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Management of radioactive solid waste generated during mining and milling activities; radiological assessment towards sustainable near-zero-waste approach

NMA-Egypt conducted extensive exploration programs for the discovery of radioactive and nuclear raw materials. Several, uranium occurrences were discovered such as El-Erediya, Egypt. Accordingly, the discovered uranium ore materials are subjected to mining and processing activities, because of these activities, different types of solid wastes are obtained. The disposal of large quantities of waste produced in mining and milling does have environmental risks. Driven by the strategy of the Zero-waste concept, Co- and by-product recovery of uranium and related elements, reuse and recycling of wastes, and reprocessing of resource ingredients from radioactive wastes could be one effective solution for the global challenge to provide uranium resources for humanity well into the 21st century. In this contribution, the citric acid solution was effectively applied for the recovery of uranium as well as rare earth elements (REEs) from the solid residues that were generated during the various activities at the El-Erediya uranium deposit. Radiological assessment for El-Erediya radioactive solid residue before and after the citric acid leaching process was investigated. The activity concentration of radionuclides ^{238}U , ^{226}Ra , ^{232}Th , and ^{40}K maintained in the solid residue before and after the leaching process was measured using a Gamma-ray spectrometer. The environmental radiation impact and radiation hazard indices factors for El-Erediya solid residue samples before and after the leaching process were detected. The obtained results showed that treating the solid residue with citric acid will generate valuable and critical elements such as uranium and REEs, as well as an environmentally safe solid residue. This means that means the final residue after the leaching process will not need specific radiation protection precautions before discharge into the environment.

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