INTISARI

Perkembangan teknologi dibidang otomotif di dunia termasuk Indonesia membuat peralihan kendaraan bermotor yang mengunakan bahan bakar minyak berganti menjadi tenaga listrik. Berdasar analisis perkembangan otomotif dan kebijakan pemerintah terhadap kendaraan listrik di Indonesia, diprediksi tahun 2030 sudah terdapat 28.099.822 kendaraan listrik, sehingga mulai tahun 2039 setidaknya akan terkumpul 130.000 ton pertahun limbah baterai Litium berjenis NCA. Oleh karena itu perlu diperlukan pendirian industri pengolahan limbah baterai sehingga dapat diolah dan digunakan kembali menjadi bahan pembuat baterai. Pabrik pengolahan limbah baterai berjenis NCA sangat cocok menggunakan proses *leaching* kimia *hydrometallurgi*. Proses *leaching* terhadap bahan aktif baterai (katoda) menggunakan Asam Sulfat (H_2SO_4) 2M dan Hidrogen Peroksida (H_2O_2) 2% pada suhu 60^0C dan tekanan 1 atm mampu mengambil kembali material baterai berupa Litium, Nikel, dan Kobalt hingga 99-100%. Logam yang ter-*leaching* akan membentuk logam sulfat dan di pisahkan menggunakan precipitasi. Pengambilan logam Nikel dan Kobalt dilakukan precipitasi pada kondisi pH 11 suhu 35^0C dan tekanan 1 atm dengan Natrium Hidroksida (NaOH), sedangkan untuk pengambilan logam Litium dilakukan menggunakan Natrium Karbonat (Na_2CO_3)pada pH 11 suhu 60^0C dan tekanan 1 atm.

Proses pengolahan limbah baterai sebanyak 130.000 ton pertahun (330 hari, 24 jam), setidaknya membutuhkan bahan baku H_2SO_4 98% sebanyak 146.563 MT/tahun, H_2O_2 30% 68.233 MT/tahun, $Ca(OH)_2$ 95% 82.094 MT/tahun, NaOH 99% 21.181MT/tahun dan Na_2CO_3 99% 14.875 MT/tahun. Selain itu juga dibutuhakan bahan-bahan penunjang utama seperti *make-up water* sebanyak 1201 m^3/hari, 4.391 kg/jam *steam* jenuh 1,68 bar, 15,5 MMBTU/jam LNG, serta listrik sebesar 1,87 MW. Proses yang bersifat eksotermis juga memerlukan air pendingin. Kebutuhan pendingin total adalah sebanyak 913 m^3/jam. Akhir dari pengolahan pabrik ini akan dihasilkan precipitat logam sebagai produk utama yaitu 1321 kg/jam Litium Karbonat 96,4% dan 3041 kg/jam Nikel-Kobalt Hidroksida 99%, dan 2468 kg/jam grafit. Selain itu juga dihasilkan produk samping berupa 18268 kg/jam Kalsium Sulfat 99%, 2126 kg/jam lembaran Tembaga, 1125 kg/jam lembaran Aluminium serta 4718 kg/jam selongsong *Stainless*.

Pabrik ini dirancang untuk berdiri di tanah dengan luas 16,32 ha dengan luas bangunannay sebesar 4,21 ha. Modal untuk berdirinya pabrik berupa modal tetap sebesar US$ 40.867.994,64 dan Rp 527.496.402.898,67 sedangkan modal beroperasinya pabrik berupa *working capital* adalah sebesar US$ 88.944.550,89 dan Rp 902.786.667.556,36. Berdasarkan analisis ekonomi yang di perhitungkan akan menghasilkan profit bersih sebesar US$ 31.637.495,45/tahun, dengan parameter ROI dan POT sebelum pajak sebesar 57,72% dan 1,50 tahun. Selain itu didapatkan juga nilai BEP dan SDP sebesar 51,24% dan 41,62%, serta nilai DCFRRsebesar 22,47%. Berdasarkan penilaian paremeter-parameter kelayakan ekonomi, pabrik pengolahan limbah baterai yang dirancang ini menarik untuk didirikan.

Kata Kunci: baterai, *leching*, precipitasi, Litium Karbonat, Nikel, Kobalt

ABSTRACT

Technology development in the field of automotive in the world, including Indonesia, made the transition of motorized vehicles that use fuel to change into electric power. Based on an analysis of automotive developments and government policies on electric vehicles in Indonesia, it is predicted that in 2030 there will be 28,099,822 electric vehicles, so that starting in 2039, at least 130,000 tons of NCA type Lithium battery waste will be collected annually. Therefore it is necessary to establish the waste battery processing industry so that it can be processed and reused as a material for making batteries. The NCA-type battery waste treatment plant is suitable for using the chemical leaching hydrometallurgi process. The leaching process of the active ingredient of the battery (cathode) using Sulfuric Acid (H_2SO_4) 2M and Hydrogen Peroxide (H_2O_2) 2% at 60^0C and 1 atm pressure is able to recover battery material in the form of Lithium, Nickel and Cobalt up to 99-100%. Leached metal forms sulfate metal and is separated using precipitation. Nickel and Cobalt metals were taken precipitated at pH 11 temperature 35^0C and 1 atm pressure with Sodium Hydroxide (NaOH), whereas for lithium metal uptake was carried out using Sodium Carbonate (Na_2CO_3) at pH 11 at 60^0C temperature and 1 atm pressure.

The process of treating waste batteries as much as 130,000 tons per year (330 days, 24 hours), requires at least 98% H_2SO_4 raw materials as much as 146,563 MT/year, H_2O_2 30% 68,233 MT/year, $Ca(OH)_2$ 95% 82,094 MT/year, NaOH 99% 21,181MT/year and Na_2CO_3 99% 14,875 MT/year. In addition, major supporting materials such as make-up water are needed as much as 1201 m^3/day, 4,391 kg / hour of saturated steam 1.68 bar, 15.5 MMBTU / hour of LNG, and electricity of 1.87 MW. Exothermic processes also require cooling water. The total cooling requirement is 913 m^3/hour. The end of the processing plant will produce metal precipitat as the main product, namely 1,321 kg/hour 96.4% Lithium Carbonate and 3,041 kg/hour 99% Nickel-Cobalt Hydroxide, and also 2,468 kg/hour graphite. In addition, side products were also produced in the form of 18,268 kg/hour of Calcium Sulfate 99%, 2,126 kg/hour of Copper sheet, 1,125 kg/hour of Aluminum sheet and 4,718 kg/hour of Stainless sleeve.

The plant is designed to stand on land with an area of 16.32 ha with a building area of 4.21 ha. The capital for the establishment of the plant in the form of fixed capital was US$ 40.867.994,64 and Rp 527.496.402.898,67 while the operating capital of the factory in the form of working capital was US$ 88.944.550,89 and Rp 902.786.667.556,36. Based on the economic analysis that is calculated will generate a net profit of US$ 31,637,495.45/year, with parameters ROI and POT before tax of 57.72% and 1.50 years. In addition, BEP and SDP values of 51.24% and 41.62%, and DCFRR values of 22.47% were also obtained. Based on the assessment of economic feasibility parameters, the battery waste treatment plant that was designed was interesting to be established.

***Keywords**: battery, leching, precipitation, Lithium Carbonate, Nickel, Cobalt*