RECOVERY OF RARE EARTHS AND P FROM A PHOSPHATE FLOTATION TAILS

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Phosphate ore is one of the most significant secondary resources for rare earth elements (REEs), and Florida phosphate is of particular interest due to its much higher ratio of heavy REEs, especially yttrium. Analyses of numerous samples from different phosphate processing streams in Florida showed that heavy REEs account for about 50% of the total REEs in Florida phosphate with yttrium accounting for approximately 30%. It was estimated that the amount of yttrium from US phosphate processing could meet the world demand for this critical element.

This research aimed at recovering both REEs and phosphorus from a phosphate flotation tails. This tails is composed of mainly silica and phosphate with a small fraction of heavy minerals including monazite and xenotime. Since the specific gravity of silica is 2.6 versus 3.2 for phosphate and 4.5-5 for rare earth minerals, pre-concentration of the minerals of interest by gravity separation was investigated first. A pilot scale shaking table was used in this study. One pass gravity concentration achieved a shaking table concentrate analyzing over 600 ppm REEs at about 40% recovery. Flotation of the shaking table concentrate resulted in a product containing 1809 ppm REEs and 26.37% P₂O₅ with corresponding recoveries of 73% and 82%.

Sulfuric acid leaching at 75°C could recover over 60% REE and nearly all the P₂O₅. Higher REEs (>90%) recovery was achieved by conducting leaching at higher temperature with concentrated sulfuric acid. The phosphoric acid from leaching of the flotation concentrate is of superior quality compared with that generated from regular phosphate rock.