

INTISARI

Ita Nur Hanifah dan Resqi Dwi Oktaviani, 2016, Prarancangan Pabrik Nitrobenzena dari Benzena dan Asam Campuran (Asam Nitrat dan Asam Sulfat) dengan Kapasitas 20.000 ton/tahun, Program Studi S1 Teknik Kimia, Fakultas Teknik, Universitas Sebelas Maret, Surakarta

Pabrik Nitrobenzena dengan kapasitas 20.000 ton/tahun akan didirikan di daerah Cikampek, Jawa Barat pada tahun 2018 dan beroperasi pada tahun 2020. Kebutuhan spesifik bahan baku benzena sebesar 0,64 kg/kg produk diperoleh dari Pertamina RU IV Cilacap, asam nitrat 66,67% sebesar 0,54 kg/kg produk diperoleh dari PT. Multi Nitrotama Kimia Cikampek, asam sulfat 98% sebesar 0,01 kg/kg produk diperoleh dari PT. Indonesia Acid Industry Jakarta dan air sebesar 0,02 kg/kg produk diperoleh dari PT. Pupuk Kujang. Limbah yang dihasilkan berupa larutan asam sebesar 0,21 kg/kg produk. Pabrik beroperasi selama 24 jam per hari dan 330 hari per tahun dengan waktu *shut down* satu bulan.

Tahapan proses meliputi penyiapan bahan baku benzena dan asam campuran, pembentukan nitrobenzena dalam reaktor, dan pemurnian produk. Reaksi pembuatan nitrobenzena dilakukan dengan mereaksikan benzena dengan asam nitrat dan katalis asam sulfat dalam reaktor RATB pada kondisi tekanan 1 bar dan suhu 50 °C pada fase cair. Rasio antara benzena dan asam nitrat adalah 1: 1,05. Reaksi bersifat eksotermis sehingga reaktor dilengkapi dengan koil pendingin. Konversi terhadap benzena pada reaksi ini adalah 99,6%. Produk yang dihasilkan adalah nitrobenzena 99,95% berat. Pemurnian produk dilakukan oleh dekanter, tangki pencuci dan menara distilasi.

Unit pendukung proses pabrik meliputi unit pengadaan air, steam, udara tekan, tenaga listrik dan bahan bakar. Kebutuhan spesifik air sebesar 2,02 L air/kg produk, steam sebesar 0,45 kg steam/kg produk, udara tekan ($P = 4,05$ bar dan $T=35^{\circ}\text{C}$) sebesar 0,04 m³ udara/kg produk, listrik dari PLN sebesar 0,02 kWh/kg produk dan bahan bakar IDO sebesar 45,25 L bahan bakar/kg produk. Pabrik juga didukung laboratorium yang mengontrol mutu bahan baku dan produk serta bahan buangan pabrik berupa cairan. Pabrik direncanakan berdiri di kawasan Industri Pupuk Kujang, Jawa Barat pada tahun 2018, dan dibangun diatas lahan seluas 11.000 m².

Bentuk perusahaan adalah PT (Perseroan Terbatas) dengan struktur organisasi *line and staff*. Jumlah kebutuhan tenaga kerja sebanyak 117 orang, yaitu 64 karyawan *shift* dan 53 karyawan *non shift*.

Harga jual nitrobenzena US\$ 1,44/kg dan harga bahan baku benzena US\$ 1,06/kg, asam nitrat US\$ 0,26/kg, dan katalis asam sulfat US\$ 0,09/kg. Hasil analisis ekonomi diperoleh, ROI (*Return on Investment*) sebelum dan sesudah pajak sebesar 48% dan 36%, POT (*Pay Out Time*) sebelum dan sesudah pajak selama 1,7 tahun dan 2,2 tahun, DCF (*Discounted Cash Flow*) sebesar 31%, BEP (*Break Event Point*) 42% dan SDP (*Shut Down Point*) 27%. Jadi, dari segi ekonomi pabrik ini layak untuk didirikan.

ABSTRACT

Ita Nur Hanifah and Resqi Dwi Oktaviani, 2016, Preliminary Plant Design of Nitrobenzene from Benzene and Mixed Acid (Nitric Acid and Sulfuric Acid) Capacity 20.000 Tonnes/year, Bachelor Degree of Chemical Engineering, Faculty of Engineering, Sebelas Maret University.

Nitrobenzene plant is designed with a capacity of 20,000 tons / year, and planned to be built in Cikampek, West Java Province in 2018, and will be operating by 2020. The specific requirements of raw material benzene of 0.64 kg / kg of products obtained from Pertamina RU IV Cilacap, nitric acid 66.67 % of 0.54 kg / kg of products obtained from PT. Multi Nitrotama Chemical Cikampek, 98% sulfuric acid of 0.01 kg / kg of products obtained from PT. Acid Industry Jakarta Indonesia and water of 0.02 kg / kg of products obtained from PT. Pupuk Kujang. Waste generated in the form of an acid solution of 0.21 kg / kg of product. The plant operates 24 hours per day and 330 days per year with a one-month shut down.

The process steps include the preparation of raw materials benzene and mixed acid, the formation of nitrobenzene into a reactor, and product purification. The reaction of nitrobenzene manufacture carried out by reacting benzene with nitric acid and sulfuric acid catalyst in the reactor RATB conditions 1 bar pressure and a temperature of 50 ° C in the liquid phase. The ratio between benzene and nitric acid is 1: 1.05. The reaction is exothermic so that the reactor is equipped with a cooling coil. Conversion to benzene in this reaction is 99.6%. The resulting product is 99.95% by weight of nitrobenzene. Purification of the products made by the decanter, tank washers and distillation towers.

A support unit includes unit procurement process plant water, steam, compressed air, electricity and fuel. Specific requirements of water by 2.02 L of water / kg of product, steam of 0.45 kg of steam / kg of product, compressed air (P=4.05 bar and T = 35 ° C) of 0.04 m³ air / kg products, electricity PLN 0.02 kWh/kg of fuel products and IDO amounted to 45.25 L of fuel / kg product. The plant is also supported by laboratories that control the quality of raw materials and products as well as plant waste material is a liquid. The plant is planned to stand in the Fertilizer Industry Area Kujang, West Java in 2018, and built on an area of 11,000 m².

The company management is a Limited Liability Company (Perseroan Terbatas), with line and staff organizational structure. Employees working systems is based on the division of employee working hours consisting of 117 people with 64 shift employees and 53 non-shift employees.

The selling price of nitrobenzene is US\$ 1,44/kg product and price of of raw material benzene is US\$ 1,06/kg, nitric acid is US\$ 0,26/kg, and sulfuric acid catalyst is US\$ 0,09/kg. Economic analysis shows that Percent Return on Investment (ROI) before taxes is 48% and 36% after taxes, Pay Out Time (POT) before taxes is 1.7 years, 2.2 years after taxes, Discounted Cash Flow (DCF) is

31%, Break Even Point (BEP) is 42% and the Shut Down Point (SDP) is 27%. From the results of the economic analysis, we can conclude that the nitrobenzene plant is worthy established.