Translation from Russian.
Report on the VIII International Research and Practical Conference “The topical issues of the uranium industry” August 3-5, 2017, Astana, Republic Kazakhstan

TRIAL PRODUCTION AND TESTS FOR LEACHING URANIUM FROM "KAMYSHANOVSKOE" URANIUM DEPOSIT

Evteeva L.I.[1], Savenya N.V.[2], Khokhlov S.V.[3].

1 – “Information Research Center LLC”, Kyrgyz Republic
2 –“Ural Geotechnological company Ltd”, Ekaterinburg, Russin Federation
3– CJSC “IMC Invest”, Kyrgyz Republic;

The Kamyshanovsky U deposit is located in the Sokuluksky district of the Chui oblast of the Kyrgyz Republic, near the village of Kamyshanovka, 65 km from Bishkek and 85 km from the city of Karabalta (Fig. 1). The exploratory and exploration work on Kamyshanovsky Square is carried out by CJSC IMC Invest company since 2006, in accordance with the license of 2276 MR issued by the Agency for Geology and Mineralogy of the Kyrgyz Republic.

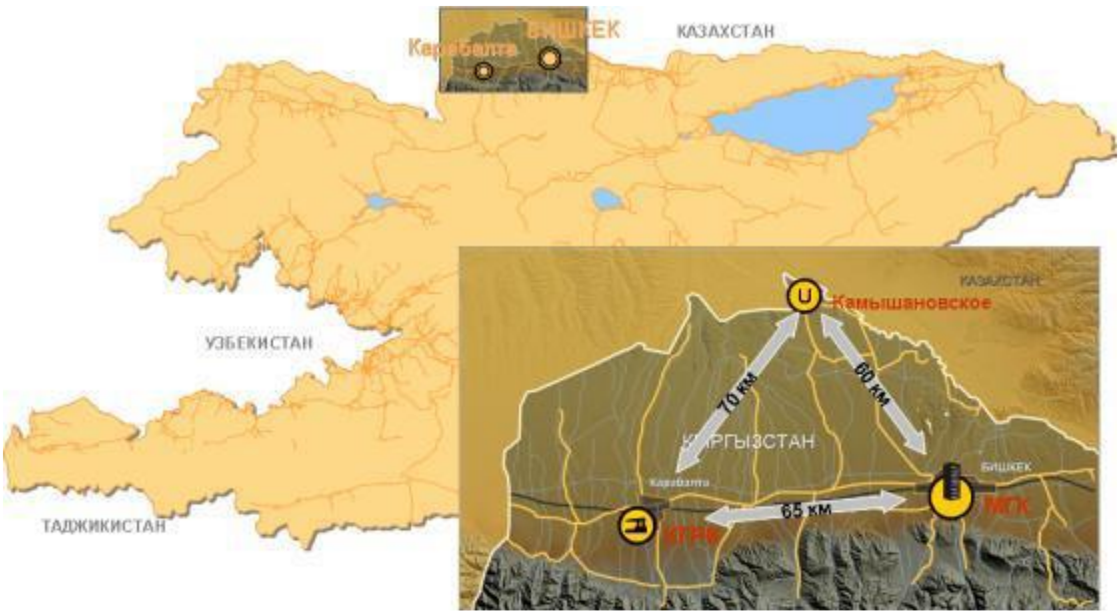

Fig.1. Schematic map of the location of the Kamyshanovsky deposit

The deposit has a sedimentary genesis and belongs to the class of exogenous soil-infiltration deposits. The formation of peatlands and, accordingly, the deposition of uranium in them began almost simultaneously with the onset of the formation of floodplain bogs on I and II above-flood terraces, presumably in the Pleistocene-Holocene, i.e. about 10 - 15 thousand years ago. Due to the "youth" of uranium-bearing ores, there are practically no nuclear decay products in them, and as a consequence, they are characterized by relatively low gamma activity, rarely exceeding 30-50 microR / h.

In the transverse profile of the deposit (Fig. 2), peaty, ory-peat and silt interlayers from the south to the north regularly change each other. On the southern margin of the deposit, pure or slightly silted peat is predominant, whose thickness in some places reaches two or more meters. They are located directly at the base of the third terrace and fill the deeply embedded sections of the paleo-oil on the outside of the bend of the river, i.e. her former arrow.

The rocks lying between peat interlayers are represented in the southern part by dark gray to black silty peats and muds, which are replaced in the north with silt containing less and less organic impurities.

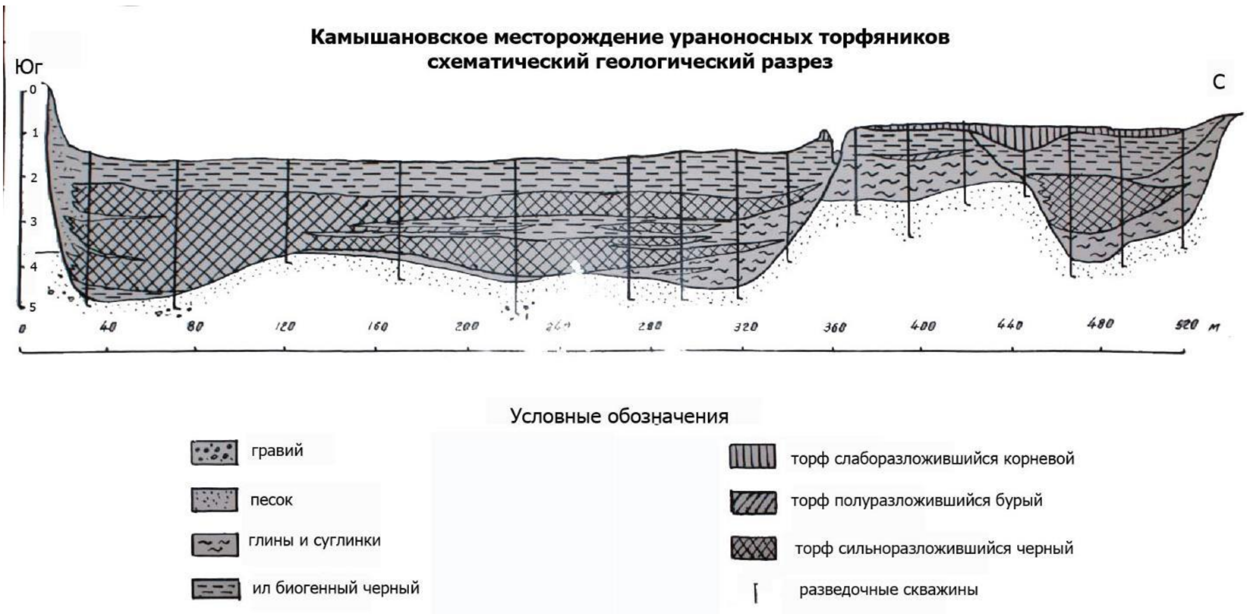

Fig.2. Schematic geological section of the deposit

Uranium reserves, calculated by Saint Barbara in accordance with JORC standards, are estimated at 2288 tons.

As a result of numerous studies, it was originally planned to develop the Kamyshanovsky deposit by the method of open peat extraction with preliminary drainage of the deposit and subsequent enrichment with physical methods (gravity enrichment, incineration, pyrolysis with gasification), uranium leaching from the resulting concentrates to obtain a "yellow cake", refining to commercial grade product - nitrous oxide of uranium. Preliminary economic evaluation of the development of the field showed a large capital intensity of the construction of a mining enterprise with high operating costs and relatively low profitability.

In 2015, a complex of works was carried out to assess the possibility of in situ leaching of uranium with subsequent sorption operations for ion exchange, desorption and the production of "yellow cake".

Preliminary hydrogeological studies performed on two wells showed satisfactory filtration properties of uranium-bearing peat: the average filtration factor K was 1.76 m / day with fluctuations from 0.30 to 2.18 m / day.

As a result of laboratory studies on percolation leaching of uranium by solutions of sulfuric acid, carbonates and bicarbonates of sodium and ammonium, the carbonate leaching regim When choosing the location of the site for conducting experiments to determine the main filtration parameters of ore-bearing peat bogs and the experimental cell for carrying out field experiments on leaching, the main criteria were the lithological structure of the section and its thickness, the average content of the extracted useful component and the expected filtration properties of the ore-bearing rocks. The southern band of distribution of uranium-bearing peatlands was chosen as the main one, as the most studied, whose resources are estimated according to the highest category Measured. It is from this part of the field that it is planned to begin its development. The leaching process: (Na_2CO_3) was chosen by chloride-carbonate solutions (soda).

The basic scheme of uranium in situ leaching included:

- supplying solutions of soda of a given concentration to the body of the peat deposit through a system of workings (trenches and boreholes), including a set of technical methods and means for subsoil feeding, control of movement and lifting solutions to the surface, due to hydrogeological features of the deposit;
- leaching of uranium as the leaching solutions move from the pumping workings to the pumping out;
- lifting to the surface of productive (uranium-containing) solutions through a system of pumping workings (trenches and wells);
- extraction of uranium from productive solutions to the sorbent;
- reinforcing the mother liquors with soda and feeding them to the bowels for leaching.

The experimental cell was a closed isolated rectangle with dimensions in the axes of 8x15 m. On the perimeter of the cell, an excavator traversed an annular trench with a depth of 2.5-2.6 m and a width of 280 mm (Fig. 3). The depth of the trench was determined by the thickness of the peat. The trench is passed to the ooze, strictly not reaching the underlying alluvial deposits (sand, gravel). For this, wells were drilled at the corners of the trench and the thickness of the peat was accurately determined.

After penetrating the trench, its outer perimeter was laid, including the bottom, with a polyethylene film 100-200 microns thick. To lower the film into the trench, its bottom was loaded so that it does not float, with nails of 150 mm through 300-400 mm. The film was bent to the outer side of the trench and sprinkled with peat, taken from the trench. After lining the outer side of the trench with the film, corners and in the middle of the long sides of the trench, perforated pipes with a diameter of 110 mm were installed, acting as pumping wells. In the center of the cell, a pumping well-trench was built (Fig. 4).

Fig.3. Construction of the experimental cell

The hardware diagram of the whole complex included:
- pumping in and pumping out wells;
- pump for lifting productive solutions from a pumping well;
- sorption column with anion exchanger;
- buffer capacity of process solutions;
- capacity of soda solutions;
- dosing unit for leaching solutions with pumps;
- piping system with shut-off and control and monitoring equipment.

To provide the pilot section with electric power, a mobile diesel power station was used.

а в

Fig.4.Technological wells: a – injection well; в – pumping out well.

Before carrying out the tests, all the wells were pumped by an elevator to "light water". The discharge of pumped water was made to the nearest drainage channel. After pumping and establishing static water levels in all wells, a central pump was pumped out with a submersible pump at maximum flow. The buffer tank and tanks (IBC containers) for the preparation of solutions were filled with pumped water. The pumping was performed until the water level in the central trench dropped to the bottom of the peat deposit. At the same time, excess water was also discharged to the nearest drying channel. By bypass, the flow rate (flow) of water from the central well has been adjusted so that the dynamic water level in the well stabilizes at the level of the bottom of the peat deposit - 2.7 m. The discharge rate is 0.8 m3 / h. The hydrogen index in the evacuated water was pH = 7.60. The pH was measured by the ionomer Hanna HI 8314 with a temperature compensator.

During the tests, the feeding of leach solutions into the test system of the test cell was carried out through 6 injection wells. The injection rate was measured by the calibrated capacity and the stopwatch for each well by summing the partial measurements. Leaching solutions by means of valves were evenly distributed along the wells. The injection was fed 0.8 m3 / h, i.e. pumping and pumping worked in the balance. The leaching solution was prepared by feeding a strong solution of soda into the casting line. The concentration of soda in the leach solution was maintained at 30 kg / m3.

The pumping in and out of technological solutions continued uninterruptedly. In this case, the pH value was measured in the pumping (productive) solutions with a frequency of 3 h. In addition, two times a day at 9:00 and 21:00 samples of productive solutions were selected for measuring the residual concentration of soda and the concentration of uranium.

The productive solutions were sent to a sorption column loaded with anion exchanger AB-17-8. The sorbent was in a swollen state. The weight of the anion exchanger loaded into the column was 42 kg, or 21 kg in terms of dry weight. The productive solution was supplied from below to top, the resin was in the state of the clamped layer, i.e. did not mix.

A day after the leach solution was supplied to the subsoil in the productive solution, uranium concentrations of 4.13 mg / dm3 were detected, the concentration of soda was 8.5 mg / dm3, pH = 9.5. Further, the concentration of uranium rose steadily and reached 11, 81 mg / dm3 on day 3. At the same time, the hydrogen index of the solution reached a value of 10.2.

In total, 168 m3 of productive solutions (PR) with an average uranium content of 13.66 mg / dm3 were supplied to the sorption column during the experiment. Of the productive solutions, 1.9 kg of uranium was extracted to the sorbent with an average recovery of 0.19 kg / day. The content of uranium in the sorbent was 58.3 kg / t in terms of dry or 42 kg / m3 in terms of wet sorbent. These data are close to the total dynamic exchange capacity (PDOE) of the anionite AB-17-8.

Desorption of uranium was carried out with a solution of ammonium nitrate of concentration 2M. A desorbate with a uranium content of 4.6 g / dm3 was obtained. The extraction of uranium into the desorbate was 98.1%.

To obtain the "yellow cake", peroxide deposition was chosen, since the solubility of ammonium-uranyl tricarbonate is about 13 g / dm3 (6 g / dm3 for uranium), and uranium peroxide is practically insoluble.

As a result, the following concentrate was obtained:
the uranium content is 60%
Fe <170 ppm
Cu <60 ppm
Zn <250 ppm
The rest of the elements were not found.

Conclusion

For the first time in the world successful experience was gained in extracting uranium from uranium-bearing peat bogs by in situ leaching.

The principal possibility of using this method for mining such deposits is shown and proven.

The method of in situ leaching of U from ore for the Kamyshanovsky U deposit considered the most economical.

ircenter@inbox.ru
savenyanv@mail.ru
office@imcinvest.com