

Recovery of uranium and accompanying metals from various types of industrial wastes

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On January 28th 2014 the Program of Polish Nuclear Energy was signed by Polish Government. According to this program Poland has to secure a constant supply of uranium for Polish NPPs in the future. Uranium in Poland occurs in Vistula Spit area in sandstone rocks and Podlasie Depression area in black dictyonema shales, which are low grade ores. Scarce uranium resources stimulate interest in its recovery from secondary resources as potential raw materials. Industrial wastes and by-products were considered as a source of uranium in this studies. Apart from uranium other valuable metals (e.g. vanadium, molybdenum or lanthanides) were recovered to improve the economy of the process. Three types of industrial wastes were examined: flotation tailings from the copper industry, phosphoric acid from the fertilizer industry and fracturing fluid from shale gas exploitation.

Metals from flotation tailings were separated in two steps: 1) acidic leaching of the flotation waste using sulfuric acid solution and 2) separation of metals by ion-exchange chromatography. All the liquid samples were analyzed by ICP-MS method to determine the separation efficiency of the process.

Uranium was recovered from phosphoric acid by high-pressure membrane filtration or by extraction/stripping integrated processes applying membrane modules Liquid-Cel® Extra-Flow (Celgard).

Aqueous solutions after hydraulic fracturing are very diverse in terms of chemical composition, depending on borehole and fracturing technology applied. The content of various substances in backflow fluid depends on mechanical behavior and chemical composition of shale. Organic matter content in this type of waste did not exceed 1% usually, but the salinity is high. Initially, organic pollutants were removed and next the fluid was purified by combined various ion-exchangers. Individual metals were selectively eluted from ion-exchanger by combination of different eluents. The content of metals in samples was analyzed by ICP-OES. Organic matter was analyzed by TOC method.