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Hydrometallurgical separation of titanium and iron in ilmenite

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Abstract

The recovery of titanium from ilmenite has been under investigation and researched for many years. This study aims at finding the optimal dissolution route for ilmenite and the separation of the titanium and iron components therein, while maintaining a balance between the economics and optimum operational conditions. Investigated parameters were the leaching of ilmenite using different acids, together with hydrogen peroxide additions. Separation methods that were investigated after leaching included selective precipitation, solvent extraction and the use of ion-exchange resins. Two acids were used for the leaching of ilmenite, namely concentrated sulphuric acid and phosphoric acid. The second dissolution attempt was carried out using a mixture of hydrogen peroxide and the acids mentioned above. Each sample was prepared using 0.5g of ilmenite and 10ml of acid. Hydrogen peroxide concentrations of 2; 5; 10; 15 and 20 vol % H_2O_2 were used, respectively. A combination of H_2SO_4 and 15 vol % H_2O_2 was selected as the optimum mixture for dissolution. The temperature for the dissolution increased rapidly to temperature of about 155 °C and no heat was added until the end of the 30min period. The optimum mixture achieved 81 % Ti dissolution, with only trace amounts of Fe present in the solution.An evaluation of the different separation methods was undertaken. Selective precipitation using Phenantroline (phen) and NaTPB (sodium tetra-phenyl borate) as precipitation reagents was carried out. Each of these reagents were used at varied volume concentrations of 2 %, 5 %, 10 %, 15 % and 20 %. The precipitated titanium oxide was recovered through filtration. No precipitation occurred when phen was used. When 2 % NaTPB was used, the amount of Fe remaining in solution at the end of a 30 min period, was approximately 85 %. The recovery of Ti was close to 100 % and no Ti remained dissolved in solution. Solvent extraction was also investigated. Acetylacetone (acacH) and 1-octanol were used as chelating reagent and extraction solvent respectively.90-95 % Fe was recovered in the aqueous layer and titanium to the organic layer. Cationic and anionic resins were also used in order to investigate the separation of titanium and iron. Dowex marathon C hydrogen was used as a cationic resin, with Amberlite IRA-900 and Amberlite IRA-67 as strong and weak anionic resins, respectively. A recommended elution flow rate of approximately 0.7 mL/min was employed. It was found that using Dowex marathon C hydrogen at 15 % achieves better separation of Ti and Fe than both IRA-900 and IRA-67. A process flowsheet was designed with a mass efficiency of approximately 50 %. Solvent extraction using 2 % acetylacetone in 1-octanol was used as a separation medium. A plant utility structure was also constructed as

the plant is aimed at being a Greenfield plant. A techno-economic evaluation found that the proposed plant for the process could yield returns of approximately 18 %.