

INTISARI

Dilakukannya prarancangan pabrik *Cumene* (isopropilbenzena, C_9H_{12}) berkapasitas 65.000 ton/tahun yang dilatarbelakangi oleh belum tersedianya pabrik *cumene* yang beroperasi secara mandiri di Indonesia, sehingga seluruh kebutuhan domestik masih dipenuhi melalui impor, padahal *cumene* merupakan senyawa antara petrokimia strategis yang sekitar 95% produksinya digunakan sebagai bahan baku utama sintesis fenol dan aseton bagi industri polimer, resin, plastik, dan farmasi; kapasitas 65.000 ton/tahun ditetapkan berdasarkan proyeksi kebutuhan *cumene* di Indonesia dan ASEAN pada tahun 2030 yang mencapai 40.856,43 ton setelah penerapan faktor keamanan, dengan lokasi pabrik yang direncanakan di Kawasan Industri Cilegon, Banten, mempertimbangkan kedekatan pasokan propilena dari PT Chandra Asri Petrochemical Tbk dan benzena dari kilang PT Pertamina (Persero) RU IV Cilacap serta ketersediaan infrastruktur pelabuhan dan utilitas kawasan; pabrik dirancang menggunakan teknologi *UOP Q-Max* dengan katalis β -zeolit melalui proses alkilasi *Friedel-Crafts* fase cair yang menghasilkan selektivitas *cumene* >99%, dengan proses produksi mencakup empat tahap utama yaitu penyimpanan bahan baku di TK-101 (benzena) dan TK-102 (propilena), reaksi alkilasi pada Reaktor Alkilasi R-201 yang beroperasi secara adiabatik pada suhu inlet 170°C dan outlet 254°C serta tekanan 30 bar dengan rasio molar benzena/propilena 5:1, reaksi transalkilasi pada Reaktor Transalkilasi R-202 bersuhu 150°C untuk mengkonversi DIPB menjadi *cumene* tambahan, pemurnian melalui Depropanizer T-201, Kolom Benzena T-202, dan Kolom *Cumene* T-203 yang menghasilkan produk *cumene* berkadar 99,4%, serta penyimpanan produk di TK-302; berdasarkan neraca massa overall, kebutuhan bahan baku adalah benzena 5.269,27 kg/jam dan propilena 2.855,73 kg/jam menghasilkan *cumene* 8.059,32 kg/jam, DIPB 65,68 kg/jam, dan propana (GPL) 124,70 kg/jam, dengan kebutuhan utilitas meliputi air 4.887,83 m³/hari, steam 614.410,10 kg/hari, listrik 6.000,19 kWh, dan bahan bakar IDO 38.589,18 kg/hari; sedangkan hasil analisis ekonomi dengan basis kurs Rp 17.685,56/USD menunjukkan *Total Capital Investment* (TCI) sebesar USD 28.938.947, *Profit on Sales* (POS) 13,51%, *Return on Investment* (ROI) 34,97%, *Pay Out Time* (POT) 4 tahun 11 bulan 5 hari, *Internal Rate of Return* (IRR) 21,40%, *Break Even Point* (BEP) pada kapasitas 49,90%, dan *Shut Down Point* (SDP) 22,08%, sehingga dengan nilai IRR yang melebihi suku bunga bank yang berlaku, pabrik *cumene* berkapasitas 65.000 ton/tahun ini dinyatakan layak untuk didirikan dan dioperasikan.

Kata kunci: alkilasi, aseton, β -zeolit, *cumene*, fenol, isopropilbenzena, prarancangan pabrik, *UOP Q-Max*

SUMMARY

A preliminary plant design of Cumene (isopropylbenzene, C_9H_{12}) with a capacity of 65,000 tons per year has been carried out, motivated by the absence of a domestically operating cumene plant in Indonesia where all domestic demand is still met through imports, even though cumene is a strategically important petrochemical intermediate with approximately 95% of its production used as the primary raw material for phenol and acetone synthesis in the polymer, resin, plastics, and pharmaceutical industries; the capacity of 65,000 tons/year was established based on the projected cumene demand in Indonesia and the ASEAN region of 40,856.43 tons by 2030 after applying a safety factor, with the plant planned to be located in the Cilegon Industrial Zone, Banten Province, considering its proximity to propylene supply from PT Chandra Asri Petrochemical Tbk and benzene from the PT Pertamina (Persero) RU IV Cilacap refinery as well as the availability of port infrastructure and industrial utilities; the plant is designed using UOP Q-Max technology with β -zeolite catalyst through a liquid-phase Friedel-Crafts alkylation process achieving cumene selectivity of >99%, with the production process comprising four main stages, namely raw material storage in TK-101 (benzene) and TK-102 (propylene), alkylation reaction in the Alkylation Reactor R-201 operating adiabatically at an inlet temperature of 170°C and outlet temperature of 254°C at 30 bar with a benzene/propylene molar ratio of 5:1, transalkylation in the Transalkylation Reactor R-202 at 150°C to convert DIPB back to cumene, purification through Depropanizer T-201, Benzene Column T-202, and Cumene Column T-203 yielding 99.4% purity cumene product, and product storage in TK-302; based on the overall mass balance, raw material requirements are benzene at 5,269.27 kg/h and propylene at 2,855.73 kg/h, producing cumene at 8,059.32 kg/h, DIPB at 65.68 kg/h, and propane (LPG) at 124.70 kg/h, with utility requirements including water at 4.887,83 m³/day, steam at 614.410,10 kg/day, electricity at 6.000,19 kWh, and IDO fuel at 38.589,18 kg/day; while economic analysis results based on an exchange rate of IDR 17,685.56/USD show a Total Capital Investment (TCI) of USD 28,938,947, Profit on Sales (POS) of 13.51%, Return on Investment (ROI) of 34.97%, Pay Out Time (POT) of 4 years 11 months and 5 days, Internal Rate of Return (IRR) of 21.40%, Break Even Point (BEP) at 49.90% of production capacity, and Shut Down Point (SDP) at 22.08%, such that with an IRR exceeding the prevailing bank interest rate, the 65,000 tons/year cumene plant is declared economically feasible for establishment and operation.

Keywords: cumene, isopropylbenzene, alkylation, β -zeolite, UOP Q-Max, phenol, acetone, preliminary plant design