

Extraction of uranium from low-grade uranium ores in Poland

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In January 2014 Polish Government adopted the Program of Polish Nuclear Energy [1]. One of the objectives of this Program is the assessment of domestic uranium deposits as a potential source of uranium for Polish nuclear reactors. Presently, mining of Polish low-grade uranium ores is unprofitable. However, studies on the prospects of recovery of uranium from domestic resources are in progress, keeping in mind the inevitable growing uranium demand and perspectives of the global uranium market.

The most perspective deposits are in the Lower Ordovician Dictyonema shale of Podlasie Depression (North-East Poland) with uranium concentration of 75-250 ppm and the Lower and Middle Triassic rocks of the central parts of Peribaltic Syncline, where concentrations reach 1.5% U (recent analysis of archive samples).

Uranium usually is accompanied by other rare metals e.g. V, Mo, Ln, Ag or Co that can be recovered in technological process to improve the profitability of the whole venture.

The characteristics of the material originating from uranium ores vary significantly from deposit to deposit. The effect of ore mineralogy and mineral liberation on the leaching behaviour of uranium is not well defined. The procedure of uranium extraction must be designed to fit specific characteristics of the ore; however the general scheme of the process is similar for most of the ore materials [2].

The main objectives of this research were: to assess the possibility of exploitation of uranium resources in Poland, and to work out methods of uranium extraction from the ores to produce yellow cake –U₃O₈.

In the present work at the beginning of the extraction process, uranium was leached from the ground ore by using sulphuric acid or carbonate (CO₃²⁻) solutions [3]. In comparison with acid processing, alkaline leaching had the advantage of being selective for uranium. The post-leaching solutions were concentrated and purified using solvent extraction or ion exchange chromatography. Novel systems for solvent extraction were tested [4] and the use of new extracting agents were considered [5]. The precipitation of ammonium diuranate or uranium peroxide forms was the most crucial step in the production of uranium oxide. This is followed by calcination step forming U₃O₈. The preliminary economic assessment of the technology employing several stages of processing, carried out in the pilot-scale installation was done on the basis of the data collected in laboratory-scale experiments.

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