

## ABSTRAK

Hidrogen merupakan gas ringan yang memiliki energi tinggi dan berbagai kegunaan. Selain menjadi sumber energi untuk bahan bakar kendaraan atau industri kimia, hidrogen dapat menjadi senyawa intermediet dalam memproduksi ammonia dan pupuk, bahan baku senyawa peroksida, dan dihidrogenasi asam. Produksi hidrogen terdiri dari tiga tahap yaitu pemurnian gas alam, pembuatan *syngas* dengan reaksi eksotermis pada tri-reformer, dan pemurnian produk dengan absorpsi CO<sub>2</sub>, metanasi, dan adsorpsi CH<sub>4</sub> dan H<sub>2</sub>O. Produk hidrogen yang memiliki 99,99% dihasilkan dan dapat dijual seharga 8000 USD/tonne. Pabrik Hidrogen akan dirancang untuk dibangun di Bontang, Kalimantan Timur dengan kapasitas produksi 70.000 ton/tahun. Adapun pertimbangan pemilihan lokasi pabrik berdasarkan sumber air dan bahan baku. Pabrik ini membutuhkan luas tanah 1.000.000 m<sup>2</sup>, total pegawai 351 orang, dan beroperasi selama 24 jam per hari dengan 330 hari operasi setiap tahunnya. Jumlah gas alam yang dibutuhkan yaitu 28.887,12 kg/jam dari sumur gas alam Bontang. Air yang dibutuhkan untuk pabrik hidrogen ini sebesar 1450,16 m<sup>3</sup>/jam yang diambil dari selat Makassar. Pengoperasian pabrik membutuhkan penunjang berupa gas alam sebesar 0,3428 m<sup>3</sup>/jam bahan bakar, 1,88 kg/jam gas alam, 3551,25 HP listrik, dan steam sebanyak 399.007,0353 kg/jam. Pabrik ini membutuhkan \$218,049,506.27 untuk biaya modal tetap (fixed capital), sedangkan modal kerja (working capital) yang diperlukan adalah \$53,800,241.24. Keuntungan sebelum pajak diperoleh Rp1,383,072,562,029.32 dan keuntungan setelah pajak Rp898,997,165,319.06. Baik secara hazard proses maupun secara ekonomi, pabrik ini memiliki resiko tinggi, dengan return on investment (ROI) 44,04%, pay out time (POT) 1,83 tahun, breakeven point (BEP) 41,70%, shut down point (SDP) 14,36%, dan discounted cash flow rate of return (DCFRR) 35,09%. Berdasarkan nilai tersebut, prarancangan pabrik hidrogen secara finansial layak untuk didirikan setelah proses pengkajian lebih dalam. Pabrik hidrogen diharapkan dapat menyumbang produksi hidrogen di Indonesia dan memajukan berbagai sektor industri di Nusantara.

**Kata kunci : hidrogen, gas alam, syngas, tri-reformer**

## ABSTRACT

*Hydrogen is a lightweight gas that contains high energy with several uses. Aside from being an energy source as fuel for vehicle or chemical industry, hydrogen can be an intermediary compound in producing ammonia and fertilizer, as raw material for proxide, and acid dehydrogenation. The production of hydrogen consists of 3 stages that is natural gas purification, making of syngas by exothermic reaction inside a Tri Reformer, and product purification with CO<sub>2</sub> absorption, methanation, and also CH<sub>4</sub> and H<sub>2</sub>O absorption. Hydrogen product with 99,99% purity are made and can be sold as much as 8000 USD/tonne. Hydrogen plant will be built in Bontang, East Kalimantan with a production capacity of 70.000 ton/year. The considerations in picking the plant location are based on water and raw material availability. This plant requires an empty land with a measurement of 1.000.000 m<sup>2</sup>, a total of 351 employees, and will be operating for 24 hours per day with 330 days of operation annually. The amount of natural gas required for the production is 28.887,12 kg/hour which is obtained from Bontang natural gas well. The required water for the hydrogen plant is as much as 1450,16 m<sup>3</sup>/hour which will be taken from Makassar Strait. The operational activities in plant requires support in the form of natural gas as much as 0,3428 m<sup>3</sup>/hour of fuel, 1,88 kg/hour of natural gas, 3551,25 HP of electricity and 399.007,0353 kg/hour of steam. This plant requires \$218,049,506.27 of Fixed Capital, while the Working Capital needed is \$53,800,241.24. The profit before tax that is obtained is Rp1,383,072,562,029.32 while the profit after tax is Rp898,997,165,319.06. Based on either process or economical viewpoint, this plant is considered as high risk, with a Return On Investment (ROI) of 44,04%, Pay Out Time (POT) of 1,83 year, Breakeven Point (BEP) of 41,70%, Shut Down Point (SDP) of 14,36% and Discounted Cash Flow Rate of Return (DCFRR) of 35,09%. Based on those parameters, pre design of hydrogen plant is considered financially worthy after undergoing a detailed examination and calculation. This hydrogen plant is expected to contribute towards hydrogen production in Indonesia and also help advancing various industrial sectors.*

**Keywords : hydrogen, natural gas, syngas, tri-reformer**