

DAFTAR ISI

| | |
|---|--------|
| LEMBAR PENGESAHAN | ii |
| PERNYATAAN BEBAS PLAGIASI | iii |
| PRAKATA | iv |
| DAFTAR ISI | v |
| DAFTAR TABEL | xiii |
| DAFTAR GAMBAR | xxii |
| DAFTAR <i>CODE AND STANDARD</i> | xxvi |
| <i>ABSTRACT</i> | xxvii |
| INTISARI | xxviii |
| BAB I PENGANTAR | 1 |
| 1.1 Latar Belakang | 1 |
| 1.2 Tinjauan Pustaka | 2 |
| 1.2.1 Hidrogen Peroksida (H ₂ O ₂) | 2 |
| 1.2.2 Proses Elektrolisis | 2 |
| 1.2.3 Proses Oksidasi Alkohol | 3 |
| 1.2.4 Proses Auto-Oksidasi <i>Ethyl-Anthraquinone</i> | 4 |
| 1.3 Pemilihan Proses | 5 |
| 1.4 <i>Market Analysis</i> | 6 |
| 1.4.1 Potensi Pasar | 6 |
| 1.4.2 Kapasitas Pabrik yang Sudah Ada | 6 |
| 1.4.3 Kapasitas Produksi Optimum | 8 |
| 1.5 Pemilihan Lokasi | 8 |
| 1.5.1 Bahan Baku dan Transportasi | 11 |
| 1.5.2 Air, Energi, dan Utilitas Lainnya | 11 |
| 1.5.3 Buruh (<i>Manpower</i>) | 12 |
| 1.5.4 Iklim | 12 |
| 1.5.5 Faktor Ekonomi, Sosial, dan Hukum | 12 |
| BAB II URAIAN PROSES | 14 |
| BAB III SPESIFIKASI BAHAN | 16 |
| 3.1 Bahan Baku Utama | 16 |

| | | |
|---------------------------|-------------------------------------|----|
| 3.1.1 | <i>2-Ethyl Anthraquinone</i> | 16 |
| 3.1.2 | Benzena | 16 |
| 3.2 | Bahan Baku Tambahan | 17 |
| 3.2.1 | Hidrogen | 17 |
| 3.2.2 | Udara (Oksigen) | 18 |
| 3.3 | Bahan Pembantu | 18 |
| 3.3.1 | Air | 18 |
| 3.3.2 | Katalis Palladium | 19 |
| 3.4 | Produk | 19 |
| 3.4.1 | Hidrogen Peroksida (50%) | 19 |
| 3.5 | Bahan Utilitas | 20 |
| 3.5.1 | Natrium Hipoklorit | 20 |
| 3.5.2 | Natrium Bisulfit | 20 |
| 3.5.3 | Asam Klorida | 21 |
| 3.5.4 | Natrium Hidroksida | 21 |
| 3.5.5 | <i>Anti-Scalant</i> | 22 |
| 3.5.6 | <i>Hydrazine</i> | 22 |
| BAB IV DIAGRAM ALIR | | 23 |
| BAB V NERACA MASSA | | 26 |
| 5.1 | Neraca Massa Total | 26 |
| 5.2 | Neraca Massa pada Setiap Alat | 27 |
| 5.2.1 | Mixer-01 (M-01) | 27 |
| 5.2.2 | Reaktor Hidrogenasi (R-01) | 27 |
| 5.2.3 | Reaktor Oksidasi (R-02) | 28 |
| 5.2.4 | Menara Ekstraksi (ME-01) | 28 |
| 5.2.5 | Dekanter (D-01) | 29 |
| 5.2.6 | Menara Distilasi (MD-01) | 29 |
| 5.2.7 | Mixer-02 (M-02) | 30 |
| BAB VI NERACA PANAS | | 31 |
| 6.1 | Neraca Panas Total | 31 |
| 6.2 | Neraca Panas pada Setiap Alat | 32 |
| 6.2.1 | <i>Mixer-01 (M-01)</i> | 32 |

| | | |
|--------------------------------|--|----|
| 6.2.2 | Reaktor Hidrogenasi (R-01)..... | 32 |
| 6.2.3 | Reaktor Oksidasi (R-02) | 33 |
| 6.2.4 | Menara Ekstraksi (ME-01) | 33 |
| 6.2.5 | Dekanter (D-01)..... | 34 |
| 6.2.6 | Menara Distilasi (MD-01)..... | 34 |
| 6.2.7 | <i>Mixer-02 (M-02)</i> | 35 |
| 6.2.8 | <i>Heat Exchanger-01 (HE-01)</i> | 35 |
| 6.2.9 | <i>Heat Exchanger-02 (HE-02)</i> | 36 |
| 6.2.10 | <i>Heat Exchanger-03 (HE-03)</i> | 36 |
| 6.2.11 | <i>Heat Exchanger-04 (HE-04)</i> | 37 |
| BAB VII SPESIFIKASI ALAT | | 38 |
| 7.1 | Pompa..... | 38 |
| 7.1.1 | Pompa-01 (P-01)..... | 38 |
| 7.1.2 | Pompa-02 (P-02)..... | 38 |
| 7.1.3 | Pompa-03 (P-03)..... | 39 |
| 7.1.4 | Pompa-04 (P-04)..... | 40 |
| 7.1.5 | Pompa-05 (P-05)..... | 40 |
| 7.1.6 | Pompa-06 (P-06)..... | 41 |
| 7.1.7 | Pompa-07 (P-07)..... | 42 |
| 7.1.8 | Pompa-08 (P-08)..... | 42 |
| 7.1.9 | Pompa-09 (P-09)..... | 43 |
| 7.2 | <i>Compressor-01 (COMP-01)</i> | 44 |
| 7.3 | <i>Belt Conveyor-01 (BC-01)</i> | 44 |
| 7.4 | <i>Heat Exchanger</i> | 45 |
| 7.4.1 | <i>Heat Exchanger-01 (HE-01)</i> | 45 |
| 7.4.2 | <i>Heat Exchanger-02 (HE-02)</i> | 46 |
| 7.4.3 | <i>Heat Exchanger-03 (HE-03)</i> | 47 |
| 7.4.4 | <i>Heat Exchanger-04 (HE-04)</i> | 48 |
| 7.5 | <i>Mixer</i> | 49 |
| 7.5.1 | <i>Mixer-01 (M-01)</i> | 49 |
| 7.5.2 | <i>Mixer-02 (M-02)</i> | 50 |
| 7.6 | <i>Hopper-01 (H-01)</i> | 51 |

| | | |
|-------------------------|---|-----|
| 7.7 | <i>Storage</i> | 52 |
| 7.7.1 | Tangki Penyimpanan Benzena (T-01) | 52 |
| 7.7.2 | Tangki Penyimpanan Hidrogen Peroksida (T-02) | 53 |
| 7.7.3 | Silo Penyimpanan 2-Ethyl Anthraquinone (S-01) | 54 |
| 7.8 | Reaktor | 55 |
| 7.8.1 | Reaktor Hidrogenasi (R-01) | 55 |
| 7.8.2 | Reaktor Oksidasi (R-02) | 56 |
| 7.9 | Dekanter-01 (D-01) | 57 |
| 7.10 | Menara Distilasi-01 (MD-01) | 57 |
| 7.11 | Menara Ekstraksi-01 (ME-01) | 59 |
| BAB VIII UTILITAS | | 61 |
| 8.1 | Unit Utilitas | 61 |
| 8.2 | Unit Penyediaan dan Pengolahan Air | 61 |
| 8.2.1 | Kebutuhan Air | 61 |
| 8.2.2 | Pemilihan Sumber Air | 64 |
| 8.2.3 | Proses Pengolahan Air | 65 |
| 8.2.4 | Alat-alat pada Unit Pengolahan Air | 72 |
| 8.3 | Unit Pembangkit <i>Steam</i> | 95 |
| 8.4 | Unit Penyediaan Udara Instrumen | 99 |
| 8.4.1 | Estimasi Kebutuhan Laju Udara | 99 |
| 8.4.2 | Pengeringan Udara dengan Adsorben | 101 |
| 8.4.3 | Daya Kompresor Udara Instrumen | 102 |
| 8.5 | Unit Pembangkit dan Pendistribusian Listrik | 103 |
| 8.5.1 | Kebutuhan Listrik Alat Proses | 103 |
| 8.5.2 | Kebutuhan Listrik Alat Utilitas | 104 |
| 8.5.3 | Kebutuhan Listrik untuk Instrumentasi | 105 |
| 8.5.4 | Kebutuhan Listrik Perkantoran, Taman, Penerangan, dan lain-lain | 105 |
| 8.5.5 | Perkiraan <i>Diesel Emergency Generator</i> | 106 |
| 8.6 | Unit Pengolahan Limbah | 106 |
| 8.6.1 | Limbah Gas | 107 |
| 8.6.2 | Limbah Cair | 107 |
| 8.6.3 | Limbah Padat | 110 |

| | |
|--|-----|
| BAB IX TATA LETAK PABRIK..... | 111 |
| 9.1 Tata Letak Pabrik | 111 |
| 9.2 Tata Letak Alat Proses..... | 113 |
| BAB X PERTIMBANGAN ASPEK KESELAMATAN, KESEHATAN KERJA, DAN LINGKUNGAN..... | 115 |
| 10.1 <i>Safety, Health, dan Environment (SHE) Management</i> | 115 |
| 10.2 Struktur Organisasi Manajemen SHE | 123 |
| 10.3 Identifikasi <i>Hazard</i> Bahan..... | 125 |
| 10.4 Identifikasi <i>Hazard</i> Limbah | 129 |
| 10.5 Identifikasi <i>Hazard</i> Proses | 132 |
| 10.6 <i>Hazard and Operability Study (HAZOP)</i> | 148 |
| BAB XI ORGANISASI PERUSAHAAN..... | 164 |
| 11.1 Bentuk Perusahaan | 164 |
| 11.2 Struktur Organisasi..... | 165 |
| 11.3 Tugas dan Wewenang..... | 167 |
| 11.4 Jam Kerja Karyawan | 172 |
| 11.5 Kebutuhan Operator | 172 |
| 11.6 Golongan Gaji Karyawan..... | 173 |
| 11.7 Kesejahteraan Sosial Karyawan | 175 |
| 11.8 Manajemen Produksi..... | 177 |
| BAB XII ANALISIS EKONOMI..... | 180 |
| 12.1 Perhitungan <i>Index</i> Harga..... | 180 |
| 12.2 Modal Tetap (<i>Capital Investment</i>)..... | 182 |
| 12.2.1 <i>Purchased Equipment Cost (PEC)</i> | 182 |
| 12.2.2 <i>Utility Equipment Cost (UEC)</i> | 185 |
| 12.2.3 Perhitungan Biaya <i>Raw Material, Sales</i> , dan Bahan Utilitas..... | 190 |
| 12.2.4 Perhitungan Biaya Pekerja Pembangunan Pabrik..... | 192 |
| 12.2.5 Perhitungan Biaya <i>Operating Labor</i> | 193 |
| 12.2.6 Perhitungan Harga Tanah dan Bangunan | 193 |
| 12.2.7 Perhitungan <i>Fixed Capital</i> | 193 |
| 12.3 Biaya Produksi (<i>Manufacturing Cost</i>) | 196 |
| 12.4 Modal Kerja (<i>Working Capital</i>) | 197 |

| | | |
|---|---|-----|
| 12.5 | Pengeluaran Umum (<i>General Expense</i>)..... | 198 |
| 12.6 | Analisis Keuntungan | 199 |
| 12.7 | Analisis Kelayakan <i>Profitability</i> | 200 |
| 12.7.1 | Faktor Lang..... | 200 |
| 12.7.2 | <i>Return of Investment</i> (ROI)..... | 201 |
| 12.7.3 | <i>Payout Time</i> (POT) | 201 |
| 12.7.4 | <i>Discounted Cash Flow Rate of Return</i> (DCFRR)..... | 202 |
| 12.7.5 | <i>Break-Even Point</i> (BEP) dan <i>Shut Down Point</i> (SDP)..... | 203 |
| 12.7.6 | <i>Sensitivity Analysis</i> | 206 |
| BAB XIII KESIMPULAN..... | | 209 |
| DAFTAR PUSTAKA..... | | 210 |
| LAMPIRAN PERHITUNGAN ALAT PROSES..... | | 214 |
| REAKTOR OKSIDASI (R-02)..... | | 216 |
| MENARA DISTILASI (MD-01) | | 244 |
| TANGKI PENYIMPANAN BENZENA (T-01)..... | | 269 |
| TANGKI PENYIMPANAN HIDROGEN PEROKSIDA (T-02)..... | | 277 |
| SILO PENYIMPANAN <i>ETHYL-ANTHRAQUINONE</i> (S-01)..... | | 285 |
| <i>BELT CONVEYOR</i> 1 (BC-01)..... | | 289 |
| <i>HOPPER</i> 1 (H-01) | | 292 |
| <i>MIXER</i> 1 (M-01) | | 296 |
| <i>MIXER</i> 2 (M-02) | | 304 |
| REAKTOR HIDROGENASI (R-01) | | 306 |
| DEKANTER 1 (D-01) | | 310 |
| MENARA EKSTRAKSI 1 (ME-01)..... | | 317 |
| POMPA 09 (P-09) | | 324 |
| POMPA 01 (P-01) | | 331 |
| POMPA 02 (P-02) | | 331 |
| POMPA 03 (P-03) | | 333 |
| POMPA 04 (P-04) | | 334 |
| POMPA 05 (P-05) | | 335 |
| POMPA 06 (P-06) | | 336 |
| POMPA 07 (P-07) | | 337 |

| | |
|--|-----|
| POMPA 08 (P-08) | 338 |
| KOMPRESOR 01 (COMP-01) | 339 |
| <i>HEAT EXCHANGER</i> 01 (HE-01) | 343 |
| <i>HEAT EXCHANGER</i> 02 (HE-02) | 357 |
| <i>HEAT EXCHANGER</i> 03 (HE-03) | 358 |
| <i>HEAT EXCHANGER</i> 04 (HE-04) | 373 |
| LAMPIRAN PERHITUNGAN ALAT UTILITAS..... | 374 |
| <i>SCREENER</i> (SC-101) | 375 |
| BAK EKUALISASI (K-101)..... | 376 |
| BAK SEDIMENTASI (K-102) | 377 |
| <i>CARBON FILTER</i> (F-101) | 379 |
| <i>SEAWATER REVERSE OSMOSIS</i> (RO-101)..... | 381 |
| <i>COLD BASIN</i> (B-101)..... | 383 |
| <i>HOT BASIN</i> (B-102) | 384 |
| <i>COOLING TOWER</i> (CT-101) | 385 |
| <i>CATION EXCHANGER</i> (X-101 A/B) | 393 |
| <i>ANION EXCHANGER</i> (X-102 A/B) | 397 |
| <i>DEAERATOR</i> (DA-101)..... | 401 |
| <i>MIXER</i> DEKLORINASI (M-101) | 405 |
| <i>MIXER ANTI-SCALANT</i> (M-102)..... | 412 |
| <i>MIXER</i> KLOORINASI (M-103)..... | 414 |
| TANGKI PENYIMPANAN AIR KEBUTUHAN UMUM (TK-105) | 416 |
| TANGKI PENYIMPANAN NaHSO ₃ 15% (TK-101) | 421 |
| TANGKI PENYIMPANAN NaOCl 10% (TK-102) | 422 |
| TANGKI PENYIMPANAN <i>ANTI-SCALANT</i> (TK-103) | 423 |
| TANGKI PENYIMPANAN AIR DESALINASI (TK-104)..... | 424 |
| TANGKI PENYIMPANAN AIR <i>HYDRANT</i> (TK-106) | 425 |
| TANGKI PENYIMPANAN HCl 5% (TK-107)..... | 426 |
| TANGKI PENYIMPANAN NaOH 5% (TK-108) | 427 |
| TANGKI PENYIMPANAN <i>HYDRAZINE</i> (TK-109) | 428 |
| TANGKI PENYIMPANAN AIR DEMINERALISASI (TK-110)..... | 429 |
| TANGKI PENYIMPANAN BFW (TK-111) | 430 |

| | |
|---|-----|
| TANGKI PENYIMPANAN KONDENSAT (TK-112) | 431 |
| POMPA UTILITAS | 432 |