

INTISARI

Laporan tugas akhir ini berjudul “Pra-Rancangan Pabrik Fenilamina dengan Proses Hidrogenasi Nitrobenzene Fase Uap Kapasitas 46.000 Ton/Tahun”. Fenilamina (anilin, $C_6H_5NH_2$) merupakan senyawa aromatik amina yang berperan sebagai bahan intermediate utama dalam industri kimia, khususnya sebagai bahan baku pembuatan Methylene Diphenyl Diisocyanate (MDI) untuk busa poliuretan, serta digunakan dalam industri karet, pewarna sintetis (pigmen), farmasi (API), dan pestisida. Hingga saat ini Indonesia belum memproduksi Fenilamina secara komersial sehingga seluruh kebutuhan nasional dipenuhi melalui impor.

Pabrik dirancang dengan kapasitas 46.000 ton/tahun berdasarkan proyeksi kebutuhan impor nasional pada tahun operasi 2029 (± 30.362 ton/tahun) dikalikan faktor 1,5 dengan mempertimbangkan skala keekonomian pabrik sejenis di dunia. Proses produksi menggunakan reaksi hidrogenasi katalitik nitrobenzene dengan gas hidrogen berlebih (rasio mol 1:10) dalam reaktor fixed bed multitubular bersuhu $270\text{--}312^\circ\text{C}$ dan tekanan 2,7 atm, dengan katalis Cu-Ni/SiO₂, menghasilkan konversi 99% dan kemurnian produk akhir 99,5% berat. Pabrik direncanakan berlokasi di Kota Cilegon, Provinsi Banten, karena keunggulannya dalam ketersediaan bahan baku impor, akses pelabuhan, kedekatan pasar, serta kesesuaian tata ruang industri.

Hasil analisis ekonomi menunjukkan Total Capital Investment sebesar $\pm$ USD 112 juta ($\pm$ Rp 2 triliun), dengan pendapatan penjualan USD 62,1 juta/tahun dan biaya produksi USD 38,88 juta/tahun, sehingga diperoleh laba bersih setelah pajak USD 17,42 juta/tahun. Parameter kelayakan yang diperoleh yaitu ROI setelah pajak 23,54%, IRR 20,36%, Pay Out Time 3,6 tahun, BEP 38,11%, dan SDP 21,36% — seluruhnya berada pada kategori layak dengan risiko rendah. Dengan demikian, pendirian pabrik Fenilamina ini dinyatakan layak untuk direalisasikan baik secara teknis maupun ekonomis, sekaligus memberikan manfaat strategis berupa substitusi impor dan penyerapan sekitar 111 Tenaga kerja.

Kata kunci: Fenilamina, anilin, hidrogenasi nitrobenzene, fase uap, katalis Cu-Ni/SiO₂, kapasitas 46.000 ton/tahun, kelayakan ekonomi.

SUMMARY

This final year project report is titled “Preliminary Design of an Aniline (Phenylamine) Plant via Vapor-Phase Nitrobenzene Hydrogenation, Capacity 46,000 Tons/Year.” Aniline (phenylamine, $C_6H_5NH_2$) is an aromatic amine compound that serves as a key intermediate in the chemical industry, particularly as a raw material for Methylene Diphenyl Diisocyanate (MDI) production used in polyurethane foam, as well as in the rubber, synthetic dye (pigment), pharmaceutical (API), and pesticide industries. To date, Indonesia does not produce aniline commercially, so the entire national demand is met through imports.

The plant is designed with a capacity of 46,000 tons/year based on the projected national import demand for the start-up year 2029 ($\pm 30,362$ tons/year), multiplied by a factor of 1.5 considering the economic scale of similar plants worldwide. The production process uses catalytic hydrogenation of nitrobenzene with excess hydrogen gas (molar ratio 1:10) in a multitubular fixed-bed reactor operating at 270–312°C and 2.7 atm, using a Cu-Ni/SiO₂ catalyst, achieving a 99% conversion and a final product purity of 99.5% by weight. The plant is planned to be located in Cilegon City, Banten Province, owing to its advantages in access to imported raw materials, port access, market proximity, and compliance with industrial zoning regulations.

The economic analysis results show a Total Capital Investment of approximately USD 112 million ($\pm$ IDR 2 trillion), with annual sales revenue of USD 62.1 million and annual production costs of USD 38.88 million, yielding an after-tax net profit of USD 17.42 million per year. The feasibility parameters obtained are an after-tax ROI of 23.54%, IRR of 20.36%, Pay Out Time of 3.6 years, BEP of 38.11%, and SDP of 21.36% — all of which fall into the feasible, low-risk category. Accordingly, the establishment of this aniline plant is deemed feasible both technically and economically, while also providing strategic benefits in the form of import substitution and the absorption of approximately 111 workers.

Keywords: Phenylamine, aniline, nitrobenzene hydrogenation, vapor phase, Cu-Ni/SiO₂ catalyst, 46,000 tons/year capacity, economic feasibility.