

## INTISARI

Kontribusi industri kimia yang signifikan terhadap peningkatan emisi gas rumah kaca, terutama dari penggunaan bahan bakar fosil dalam proses produksinya, menjadikan transisi menuju energi bersih sangat diperlukan. Salah satu contoh transisi energi bersih yang menjadi kunci mitigasi perubahan iklim ialah pemanfaatan *green hydrogen*. *Green Hydrogen* dapat dihasilkan dari proses elektrolisis air berbasis energi terbarukan. Gas *green hydrogen* yang dihasilkan nantinya dapat dimanfaatkan sebagai bahan baku pada industri kimia, salah satunya ialah industri pupuk. Melalui reaksi gas *green hydrogen* dengan nitrogen, *green ammonia* dapat dihasilkan dan dimanfaatkan untuk pembuatan ammonium sulfat, pupuk yang mengandung 21% nitrogen dan 24% sulfur yang penting untuk meningkatkan produktivitas pertanian, terutama pada lahan tropis yang kekurangan unsur sulfur. Di Indonesia, kebutuhan pupuk ammonium sulfat belum dapat terpenuhi oleh produksi dalam negeri, sehingga angka impor ammonium sulfat terus meningkat. Diproyeksikan pada tahun 2029, kebutuhan impor ammonium sulfat berada di angka 255.544,67 ton. Studi ini menyajikan prarancangan pabrik ammonium sulfat dari *green hydrogen (via green ammonia)* dengan kapasitas 77.000 ton/tahun yang dapat mengurangi 29% kebutuhan impor. Proses utama meliputi sintesis *green ammonia*, reaksi netralisasi dengan asam sulfat dalam reaktor *bubble column*, diikuti dengan pengeringan dan pemisahan padatan. Produk utama yang dihasilkan adalah ammonium sulfat padat berbentuk granular, dengan produk samping berupa oksigen. Untuk mendukung produksi, dibutuhkan 61.172 ton/tahun asam sulfat. Kebutuhan utilitas meliputi 888.961,47 kg/jam air, 50,66 MW listrik, dan 38.313,37 kg/jam steam. Pabrik direncanakan berlokasi di Desa Cilangkap, Kecamatan Babakancikao, Kabupaten Purwakarta, Jawa Barat di atas lahan seluas 55,4 ha. Evaluasi kelayakan ekonomi menunjukkan nilai *break-even point* (BEP) sebesar 38,01%, *pay out time* (POT) 2,03 tahun, *return on investment* (ROI) 40,32% dan *discounted cash flow rate of return* (DCFRR) sebesar 31,21%. Berdasarkan hasil tersebut, proyek ini dinilai layak secara teknis dan ekonomis, serta memiliki dampak positif terhadap pengurangan emisi karbon dan ketahanan pangan nasional melalui penyediaan pupuk berkelanjutan.

**Kata Kunci:** amonium sulfat, elektrolisis, *green ammonia*, *green hydrogen*, keberlanjutan

## ABSTRACT

*The significant contribution of the chemical industry to the rise in greenhouse gas emissions, primarily due to the use of fossil fuels in its production processes, makes the transition to clean energy essential. One key example of clean energy transition that plays an important role in climate change mitigation is the utilization of green hydrogen, which produced via water electrolysis powered by renewable energy. Green hydrogen can be used as a raw material in various chemical industries, including the fertilizer industry. Through the reaction of green hydrogen with nitrogen, green ammonia can be synthesized and further used in the production of ammonium sulfate, a fertilizer containing 21% nitrogen and 24% sulfur, which is crucial for improving agricultural productivity, especially in tropical soils that are typically sulfur-deficient. In Indonesia, domestic production of ammonium sulfate is insufficient, resulting in increasing import volumes. By 2029, the projected import demand for ammonium sulfate is estimated to reach 255,544.67 tons. This study presents the preliminary design of an ammonium sulfate plant based on green hydrogen (via green ammonia) with a production capacity of 77,000 tons per year, which can reduce import dependency by 29%. The main processes include green ammonia synthesis, neutralization with sulfuric acid in a bubble column reactor, followed by drying and solid separation. The primary product is granular ammonium sulfate, with oxygen as a by-product. To support this production, the plant will require 61,172 tons/year of sulfuric acid. Hourly utility needs include 888.961,47 kg of water, 50,66 MW of electricity, and 38,313.38 kg of steam. The plant is planned to be located in Purwakarta, West Java, on a 55.4-hectare.. The economic feasibility evaluation shows a break-even point (BEP) of 38,01%, a pay out time (POT) of 2,03 years, a return on investment (ROI) of 40,32%, and a discounted cash flow rate of return (DCFRR) of 31,21%. Based on these results, the project is considered technically and economically feasible and is expected to contribute positively to both carbon emission reduction and national food security through the production of sustainable fertilizer.*

**Keywords:** *green hydrogen, ammonium sulfate, green ammonia, electrolysis, sustainability*