

## **BAB XII**

### **DISKUSI DAN KESIMPULAN**

#### **XII. 1. Diskusi**

Pendirian pabrik *isosorbide* dari TKKS melalui proses multikatalitik didasarkan pada pemanfaatan TKKS sebagai bahan baku terbarukan dengan biaya lebih rendah. Pabrik *isosorbide* tergolong sebagai pabrik *zero carbon waste*, dimana hasil karbon dioksida yang dihasilkan pabrik akan dimanfaatkan perkebunan kelapa sawit untuk tumbuh dan menghasilkan FEB. Hasil olahan FEB ini nantinya akan menghasilkan limbah TKKS dan akan kembali digunakan sebagai bahan baku pabrik *isosorbide*. Siklus tersebut membuat pabrik turut mendukung 2 regulasi Indonesia, yaitu *Paris Agreement* dan *clean from waste* Indonesia. Tidak hanya itu, dengan berdirinya pabrik *isosorbide* diharapkan dapat memenuhi kebutuhan pasar *isosorbide* baik dalam negeri maupun luar negeri yang dapat meningkatkan pendapatan ekonomi dan meningkatkan nilai TKKS.

Kelayakan pabrik *isosorbide* berbahan baku TKKS melalui proses multikatalitik dapat ditinjau dari beberapa hal sebagai berikut:

##### **1. Bahan baku**

Bahan baku utama yang digunakan dalam pabrik ini adalah tandan kosong kelapa sawit (TKKS). TKKS dipilih karena jumlahnya yang melimpah dan adanya ketidakseimbangan antara jumlah limbah yang dihasilkan dengan pemanfaatannya di Indonesia. Limbah TKKS biasanya digunakan sebagai bahan bakar industri CPO dan pupuk oleh perkebunan sawit setempat. Jika meninjau kandungannya, limbah TKKS mengandung komposisi selulosa yang tinggi. Hal ini menjadikan TKKS berpotensi sebagai bahan baku terbarukan untuk memproduksi *isosorbide* dan akan meningkatkan nilai dari TKKS. Limbah akan diperoleh dari perkebunan kelapa sawit sekitar lokasi pabrik.

##### **2. Proses dan produk yang dihasilkan**

Proses produksi *isosorbide* dari TKKS melalui 5 tahap proses, yaitu *pre-treatment*, hidrolisis, hidrogenasi, dehidrasi, dan kristalisasi. TKKS akan

melalui proses *pre-treatment* terlebih dahulu mulai dari pengecilan ukuran hingga mencapai ukuran 3,327 mm dan dikeringkan, kemudian akan mengalami proses hidrolisis asam subkritis untuk memecah polisakarida menjadi gula-gula sederhana selama 20 menit. Produk yang keluar akan dinetralkan dengan CaO dan dipisahkan antara fasa cair dan padatan, kemudian fasa padat merupakan produk samping pabrik *isosorbide* berupa CaSO<sub>4</sub> yang akan disimpan dalam *tote tank* dan dijual ke industri *gypsum*. Fasa cair akan dihidrogenasi untuk mengubah glukosa menjadi sorbitol dengan menggunakan katalis ZnCl<sub>2</sub> dan Ru/C. Selanjutnya sorbitol akan mengalami proses dehidrasi untuk membentuk *isosorbide* dengan menggunakan katalis ZnCl<sub>2</sub> dan CuCl<sub>2</sub>. *Isosorbide* yang telah terbentuk akan difiltrasi dan dinaikkan %*moisture*nya sebelum di kristalisasi. Proses kristalisasi ini bertujuan menurunkan kadar air dan menghasilkan *isosorbide* dalam bentuk bubuk dengan kemurnian 98%.

### 3. Lokasi

Pabrik *isosorbide* ini akan didirikan di Kawasan Industri Kotawaringin Barat, Kalimantan Tengah dengan mempertimbangkan faktor ketersediaan bahan baku, utilitas, ketersediaan tenaga kerja, infrastruktur pendukung, kondisi geografi dan iklim, keberadaan pasar, serta peraturan pemerintah dan faktor komunitas seperti yang telah dijabarkan dalam bab VI.

### 4. Ekonomi

Kelayakan pabrik *isosorbide* dari TKKS melalui proses multikatalitik berdiri ditinjau dari segi ekonomi, melalui analisa ekonomi dengan metode *discounted cash flow*. Hasil analisa ekonomi menunjukkan:

- a. Laju pengembalian modal (ROI) setelah pajak diatas bunga bank (10%), yaitu 11,36%.
- b. Waktu pengembalian modal (POT) setelah pajak, yaitu 6,11 atau 6 tahun 1 bulan 3 hari.
- c. Titik impas (*Break Even Point*) mendekati BEP ideal antara 40%-60%, yaitu 44,65%.
- d. *Minimum Acceptable Rate of Return* (MARR) sebesar 15,79%.

Berdasarkan hasil analisa tersebut, dapat disimpulkan bahwa Prarencana Pabrik *Isosorbide* Berbahan Baku TKKS ini layak untuk dilanjutkan ke tahap perencanaan, baik dari segi teknis maupun ekonomi.

## **XII. 2. Kesimpulan**

Nama Perusahaan	: PT. Titah Sorbida Indonesia
Kapasitas	: 10.000 ton/tahun
Bahan Baku	: Tandan Kosong Kelapa Sawit (TKKS)
Sistem Operasi	: <i>Semi-batch</i>
Mulai beroperasi tahun	: 2027
Utilitas	
1. Air	: Air Sanitasi = 3,3 m <sup>3</sup> / hari
	Air Proses = 754,90 m <sup>3</sup> /hari
	Air Pendingin = 113,86 m <sup>3</sup> /hari
	Air umpan <i>boiler</i> = 508,91 m <sup>3</sup> /hari
2. Listrik	: 4.734,38 kWh
3. LNG	: 1.111,01 mmbtu/tahun
4.IDO	: 74.630 L/tahun
5. Solar	: 45.020 L/tahun
Jumlah Tenaga Kerja	: 100 orang
Lokasi Pabrik	: Kumai, Kecamatan Kotawaringin barat, Kalimantan Tengah

Analisa Ekonomi dengan menggunakan Metode *Discounted Cash Flow*:

- *Rate of Return Investment* (ROI) sebelum pajak : 17,22%
- *Rate of Return Investment* (ROI) setelah pajak : 11,36%
- *Rate of Return Equity* (ROE) sebelum pajak : 40,27%
- *Rate of Return Equity* (ROE) setelah pajak : 26,55%
- *Pay Out Time* (POT) sebelum pajak : 4,95 tahun
- *Pay Out Time* (POT) setelah pajak : 6,11 tahun
- *Break Even Point* (BEP) : 44,65%
- *Minimum Acceptable Rate of Return* (MARR) : 15,79%

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