

INTISARI

Nitrobenzena ($C_6H_5NO_2$) merupakan senyawa aromatik yang dalam keadaan atmosferis berupa cairan berwarna kuning pucat hingga kuning kecoklatan. Sekitar 95% nitrobenzena yang dihasilkan di dunia digunakan sebagai bahan baku pembuatan anilin ($C_6H_5NH_2$). Selain itu, nitrobenzena juga digunakan sebagai pelarut dan bahan pembuat senyawa kimia turunan lainnya.

Prarancangan pabrik nitrobenzena ini memiliki target kapasitas 200.000 ton/tahun dan beroperasi selama 330 hari dalam satu tahun. Untuk memenuhi kapasitas produksi nitrobenzena, dibutuhkan bahan baku berupa 149.134,39 ton /tahun HNO_3 70% dan 129.499,52 ton/tahun C_6H_6 dan katalis berupa 2257,2 ton/tahun kg/jam H_2SO_4 .

Sintesis nitrobenzena dilakukan dengan reaksi nitrasi benzena dengan katalis H_2SO_4 . Reaksi dijalankan pada reaktor berupa reaktor alir tangki berpengaduk pada tekanan 1 atm dan suhu $50^\circ C$. Reaksi berlangsung pada fase cair-cair, eksotermis, isothermal dan non adiabatik, sehingga dibutuhkan pendinginan agar temperatur reaktor tetap terjaga pada suhu $50^\circ C$. Untuk memperoleh produk nitrobenzena dengan kemurnian 99% (w/w), digunakan unit separasi dan purifikasi yaitu 2 dekanter dan 1 menara distilasi.

Pabrik ini direncanakan akan didirikan di Tuban, Jawa Timur, dengan luas tanah $70.000 m^2$ dan jumlah karyawan 241 orang. Kebutuhan energy untuk menjalankan pabrik ini meliputi kebutuhan listrik sebanyak 16.148.088,15 kWh/tahun dan bahan bakar berupa diesel sebanyak 1.003,90 m³/tahun. Kebutuhan air untuk utilitas adalah sebanyak 2.618.585,16 kg/jam, kebutuhan amonia sebanyak 28.817,01 kg/jam, dan kebutuhan *chilling water* sebanyak 164.563,22 kg/jam.

Untuk menjalankan produksi, dibutuhkan modal tetap sebesar \$48.708.076,96 + Rp 110.287.436.028,91 dan modal kerja sebesar \$68.116.711,07 + Rp 28.880.324.401,85. Berdasarkan evaluasi ekonomi yang dilakukan, pabrik nitrobenzena ini tergolong *high risk* dengan nilai ROI sebelum pajak 47,54%, POT



sebelum pajak 1,74 tahun, BEP 40,37%, SDP 25,82%, dan DCFRR 26,91%. Berdasarkan nilai-nilai diatas, dapat disimpulkan bahwa pabrik ini menarik secara ekonomi dan layak untuk dikaji lebih lanjut.

ABSTRACT

Nitrobenzene ($C_6H_5NO_2$) is an aromatic compound which in an atmospheric condition, it will take the form of liquid and the colour varies from pale yellow until brownish yellow. approximately 95% of nitrobenzene in the world was used to be produced as raw material for aniline ($C_6H_5NH_2$) production. In addition, nitrobenzene is also used as a solvent and other derivative chemical compounds.

The design of this nitrobenzene plant has a target capacity of 200,000 tons / year and operates for 330 days in one year. To meet the production capacity of nitrobenzene, it takes raw material in the form of 149.134,39 ton /year HNO_3 70% dan 129.499,52 ton/year C_6H_6 dan catalyst of 2257,2 ton/year H_2SO_4 .

The synthesis of nitrobenzene was carried out by a benzene nitration reaction with H_2SO_4 as the catalyst. The reaction is carried out at the reactor in the form of a stirred tank flow reactor at pressure of 1 atm and temperature of $50^\circ C$, so cooling mechanism is needed to keep the reactor temperature at $50^\circ C$. The reaction takes place in the liquid-liquid, exothermic, isothermal and non-adiabatic phases. To obtain nitrobenzene product with 99% (w/w) purity, then it will be purified with separation and purification unit consists of 2 decanters and 1 distillation column.

The plant is planned to be built in Tuban, East Java, with a land area of $70,000 m^2$ and 241 employees. Energy requirements to run this factory include electricity needs of 16.148.088,15 kWh/year and diesel fuel as much as 1.003,90 m³/year. Water demand for utilities is as much as 2.618.585,16 kg/hour, the need for ammonia is 28.817,01 kg/hour, and the need of chilling water is 164.563,22 kg/hour.

To run the production, the plant would have fixed capital of \$ 48.708.076,96 + Rp110.287.436.028,91 and working capital of \$ 68.116.711,07 + Rp 28.880.324.401,85. Based on the economic evaluation conducted, the nitrobenzene plant is classified as high risk with a pre-tax ROI of 47,54%, POT before tax of 1,74 years, BEP 40,37%, SDP 25,82%, and DCFRR 26,91%. Based on the above values,



it can be concluded that this plant is economically attractive and feasible for further study.