INTISARI

Aplikasi unsur-unsur Logam Tanah Jarang (LTJ) sangat luas mencakup berbagai sektor strategis sebagai bahan baku sumber energi seperti baterai listrik, industri pertahanan dan industri elektronika sehingga memiliki nilai ekonomi yang tinggi. Hal tersebut mendorong adanya pengembangan teknik pengolahan dan pemurnian unsur-unsur LTJ. Tujuan dari penelitian ini adalah untuk memperoleh data tahapan proses beserta kondisi yang optimum untuk pemisahan Ce dan La dengan metode pelindian, oksidasi dan presipitasi serta model kinetika yang dapat menggambarkan fenomena pelindian lantanum dari LTJOH. Kondisi optimum pelindian LTJOH diperoleh pada kosentrasi HNO_3 0,6 M, rasio L/S = 11, suhu pelindian 90^oC dengan waktu = 15 menit. Pada kondisi tersebut diperoleh konsentrat $Ce(OH)_3$ yang berada pada fasa padat (residu) dengan kadar kemurnian Ce = 73,31% dan La berada di fasa air dengan recovery La = 90,48%. Penentuan parameter reaksi, menggunakan model matematis berdasar pada laju reaksi kesetimbangan. Hasil perhitungan parameter yang dilakukan didapatkan konsetanta kecepatan reaksi pada suhu reaksi 30^oC, 60^oC, 90^oC untuk reaksi maju (k_f ($L^2.mol^{-1}.s^{-1}$)) berturut-turut = 3,119; 3,418; 6,000, untuk reaksi mundur (k_b ($L^2.mol^{-1}.s^{-1}$)) = 0,283; 0,416; 0,546 dan energi aktivasi reaksi maju (E_{Af}) = 23,386 kJ/mol sedangkan untuk energi aktivasi reaksi mundur E_{Ab} = 28,347 kJ/mol. Reaksi pelindian La bersifat eksotermis, proses pelindian berjalan spontan. Entropi yang diperoleh bernilai positif mengindikasikan terbentuk spesies ion La^{+3} yang bergerak lebih bebas dibandingkan reaktan.

Peningkatan kadar Ce dari residu pelindian REOH dilakukan dengan oksidasi menggunakan $KMnO_4$ dan presipitasi. Kondisi proses optimum dicapai pada oksidasi konsentrat $Ce(OH)_3$15 gram yang dilarutkan dalam 30 mL HNO_3 14,4M (rasio L/S = 2), rasio massa $KMnO_4$ 0,75 g/massa konsentrat $Ce(OH)_3$ 15 g (rasio S/S) = 0,05, suhu oksidasi = 100 ^oC, waktu oksidasi 10 menit dan presipitasi pada pH = 4. Produk oksidasi dan presipitasi adalah $Ce(OH)_4$ dengan *recovery* Ce^{4+} = 90%. Kalsinasi $Ce(OH)_4$ pada suhu 900^oC selama 180 menit diperoleh produk CeO_2 dengan kemurnian 97,718%.

Lantanum diperoleh dari filtrat proses pelindian REOH yang dilakukan presipitasi selekktif pada pH 8,25 menggunakan larutan NHOH 15% untuk memisahkan pengotor La dengan LTJ selain. Setiap 250 mL filtrat pH 8,25 dipresipitasi menggunakan larutan asam oksalat 15% sebanyak 12,5 mL dengan kecepatan pengadukan 250 rpm pada suhu 26^0C selama 10 menit diperoleh serbuk La oksalat ($La_2(C_2O_4)_3.10H_2O$) dengan recovery sebesar 99,6%. Lantanum oksalat dikalsinasi pada suhu 900 ^{o}C selama 1,5 jam diperoleh La_2O_3 dengan kemurnian 95,99 %.

Kata kunci: REOH, HNO_3, lanthanum, cerium, pelindian, oksidasi, presipitasi

ABSTRACT

The application of Rare Earth Elements (REE) is very broad covering various strategic sectors as a raw material for energy sources such as electric batteries, the defence industry and the electronics industry so that they have high economic value. This encourages the development of processing and refining techniques for rare earth elements. The purpose of this study was to obtain data on the process steps and the optimum conditions for the separation of Ce and La by leaching, oxidation and precipitation methods as well as a kinetic model that could describe the phenomenon of lanthanum leaching from rare earth hydroxide (REOH). The optimum REOH leaching conditions were obtained at 0.6 M HNO_3 concentration, L/S ratio = 11, leaching temperature 90^oC and stirring time 15 minutes. Under these conditions, $Ce(OH)_3$ concentrate was obtained which was in the solid phase (residue) with a purity level of Ce = 73.31% and La was in the water phase with a recovery of La = 90.48%. Determination of reaction parameters using a mathematical model based on the reaction rate equilibrium. The results of the parameter calculations carried out obtained the reaction rate constant at reaction temperatures of 30^oC, 60^oC, 90^oC for rate of reaction forward (kf (L2.mol-1.s-1)) respectively = 3.119; 3.418; 6.000, for rate of reaction backward (kb (L2.mol-1.s-1)) = 0.283; 0.416; 0.546 and the forward reaction activation energy (E_{Af}) = 23.386 kJ/mol while for the backward reaction activation energy (E_{Ab}) = 28.347 kJ/mol. The La leaching reaction is exsothermic, the leaching process runs spontaneously. The positive entropy obtained from the La leaching reaction indicates the formation of species La^{+3} ions that move more freely than the reactants.

Increasing the Ce content of REOH leaching residue was carried out by oxidation using $KMnO_4$ and precipitation. Optimum process conditions were achieved in the oxidation of 15 gram Ce(OH) concentrate dissolved in 30 mL of 14.4M HNO_3 (L/S ratio = 2), mass ratio $KMnO_4$ /mass concentrates $Ce(OH)_3$ (S/S) = 0.05, oxidation temperature = 100^oC; oxidation time 15 minutes and the precipitation at pH = 4. The product of oxidation and precipitation is $Ce(OH)_4$ with

the recovery of Ce^{4+} = 90%. Calcination of $Ce(OH)_4$ at 900^oC for 180 minutes resulted in a CeO_2 product with a purity of 97.718%.

Lanthanum was obtained from the filtrate of the REOH leaching process which was the feed to selective precipitation at pH 8.25 using 15% NH_4OH solution to separate La impurities from other REEs. Each 250 mL of filtrate pH 8.25 was precipitated using 12.5 mL of 15% oxalic acid solution with a stirring speed of 250 rpm at 26^oC for 10 minutes to obtain La oxalate powder ($La_2(C_2O_4)_3.10H_2O$) with a recovery of 99.6%. Lanthanum oxalate was calcined at 900^oC for 1.5 hours to obtain La_2O_3 with a purity of 95.99%.

Keywords: REOH, HNO_3, lanthanum, cerium, leaching, oxidation, precipitation