.4
Storehouse C	1960–1991	250	0.3	444	41
KBG	1964–1991		19.3	999	0.17
Sherbakovsko	From 1959	2250	43.2	2220	0.88

The supervision shows, that all tailings to some extent are the issue of radionuclides diffusion. The brief characteristic of the largest tailings is submitted below.

Most of tailings are located in natural folds of a region relief, however one of them (KBG) is arranged in career with depth 60–65 m. Iron ore was mined in this career and career is located on distance 2.5 km from an inhabited zone. Career was not equipped by anti filtration barriers before it was started to fill it with sludge. In total  $12.4 \cdot 10^6 \text{ t}^3$  of tails is placed in it with general activity about 1 PBq. When tailing's filling was finished at 1991 its surface was covered by 1,7 m layer of loamy soil. The tailing creation resulted in change of hydro-geological conditions of a platform and in appearance of man-caused water-bearing horizon. The halo of pollution of underground waters is moving from the bounds of the site towards the inhabited zone of Zhovty Vody city. Now polluted by radionuclides water is detected at the distance of 1.5 km from tailing. According to forecast estimations in 15 years the pollution will move forward from tailing to distance 2.4 km, i.e. will reach the bounds of an inhabited zone of city Zhovty Vody.

Large threat is posed by tailing "D", that is located in Dneprodzerjinsk city on distance of 1.5 km from the Dnieper river and is containing  $5.84 \cdot 10^6 \text{ m}^3$  of sludge of uranium mining with general activity 630 TBq. The tailing "D" is covered by phosphogypsum, which general weight is  $12 \cdot 10^6$  tons. The tailing "D" dam is made from material of final tailings of chemical recovery production and its operating conditions are not properly surveyed. Meanwhile, water samples from wells in the area of tailing "D" location have the concentration of Ra226 from 1.59 Bq/l till 5.55 Bq/l. Dose rate, that was measured tightly to one of water samples, was 13.1 mGy/h. Underground waters in area of tailing location flow in the direction of the Dnieper river.

One tailing is in operation — Shcherbakovsko, that is located in 1.5 km to the south of Zhovty Vody city. Shcherbakovsko tailing is located in a natural gully. Its first section was filled in 1959–1980 years and occupies the area  $890\,000 \text{ m}^2$ . The second section is in operation from 1979 and occupies the area  $1\,390\,000 \text{ m}^2$ . In total  $27 \cdot 10^6 \text{ m}^3$  of tailing sludge is stored with general activity 2.22 PBq. Any works for its first section conservation are not carried out. The operation condition of a dam of tailing is under control and each year the works for dam strengthening are carried out. Nevertheless, the part of water is filtering through a dam into underground water horizons. Now halo of pollution of underground waters moved from the tailing to distance 1.8 km and, according to forecast estimations in 15 years this distance will be 3 km.

Tailing "C" also is located in a natural gully and consists of two sections. The first section was filled in 1968–1983 years and occupies the area  $160\,000 \text{ m}^2$ . The second section is in operation since 1983 and occupies the area  $390\,000 \text{ m}^2$ . In total  $12.2 \cdot 10^6 \text{ m}^3$  of tailing sludge is stored with general activity 98 PBq. Four settlements are located near tailing at distance 1.0, 1.0, 2.0, and 3.5 km. Distance up to the Dnieper river is about 4 km. In underground water samples from wells in the area of tailing "C" location Ra226 is detected in amount exceeding background meanings 10 times and the greatest Ra226 contents is detected in a well on a bank of the Dnieper river.

In Ukraine the State program for contaminated areas decommissioning and recovery is adopted. However, in view of suffered by Ukraine economic crisis, this program is suspended. Moreover, the scope and volume of carried out monitoring is insufficient for fulfilling of correct estimation of tailings environmental impact and for correct estimations of the contribution of radiating pollution into public exposure.