

## RECOVERY OF RARE EARTH ELEMENTS FROM PHOSPHATE ROCK BY HYDROMETALLURGICAL PROCESSES-A CRITICAL REVIEW

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Generally, phosphate rock contains about 0.05wt% rare earth elements (REEs) on average. And the world commercial phosphate rock production is estimated to be 250 million tons per year, which makes phosphate rock a potential new REEs resource. However, low content of REEs in phosphate rock leads to the technical challenges and cost overages that hindered the commercial recovery of REEs. In this paper, an overview of achievements aiming at solving the challenges is given. Based on the decomposition processes of phosphate rock by  $H_2SO_4$ ,  $HNO_3$ ,  $HCl$ ,  $H_3PO_4$ , various REEs recovery processes via crystallization, precipitation, solvent extraction and ion exchange methods are systematically reviewed. In  $H_2SO_4$  processes, REEs are recovered based on the removal of impurities from phosphoric acid and phosphogypsum since the main challenge is the diluted content of REEs in these products. In the case of  $HCl$ ,  $HNO_3$  and  $H_3PO_4$  processes, REEs entirely transfers into leaching solution and the recovery research are mainly focused on REEs extraction from leaching solutions. For REE extraction from high phosphorus content leaching solutions, crystallization, precipitation, and ion exchange methods are currently inconsiderable due to the high energy consumption, impurity involvement and low efficiency, respectively. Solvent extraction seems to be the potential promising method in terms of its good overall performance. Finally, recommendations to promote the development of REEs recovery technologies from phosphate rock are provided.