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Chemical Predictive Modelling of Trace Elements Leaching from As-bearing Tailing Impoundment (Khovu-Aksy, Rep. Tuva, Russia)

Olga Gaskova (gaskova@uiggm.nsc.ru)[1] & **Elizaveta Bortnikova**[2]

[1] Institute of Mineralogy and Petrography, SB RAS, Novosibirsk 630090, Russia
[2] Novosibirsk State, University, Novosibirsk 630090, Russia

Co-Ni arsenide ores in carbonate veins of Khovu-Aksy deposit are one of the best in the world. The plant "Turacobalt" had been put into operation in 1970. Process flowsheet provided leaching of Co, Ni and Cu by ammoniac-carbonate autoclave method. Final product was cobaltic concentrate (8-12% Co, 8-20% Ni, 3% Cu). The processing of ores was stopped in 1991. Storage places of hydrometallurgical tailings are 5 pond reservoirs and 10 trenches that contain 2 mt of solid material reach in arsenic (3.5-6.4%), cobalt, nickel, copper (on the average 0.1%). They are dry nowadays and plants cover only two of them. The identification of present situation and the development of strategies to long-term cost-effective control of environmental pollution after closure of plant and mine have to be made. The goal of chemical modelling was to elaborate an approach, which minimize the level of details required to make predictions within a required level of certainty. The simplest experiments at ambient conditions were performed with field-sampled material from 4 and 5 tailing ponds. Static chemical modelling (water/rock ratio was equal to 1/5) and a single pass, continuous-flow system (tailings solids charge was comprised of 35 g of sample and the flow rate was set at 25 ml per day) have been used. Duration of the leach in the first case was more than 100 days and approximately 50 days in second one; output analysis – pH, Eh control, and atomic absorption spectroscopy for Co, Ni, Cu, Fe and As. During static experiment with distilled H_2O as a solvent, the of the final solutions were 8.4-8. Arsenic was registered on 28 day, after 144 day its conductivity concentrations were 10-12 mg/l that exceeds maximum permissible concentration for drinking water up to 200 times. During static experiment with 10% NH_4OH that is close by technological solution, exceedingly high concentrations of As (81-85 mg/l) were determined. It means that any accident discharge of technological solutions (although purified from As by the precipitation with MgO) can bring As in surface and ground water once again. During the experiments in continuous-flow system with slightly acid nitrate solution ($pH_{init.}$ = 3) and slightly alkaline one (NH_4HCO_3 with $pH_{init.}$ = 7.9), the of final solutions were 8.4±0.3 and 9.1±0.2 accordingly. Concentration of arsenic in the first case increased up to 16 mg/l on 14 day and then was practically unchangeable, i.e. system condition can be determined as quasi-equilibrium one. Arsenic concentration in ammoniac-carbonate solution gradually goes up to ~20 mg/l on 35 and was the same to 50 days. The unexpected sharp increase up to 43ml/l was on 51-57 days. The results of two sets of experiments have yielded the following conclusions: 1. The intensive leaching of As from "Turacobalt" tailings by all types of modelling solutions have been shown. The relative rate of As release into leachates was established as acid nitrate solution>distilled water>slightly basic solution. At the same time, namely basic solutions contain maximal As concentration. 2. The conservative behaviour of heavy metals (Fe, Co, Ni, Cu) have been detected that is in a good agreement with known fact of their immobility in carbonate-buffered solutions.