

ABSTRAK

Pabrik Paraxylene dirancang dengan kapasitas 250.000 ton/tahun dan beroperasi secara kontinyu selama 330 hari/tahun dan 24 jam/hari. Untuk mencapai target produksi, dibutuhkan bahan baku metanol sejumlah 20161,84 kg/jam dan gas alam sejumlah 29472,64 kg/jam.

Produksi diawali dengan proses *dehydrocyclization* metana menjadi *benzene*, kemudian alkilasi *benzene* menjadi *toluene* serta *toluene* menjadi *xylene*. Reaksi berlangsung secara simultan pada reaktor *furnace multitube* bersuhu 700°C dan tekanan 1,5 atm. Katalisator yang digunakan adalah H-ZSM-5 dengan impregnasi logam Mo untuk memperkecil diameter pori katalis sehingga diperoleh produk *paraxylene* dengan selektivitas yang tinggi dibanding isomernya yaitu 97,7%. Pemisahan *paraxylene* dari isomernya dilakukan dengan distilasi reaktif. Adapun total *yield paraxylene* yang diperoleh mencapai 64%.

Untuk menunjang proses produksi, diperlukan sejumlah komponen utilitas seperti air sebanyak 37043,20 kg/jam, *steam* sebanyak 20207,23 kg/jam, udara kering sebanyak 577673,11 kg/jam, bahan bakar sebanyak 6,59 MMBTU/ton PX, dan listrik sebanyak 0,96 MW. Bahan bakar yang digunakan merupakan campuran gas H₂ dan CH₄, sedangkan kebutuhan listrik akan disuplai secara penuh dari PLN.

Pabrik direncanakan untuk dibangun di daerah Bontang, Kalimantan Timur dengan luas lahan 84 ha dan mempekerjakan 139 pekerja. Estimasi pendirian pabrik membutuhkan modal tetap sejumlah US\$129.753.329,19 + Rp1.487.068.652.175,54 serta modal kerja sejumlah US\$57.519.724,35 + Rp47.989.484.760,06. Melalui konversi bahan baku menjadi produk, diperoleh harga jual 2 kali lipat lebih tinggi dengan keuntungan kotor sejumlah US\$142.860.968,35/tahun. Analisis ekonomi menunjukkan bahwa pabrik yang dirancang memiliki nilai ROI, POT, BEP, SDP, dan DCFRR secara berturut-turut sebesar 64,06%, 1,35 tahun, 42,00%, 18,87%, dan 43,32%. Berdasarkan evaluasi ekonomi tersebut, pabrik yang dirancang mempunyai profitabilitas yang baik sehingga menarik untuk dikaji lebih lanjut.

Kata kunci: alkilasi, distilasi reaktif, *dehydrocyclization*, *paraxylene*.

ABSTRACT

The paraxylene plant was designed with a capacity of 250,000 tons/year and operates continuously for 24 hours/day in 330 days/year. To achieve the production target, about 20161,84 kg/hour of methanol and 29472,64 kg/hour of natural gas are required.

Production process is initiated by dehydrocyclization of methane to benzene, then benzene alkylation to form toluene and toluene alkylation to form xylene isomers. These reactions are carried simultaneously on a furnace multitube reactor at temperature of 700°C and pressure of 1.5 atm. As the catalyst, H-ZSM-5 is used with Mo impregnation to minimize pore diameter, thus enhancing paraxylene selectivity to its isomers up to 97.7%. The separation of paraxylene from other isomers is conducted via reactive distillation. Overall yield of paraxylene achieved via these strategies is 64%.

To support the production process, several utility requirements are needed, including 37043,20 kg/hour of water, 20207,23 kg/hour of steam, 577673,11 kg/hour of air, 6,59 MMBTU/ton PX of fuel, and 0,96 MW of electricity. The fuel used to provide the heat is H₂ as the side product of reaction with addition of natural gas, meanwhile the electricity requirement will be fully obtained from PLN.

The plant is planned to be built on Bontang, East Borneo at 84 ha of land and will absorb 139 workers. Based on cost estimation, the project will require about US\$129.753.329,19 + Rp1.487.068.652.175,54 for the fixed capital investment also US\$57.519.724,35 + Rp47.989.484.760,06 for the working capital. By converting raw materials into the product, about 2 times higher value will be achieved and from a whole year production about US\$142.860.968,35 of gross profit will be achieved. Profitability analysis have shown that the designed project will provide ROIB of 64.06%, POTb of 1.35 years, BEP of 42.00%, SDP of 18.87%, and DCFRR of 43.32%. Based on this economic evaluation, the designed plant has good profitability, thus interesting to be study further.

Keywords: alkylation, dehydrocyclization, paraxylene, reactive distillation