

## INTISARI

Asam fosfat ( $H_3PO_4$ ) adalah suatu senyawa asam yang tidak mudah terbakar, stabil, dapat larut dalam air, dan bersifat korosif. Asam fosfat sendiri terdiri dari beberapa *grade* yang diperjualbelikan di pasaran, yaitu *technical grade*, *food and beverages grade*, *electronic grade*, dan *fertilizer grade* dimana masing-masing memiliki spesifikasi tersendiri. Asam fosfat *food grade* adalah aditif serta pengawet makanan penting dalam saus makanan, mayones, dan jus buah.

Pabrik asam fosfat *food grade* dari asam sulfat dan batuan fosfat ini dirancang dengan kapasitas 50.000 ton/tahun dan beroperasi secara kontinyu selama 24 jam per hari dan 330 hari per tahun. Bahan baku yang digunakan berupa asam sulfat sebanyak 209.248,3398 ton/tahun dan batuan fosfat sebanyak 239.984,4507 ton/tahun. Proses pembuatan asam fosfat *food grade* yang dilakukan pada pabrik ini adalah hemihidrat-dihidrat (HDH) dan dilanjutkan dengan purifikasi. Reaksi hemihidrat diawali dengan pencampuran batuan fosfat dan *mixed acid* di reaktor alir tangki berpengaduk (RATB) lalu dialirkan ke reaktor yang dipasang seri pada suhu  $90^{\circ}C$  dan tekanan 1 atm. Reaksi dihidrat dijalankan pada RATB pada suhu  $70^{\circ}C$  dan tekanan 1 atm. Produk utama hasil reaksi dari proses HDH adalah asam fosfat 45%  $P_2O_5$  yang kemudian perlu dipekatkan menjadi 54%  $P_2O_5$  untuk selanjutnya menuju proses purifikasi yang diawali dengan alat ekstraktor, yaitu *mixer-settler*, dan dikontakkan dengan solven metil isobutil keton (MIBK). Selanjutnya, ekstrak yang berupa campuran asam fosfat dan MIBK dilewatkan ke *stripper* untuk dipisahkan MIBKnya dengan bantuan *steam*. Fase cair *stripper* kemudian dipekatkan dengan evaporator hingga didapatkan produk utama yaitu asam fosfat *food grade* konsentrasi 85% wt. Sementara itu, keseluruhan proses di pabrik ini menghasilkan beberapa produk samping, yaitu *phospho gypsum*, asam fosfat *fertilizer grade*, asam fluorosilika, dan *slurry* silika dioksida.

Pabrik asam fosfat *food grade* ini akan didirikan di Kawasan Industri JIPE, Gresik, Jawa Timur dengan luas 4,5 hektar dan memiliki karyawan sebanyak 301 orang. Kebutuhan energi untuk menjalankan pabrik ini meliputi air sebesar 605,9469 ton/jam, penyedia udara untuk udara instrumen, udara pengering pada *ball mill*, dan udara pada *boiler* serta *furnace* sebesar 177,9081 ton/jam, bahan bakar *diesel oil* sebesar 0,018 ton/jam, bahan bakar gas alam sebesar 7,37 ton/jam, dan listrik sebanyak 2,368 MW. Sebagai cadangan, disediakan tiga *emergency diesel generator* berkekuatan 0,6 MW.

Untuk menjalankan proses produksi pada pabrik, dibutuhkan modal tetap (*fixed capital*) sebesar \$107.149.487,02 atau Rp1.559.539.353.699,23 dan modal kerja (*working capital*) sebesar \$87.156.531,52 atau Rp1.268.556.105.173,08. Berdasarkan prosesnya, pabrik ini tergolong beresiko rendah dengan nilai ROI sebelum pajak sebesar 37,28%, ROI setelah pajak sebesar 27,96%, POT sebelum pajak sebesar 2,16 tahun, POT setelah pajak sebesar 2,71 tahun, BEP sebesar 47,54%, SDP sebesar 30,89%, dan DCFRR sebesar 16,37%. Berdasarkan nilai-nilai parameter evaluasi ekonomi di atas, pabrik ini menarik dari segi ekonomi dan layak dikaji lebih lanjut.

Kata kunci: asam fosfat *food grade*, asam sulfat, batuan fosfat

## ABSTRACT

Phosphoric acid ( $H_3PO_4$ ) is an acid compound that is non-flammable, stable, soluble in water, and corrosive. Phosphoric acid is divided into several grades that are traded in the market. There are four grades; technical grade, food and beverages grade, electronic grade, and fertilizer grade; that has its own specifications. Food grade phosphoric acid is an important food additive and preservative in food sauces, mayonnaise, and fruit juices.

Food grade phosphoric acid plant from sulfuric acid and phosphate rock is designed with a capacity of 50,000 tons/year and operates continuously for 24 hours per day and 330 days per year. The raw materials used are sulfuric acid as much as 209,248.3398 tons/year and phosphate rock as much as 239.984,4507 tons/year. The process carried out in this plant is hemihydrate-dihydrate (HDH) and followed by purification. The hemihydrate reaction begins with mixing phosphate rock and mixed acid in the continuous stirred-tank reactor (CSTR) and then flows to the next reactor which is installed in series at temperature of  $90^{\circ}C$  and a pressure of 1 atm. The dihydrate reaction is carried out in CSTR at temperature of  $70^{\circ}C$  and a pressure of 1 atm. The main product of the reaction from the HDH process is phosphoric acid 45%  $P_2O_5$  which then needs to be concentrated to 54%  $P_2O_5$  for further purification, which begins with extractor and is contacted with methyl isobutyl ketone (MIBK) solvent. Then, the extract (mixture of phosphoric acid and MIBK) will flow to stripper to separate the MIBK with steam. The liquid phase of stripper is concentrated with evaporator and will produce the main product, food grade phosphoric acid 85%wt. Meanwhile, the entire process in this plant produces several by-products; phospho gypsum, fertilizer grade phosphoric acid, hydrofluorosilicic acid, and silica dioxide slurry.

The food grade phosphoric acid plant will be established in the JIPE Industrial Estate, Gresik, East Java with an area of 4.5 hectares and has 301 employees. The amount of energy required to run this plant such as water is 605.9467 tons/hour, air supply for instrument air, drying air for ball mill, and air for boiler also furnace is 177.9081 tons/hour, diesel fuel oil is 0.018 tons/hour, natural gas fuel is 7.37 tons/hour, and electricity is 2.368 MW. As a backup, three emergency diesel generators with power of 0.6 MW are provided.

To run the production process in this plant, it takes fixed capital of \$107,149,487.02 or Rp1,559,539,353,699.23 and working capital of \$87,156,531.52 or Rp1,268,556,105,173.08. Based on the process, this plant is classified as low risk with ROI before tax is 37.28%, ROI after tax is 27.96%, POT before tax is 2.16 years, POT after tax is 2.71 years, BEP is 47.54%, SDP is 30.89%, and DCFRR is 16.37%. Based on the economic evaluation that has been calculated above, this plant is considered feasible and worthy of further review.

Keywords: food grade phosphoric acid, phosphate rock, sulfuric acid