

ABSTRAK

Pabrik asam fenil asetat dari benzil klorida dan NaCN dengan kapasitas 4.000 ton/tahun yang beroperasi secara kontinyu selama 330 hari/tahun dan 24 jam/hari. Target produksi bisa tercapai dengan bahan baku benzil klorida sebesar 464,89 kg/jam; NaCN sebesar 179,99 kg/jam; H_2SO_4 sebesar 159,90 kg/jam; dan air bahan baku 769,90 kg/jam. Pabrik tersebut akan didirikan di Kecamatan Manyar, Kabupaten Gresik, Jawa Timur pada tahun 2026.

Proses produksi dimulai dengan proses reaksi hidrolisis benzil klorida ($C_6H_5CH_2Cl$) dengan natrium sianida (NaCN) reaksi cair-cair dengan dua fase (fase organik dan fase anorganik) menghasilkan produk benzil sianida ($C_6H_5CH_2CN$) dan natrium klorida (NaCl) pada reaktor hidrolisis jenis *mixed flow reactor* menggunakan reaktor alir tangki berpengaduk yang disusun secara seri sebanyak empat (4) unit agar reaktor tersebut menyerupai reaktor jenis *plug flow reactor*. Kondisi operasi pada masing-masing reaktor dengan suhu optimum reaksi $100^\circ C$ dengan tekanan operasi berturut-turut sebesar 5,5 atm untuk reaktor 1 sampai 4 dan 5,7 atm untuk reaktor 5 sampai 8. Konversi yang dicapai dari arus keluar reaktor terakhir pada reaksi ini sebesar 90% terhadap NaCN. Selanjutnya, reaksi hidrolisis kedua terjadi pada reaktor hidrolisis dengan jenis dan kondisi operasi yang sama serta disusun seri sebanyak empat (4) unit. Reaksi kedua terjadi antara benzil sianida ($C_6H_5CH_2CN$) dengan asam sulfat (H_2SO_4) dan air menghasilkan produk utama asam fenil asetat ($C_6H_5CH_2COOH$) dan ammonium sulfat ($(NH_4)_2SO_4$) sebagai *by-product* (produk samping). Konversi yang dihasilkan dari reaksi hidrolisis pada arus keluaran reaktor paling akhir sebesar 80% terhadap benzil sianida dengan kemurnian produk asam fenil asetat sebesar 99%.

Proses produksi asam fenil asetat didukung dengan komponen penunjang proses yang dihasilkan dari unit utilitas. Komponen tersebut adalah air bahan baku reaksi sebesar 769,90 kg/jam; air pendingin (*cooling water*) sebesar 46916,72 kg/jam; *saturated steam* sebanyak 4067,06 kg/jam; bahan bakar *boiler* berupa HVO100 sebanyak 197,10 kg/jam; dan listrik sebesar 9855,95 kWh.

Pabrik asam fenil asetat direncanakan akan didirikan di Kabupaten Gresik, Jawa Timur dengan luas lahan sebesar 8,36 hektar serta mempekerjakan 266 karyawan. Pembangunan pabrik asam fenil asetat diperkirakan memerlukan biaya investasi berupa *fixed capital* sebesar US\$56.817.699 (konversi Rp888.686.193.361); *manufacturing cost* sebesar US\$31.399.770 (konversi Rp417.492.017.750); *working capital* sebesar US\$20.751.489 (konversi Rp324.574.253.202); dan *general expenses* sebesar US\$46.394.790 (konversi Rp704.571.741.419). Secara evaluasi ekonomi, pabrik asam fenil asetat tergolong pabrik *low risk* dengan nilai $ROI_{\text{before tax}}$ sebesar 27,16%; $ROI_{\text{after tax}}$ sebesar 20,67%; $POT_{\text{before tax}}$ sebesar 1,70 tahun; $POT_{\text{after tax}}$ sebesar 1,91 tahun; harga BEP 53,12%; harga SDP 45,68%; dan DCFRR sebesar 34,86%. Berdasarkan hasil evaluasi ekonomi, pabrik asam fenil asetat dari benzil klorida dan NaCN layak untuk didirikan dan dikaji lebih lanjut.

Kata kunci: Asam fenil asetat, benzil klorida, benzil sianida, reaksi hidrolisis.

ABSTRACT

Phenyl acetic acid factory from benzyl chloride and NaCN with a capacity of 4,000 tons/year which operates continuously for 330 days/year and 24 hours/day. The production target can be achieved with benzyl chloride as raw material of 464.89 kg/hour; NaCN of 179.99 kg/hour; H_2SO_4 of 159.90 kg/hour; and raw material water 769.90 kg/hour. The factory will be established in Manyar District, Gresik Regency, East Java in 2026.

The production process begins with the hydrolysis reaction process of benzyl chloride ($C_6H_5CH_2Cl$) with sodium cyanide (NaCN), a liquid-liquid reaction with two phases (organic phase and inorganic phase) producing benzyl cyanide ($C_6H_5CH_2CN$) and sodium chloride (NaCl) in a mixed type hydrolysis reactor. The flow reactor uses a stirred tank flow reactor arranged in series of four (4) units so that the reactor resembles a plug flow reactor type reactor. Operating conditions in each reactor are with an optimum reaction temperature of $100^\circ C$ with an operating pressure of 5.5 atm for reactors 1 to 4 and 5.7 atm for reactors 5 to 8. The conversion achieved from the last reactor outflow in this reaction is 90% against NaCN. Next, the second hydrolysis reaction occurs in a hydrolysis reactor with the same type and operating conditions and arranged in a series of four (4) units. The second reaction occurs between benzyl cyanide ($C_6H_5CH_2CN$) with sulfuric acid (H_2SO_4) and water producing the main product phenyl acetic acid ($C_6H_5CH_2COOH$) and ammonium sulfate ($(NH_4)_2SO_4$) as a by-product. The conversion resulting from the hydrolysis reaction in the final reactor output stream was 80% for benzyl cyanide with a purity of phenyl acetic acid product of 99%.

The phenyl acetic acid production process is supported by process supporting components produced from utility units. These components are reaction raw material water amounting to 769.90 kg/hour; cooling water of 46916.72 kg/hour; saturated steam of 4067.06 kg/hour; boiler fuel in the form of HVO100 as much as 197.10 kg/hour; and electricity of 9855.95 kWh.

The phenyl acetic acid factory is planned to be established in Gresik Regency, East Java with a land area of 8.36 hectares and employing 266 employees. The construction of a phenyl acetic acid factory is estimated to require investment costs in the form of fixed capital of US\$56,817,699 (conversion Rp. 888,686,193,361); manufacturing cost of US\$31,399,770 (conversion Rp. 417,492,017,750); working capital of US\$20,751,489 (conversion Rp. 324,574,253,202); and general expenses of US\$46,394,790 (conversion Rp. 704,571,741,419). In terms of economic evaluation, the phenyl acetic acid factory is classified as a low risk factory with an ROI before tax value of 27.16%; ROI after tax of 20.67%; POT before tax of 1.70 years; POT after tax is 1.91 years; BEP price 53.12%; SDP price 45.68%; and DCFRR of 34.86%. Based on the results of the economic evaluation, the phenyl acetic acid plant from benzyl chloride and NaCN is feasible to be established and studied further.

Key words: Phenyl acetic acid, benzyl chloride, benzyl cyanide, hydrolysis reaction.