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A Kinetic Study on Recovery of High-Purity Rutile TiO_2 Nanoparticles from Titanium Slag Using Sulfuric Acid under Sonochemical Procedure

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Abstract : High-purity TiO_2 nanoparticles (NPs) with size ranging between 50 nm and 100 nm are synthesized from titanium slag through sulphate route under sonochemical procedure. The effect of dissolution parameters such as the sulfuric acid/slag weight ratio, caustic soda concentration, digestion temperature and time, and initial particle size of the dried slag on the extraction efficiency of TiO_2 and removal of iron are examined. By optimizing the digestion conditions, a rutile TiO_2 powder with surface area of 42 m^2/g and mean pore diameter of 22.4 nm were prepared. A thermo-kinetic analysis showed that the digestion temperature has an important effect, while the acid/slag weight ratio and initial size of the slag has a moderate effect on the dissolution rate. The shrinking-core model including both chemical surface reaction and surface diffusion is used to describe the leaching process. A low value of activation energy, 38.12 kJ/mol, indicates the surface chemical reaction model is a rate-controlling step. The kinetic analysis suggested a first order reaction mechanism with respect to the acid concentrations.

Keywords : TiO_2 nanoparticles, titanium slag, dissolution rate, sonochemical method, thermo-kinetic study
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