Uranium and REE recovery from Florida phosphates – Looking back and going forward

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Uranium recovered during the production of phosphoric acid represents a significant source of nuclear fuel as the gap between uranium supply and demand is expected to grow. The phosphate industry in Florida supplied uranium to both the defense and energy sectors in the past, but market conditions ended the recovery process. Currently, the uranium is retained in the phosphoric acid and the granulated fertilizer products, diammonium and monoammonium phosphate, and dispersed on farm fields as a trace element in blended fertilizers. This represents a loss to the nuclear fuel cycle that will never be recovered. In an era of heightened awareness of sustainability and increasing pressure to reduce greenhouse gas emissions, market conditions and social factors may converge to create favorable conditions for uranium recovery to resume. However, the future may not resemble the past as uranium concentrations are lower in the newer mining areas and ion exchange challenges solvent extraction for the extraction technology of choice.

New factors will also influence both the economic decision to resume recovery operations, as well as the recovery technology. Rare earth elements (REE) are also present in the processing streams at recoverable levels, and can be co-extracted with uranium using the proven solvent extraction method. REE are vital to the phosphor industry, green energy development, and technology advances in many fields. However, the world has limited REE resources, and the recovery of REE from many of these resources is both economically challenging and environmentally troublesome. Phosphate as a secondary REE resource has a great potential to fill this gap. World annual phosphate rock production has surpassed 200 million tons, representing 60,000 tons of unrecovered REE assuming an average concentration of 300 ppm. In the case of Florida, REE in the phosphate ore reports to four mining and processing streams, with approximately 10% to flotation tailings, 30-40% to waste clay, 35-40% to phosphogypsum (PG), and 15-20% to phosphoric acid. Due to the concern about disposal of thorium-containing wastes, the Florida phosphate industry stepped back from their effort to recover REE from flotation tailings in the past. Now there is even greater concern about potential disruption of the REE supply, such that the government, industry, and academia are partnering to develop economical extraction technologies. At the same time, we must develop recovery flowsheets that adhere to the regulatory framework of the US EPA for phosphogypsum management due to its radium content, and the US Nuclear Regulatory Commission for uranium as U3O8 prior to enrichment, and thorium that could approach or exceed the concentrations meeting the “source material” definition.