

## INTISARI

Pabrik hidrogen dirancang dengan kapasitas 20.000 ton/tahun dan beroperasi selama 330 hari/tahun. Hidrogen sebagai produk mempunyai kemurnian 99,34%. Bahan baku yang digunakan merupakan gas alam sebanyak 2.449.430,28 MMBTU/tahun dan *steam* sebanyak 95.769,08 ton/tahun. Hasil samping yang diperoleh berupa gas CO<sub>2</sub> dan N<sub>2</sub>. Gas CO<sub>2</sub> sebagai emisi akan diinjeksikan ke dalam sumur – sumur gas yang sudah tidak terpakai untuk mengurangi emisi.

Hidrogen pada pabrik ini dibuat dengan cara mereaksikan gas alam dan *steam* secara kontinyu di dalam *fixed bed multitube reactor* dengan katalis NiO. Reaksi pada *steam reforming* dilakukan pada fase gas dan bersifat endotermis. Reaksi berlangsung dalam range suhu 550 – 850°C dengan tekanan operasi antara 30-29 bar. Hidrogen dengan kemurnian 99,34% diperoleh dengan memurnikan campuran gas produk dengan *pressure swing adsorption* (PSA). Berdasarkan tinjauan kondisi operasi, pemilihan bahan baku dan jenis produk melalui proses *steam reforming*, pabrik ini tergolong berisiko tinggi.

Pabrik ini direncanakan akan didirikan di Bontang, Kalimantan Timur, dan memperkerjakan 195 orang karyawan. Kebutuhan energi untuk menjalankan pabrik ini meliputi kebutuhan listrik sebesar 8.490.455 kWh/tahun, kebutuhan air sebesar 41.470,83 kg/jam dan kebutuhan udara instrumen sebesar 127 m<sup>3</sup>/jam (STP).

Berdasarkan evaluasi ekonomi untuk menjalankan produksi, dibutuhkan modal tetap sebesar \$ 46.726.588,12 dan biaya modal kerja sebesar \$ 10.211.460,82. Berdasarkan evaluasi ekonomi yang dilakukan, pabrik hidrogen yang tergolong *high risk* memiliki nilai ROI sebelum pajak sebesar 41,30%, POT sebelum pajak 1,95 tahun, BEP 37,89%, SDP 18,54% dan DCFRR 31,90%. Berdasarkan nilai-nilai di atas, dapat disimpulkan bahwa pabrik ini menarik secara ekonomi dan layak untuk dikaji lebih lanjut.

**Kata kunci:** Hidrogen, Gas Alam, *Steam*, *Steam Reforming*

## ABSTRACT

The hydrogen plant is designed with a capacity of 20,000 tons/year and operates for 330 days/year. Hydrogen as a product has a purity of 99.34%. The raw materials used are natural gas as much as 2,449,430.28 MMBTU/year and steam as much as 95,769.08 tons/year. The by-products obtained are CO<sub>2</sub> and N<sub>2</sub> gases. CO<sub>2</sub> gas as emission will be injected into unused gas wells to reduce emissions.

Hydrogen in this plant is made by reacting natural gas and steam continuously in a fixed bed multitube reactor with a NiO catalyst. The reaction in steam reforming is carried out in the gas phase and is endothermic. The reaction takes place in a temperature range of 550-850°C with an operating pressure of 30-29 bar. Hydrogen with a purity of 99.34% is obtained by purifying the product gas mixture by pressure swing adsorption (PSA). Based on a review of operating conditions, selection of raw materials and types of products through the steam reforming process, this plant is classified as high risk.

This factory is planned to be established in Bontang, East Kalimantan, and employs 195 employees. The energy requirements to run this factory include electricity needs of 8,490,455 kWh/year, water requirements of 41,470.83 kg/hour and instrument air requirements of 127 m<sup>3</sup>/hour (STP).

Based on the economic evaluation to run the production, it takes a fixed capital of \$46,726,588.12 and a working capital cost of \$10,211,460.82. Based on the economic evaluation carried out, hydrogen plants classified as high risk have an ROI before tax of 41.30%, POT before tax of 1.95 years, BEP 37.89%, SDP 18.54% and DCFRR 31.90%. Based on the values above, it can be concluded that this factory is economically attractive and deserves further study.

**Keywords:** Hydrogen, Natural Gas, Steam, Steam Reforming