# BAB VII

# SPESIFIKASI ALAT

## 7.1 Spesifikasi Alat

### 1. Silo Sodium Silikat ($Na_2O.3,2SiO_2$)

**Gambar 7.1 Silo**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | S-01 | | | |
| Fungsi | = | Untuk menyimpan bahan baku $Na_2O.3,2SiO_2$ | | | |
| Tipe | = | Tangki silinder tegak lurus dengan alas conis | | | |
| Jumlah | = | 1 | unit | | |
| Bahan konstruksi | = | Carbon Steel SA-283, Grade C | | | |
| Kondisi penyimpanan | = | padat | | | |
| Suhu operasi | = | 30 | $^0C$ | | |
| Tekanan operasi | = | 1 | atm | | |
| Volume | = | 710,56 | $m^3$ | 25.093,17 | $ft^3$ |
| Diameter | = | 8,45 | m | | |

| | | | | | |
|---|---|---|---|---|---|
| Tinggi tangki | = | 14,51 | m | | |
| Tebal dinding shell | = | 1,13 | inch | 0,03 | m |
| Tebal head | = | 1 | inch | 0,03 | m |
| Tinggi head | = | 3,01 | m | | |

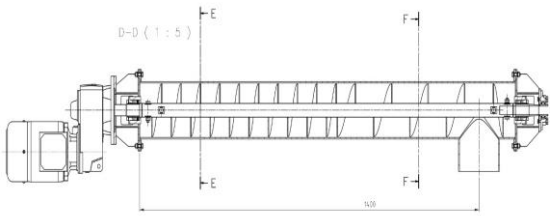
**2. Silo Produk Silicone Dioxide ($SiO_2$)**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | S-02 | | | |
| Fungsi | = | Untuk menyimpan produk SiO2 | | | |
| Tipe | = | Tangki silinder tegak lurus dengan alas conis | | | |
| Jumlah | = | 1 | unit | | |
| Bahan konstruksi | = | Carbon Steel SA-283, Grade C | | | |
| Kondisi penyimpanan | = | Padat | | | |
| Suhu operasi | = | 30 | $^0$C | | |
| Tekanan operasi | = | 1 | atm | | |
| Volume | = | 189,13 | $m^3$ | 6.678,93 | $ft^3$ |
| Diameter | = | 5,44 | m | | |
| Tinggi tangki | = | 9,33 | m | | |
| Tebal dinding shell | = | 0,63 | inch | 0,02 | m |
| Tebal head | = | 1 | inch | 0,02 | m |
| Tinggi head | = | 1,21 | m | | |

**3. Silo Produk Sodium Sulfat ($Na_2SO_4$)**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | S-03 | | | |
| Fungsi | = | Untuk menyimpan produk $Na_2SO_4$ | | | |
| Tipe | = | Tangki silinder tegak lurus dengan alas conis | | | |
| Jumlah | = | 1 | unit | | |
| Bahan konstruksi | = | Carbon Steel SA-283, Grade C | | | |
| Kondisi penyimpanan | = | Padat | | | |
| Suhu operasi | = | 30 | $^0$C | | |
| Tekanan operasi | = | 30 | atm | | |
| Volume | = | 1 | $m^3$ | 5.720,84 | $ft^3$ |
| Diameter | = | 2 | m | | |
| Tinggi tangki | = | 162,00 | m | | |
| Tebal dinding shell | = | 5,16 | inch | 0,01 | m |
| Tebal head | = | 8,86 | inch | 0,02 | m |
| Tinggi head | = | 0,50 | m | | |

**4. Screw Conveyor 01 (SC-01)**



**Gambar 7.2 Screw Conveyor**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | SC-01 | | | |
| Fungsi | = | Memindahkan Na2O.3,2SiO2 dari Silo menuju Bucket Elevator (BE-01) | | | |
| Kapasitas | = | 9,16 | ton/jam | | |
| Diameter | = | 9 | inch | | |
| Panjang | = | 20 | ft | 6,10 | m |
| Ketinggian | = | 5 | ft | 1,52 | m |
| Kecepatan | = | 83 | rpm | | |
| Daya | = | 7 | Hp | | |

**5. Screw Conveyor 02 (SC-02)**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | SC-02 | | | |
| Fungsi | = | Memindahkan $SiO_2$ menuju Rotary Dryer (RD-01) | | | |
| Kapasitas | = | 17,39 | ton/jam | | |
| Diameter | = | 14 | inch | | |
| Panjang | = | 20 | ft | 6,10 | m |
| Ketinggian | = | 5 | ft | 1,52 | m |
| Kecepatan | = | 248 | rpm | | |
| Daya | = | 12 | Hp | | |

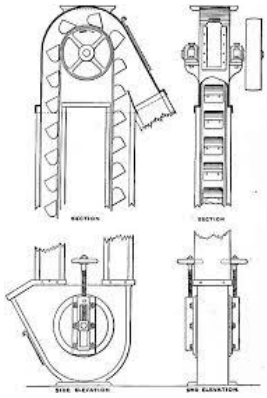
**6. Screw Conveyor 03 (SC-03)**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | SC-03 | | | |
| Fungsi | = | Mengangkut $SiO_2$ keluaran dari Ball Mill (BM-01) | | | |
| Kapasitas | = | 8,69 | ton/jam | | |
| Diameter | = | 9 | inch | | |
| Panjang | = | 20 | ft | 6,10 | m |
| Ketinggian | = | 5 | ft | 1,52 | m |
| Kecepatan | = | 78 | rpm | | |
| Daya | = | 7 | Hp | | |

**7. Screw Conveyor 04 (SC-04)**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | SC-04 | | | |
| Fungsi | = | Mengangkut $Na_2SO_4$ keluaran dari RDV-01 | | | |
| Kapasitas | = | 9,31 | ton/jam | | |
| Diameter | = | 9 | inch | | |
| Panjang | = | 20 | ft | 6,10 | m |
| Ketinggian | = | 5 | ft | 1,52 | m |
| Kecepatan | = | 115 | rpm | | |
| Daya | = | 8 | Hp | | |

**8. Bucket Elevator (BE-01)**



**Gambar 7.3 Bucket Elevator**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | BE-01 | | | |
| Fungsi | = | Mengangkut Bahan baku Na2O.3,2SiO2 menuju Hopper (H-01) | | | |
| Kapasitas | = | 10,26 | ton/jam | | |
| Ukuran | = | 8 x 5 x 5 1/2 | inch | | |
| Jarak antar bucket | = | 0,30 | m | | |
| Tinggi elevator | = | 7,62 | m | 25 | ft |
| Kecepatan bucket | = | 68,58 | m/menit | | |
| Lebar belt | = | 0,23 | m | | |
| Kecepatan putaran | = | 43 | rpm | | |
| Power | = | 2 | Hp | | |

**9. Bucket Elevator (BE-02)**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | BE-02 | | | |
| Fungsi | = | Mengangkut $SiO_2$ menuju Ball Mill (BM-01) | | | |
| Kapasitas | = | 7,78 | ton/jam | | |
| Ukuran | = | 8 x 5 x 5 1/2 | inch | | |
| Jarak antar bucket | = | 0,30 | m | | |
| Tinggi elevator | = | 7,62 | m | 25 | ft |
| Kecepatan bucket | = | 68,58 | m/menit | | |
| Lebar belt | = | 0,23 | m | | |
| Kecepatan putaran | = | 43 | rpm | | |
| Power | = | 2 | Hp | | |

**10. Bucket Elevator (BE-03)**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | BE-03 | | | |
| Fungsi | = | Mengangkut recycle $SiO_2$ menuju Ball Mill (BM-01) | | | |
| Kapasitas | = | 1,94 | ton/jam | | |
| Ukuran | = | 8 x 5 x 5 1/2 | inch | | |
| Jarak antar bucket | = | 0,30 | m | | |
| Tinggi elevator | = | 7,62 | m | 25 | ft |
| Kecepatan bucket | = | 68,58 | m/menit | | |

| | | | | | |
|---|---|---|---|---|---|
| Lebar belt | = | 0,23 | m | | |
| Kecepatan putaran | = | 43 | rpm | | |
| Power | = | 1 | Hp | | |

**11. Bucket Elevator (BE-04)**

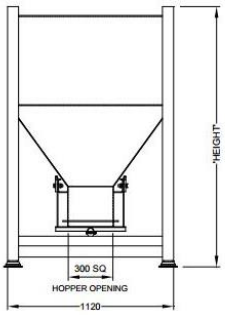
| | | | | | |
|---|---|---|---|---|---|
| Kode | = | BE-04 | | | |
| Fungsi | = | Mengangkut $SiO_2$ menuju Hopper (H-02) | | | |
| Kapasitas | = | 9,73 | ton/jam | | |
| Ukuran | = | 8 x 5 x 5 1/2 | inch | | |
| Jarak antar bucket | = | 0,30 | m | | |
| Tinggi elevator | = | 7,62 | m | 25 | ft |
| Kecepatan bucket | = | 68,58 | m/menit | | |
| Lebar belt | = | 0,23 | m | | |
| Kecepatan putaran | = | 43 | rpm | | |
| Power | = | 2 | Hp | | |

**4. Bucket Elevator (BE-05)**

| | | | |
|---|---|---|---|
| Kode | = | BE-05 | |
| Fungsi | = | Mengangkut $Na_2SO_4$ menuju Hopper (H-03) | |
| Kapasitas | = | 5,75 | ton/jam |

| | | | | | |
|---|---|---|---|---|---|
| Ukuran | = | 8 x 5 x 5 1/2 | inch | | |
| Jarak antar bucket | = | 0,30 | m | | |
| Tinggi elevator | = | 7,62 | m | 25 | ft |
| Kecepatan bucket | = | 68,58 | m/menit | | |
| Lebar belt | = | 0,23 | m | | |
| Kecepatan putaran | = | 43 | rpm | | |
| Power | = | 1 | Hp | | |

**5. Hopper (H-01)**




**Gambar 7.4 Hopper**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | H-01 | | | |
| Fungsi | = | Menampung sementara bahan baku $Na_2O.3,2SiO_2$ sebelum masuk ke Mixer (M-01) | | | |
| Volume | = | 3,88 | $m^3$ | 137 | $ft^3$ |
| Diameter | = | 0,29 | m | | |
| Tebal shell | = | 0,19 | inch | 0,005 | m |

| | | | | | |
|---|---|---|---|---|---|
| Tebal head | = | 0,19 | inch | 0,005 | m |

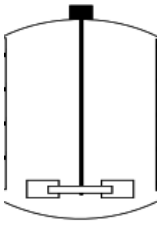
**6. Hopper (H-02)**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | H-02 | | | |
| Fungsi | = | Menampung produk $SiO_2$ sebelum masuk ke Silo (S-02) | | | |
| Volume | = | 3,61 | $m^3$ | 128 | $ft^3$ |
| Diameter | = | 0,29 | m | | |
| Tebal shell | = | 0,19 | inch | 0,005 | m |
| Tebal head | = | 0,19 | inch | 0,005 | m |

**7. Hopper (H-03)**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | H-03 | | | |
| Fungsi | = | Menampung produk $Na_2SO_4$ sebelum masuk ke Silo (S-03) | | | |
| Volume | = | 3,87 | $m^3$ | 137 | $ft^3$ |
| Diameter | = | 0,29 | m | | |
| Tebal shell | = | 0,19 | inch | 0,005 | m |
| Tebal head | = | 0,19 | inch | 0,005 | m |

**8. Mixer (M-01)**



**Gambar 7.5 Mixer**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | M-01 | | | |
| Fungsi | = | Melarutkan Sodium Silika ($Na_2O.3,2SiO_2$) dengan Air ($H_2O$) | | | |
| Tipe | = | Silinder Tegak Lurus dengn alas dan tutup ellipsoidal | | | |
| Jumlah | = | 1 unit | | | |
| Bahan konstruksi | = | Carbon steel SA-283 Grade C | | | |
| Suhu operasi | = | 30 | °C | | |
| Tekanan operasi | = | 1 | atm | | |
| Volume | = | 19,95 | $m^3$ | | |
| Diameter | = | 2,40 | m | | |
| Tinggi tangki | = | 4,80 | m | | |
| Tebal dinding shell | = | 0,25 | inch | 0,01 | m |
| Tebal head | = | 0,25 | inch | 0,01 | m |
| Tinggi head | = | 0,60 | m | | |

| | | | | | |
|---|---|---|---|---|---|
| Tinggi mixer | = | 0,80 | m | | |
| Kecepatan putaran | = | 563,25 | rpm | 9,39 | rps |
| Daya pengaduk | = | 33 | Hp | 24,61 | kW |

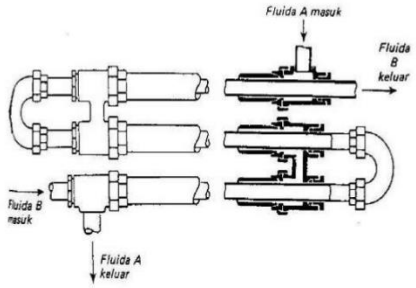
**9. Mixer (M-02)**

| | | |
|---|---|---|
| Kode | = | M-02 |
| Fungsi | = | Menurunkan kadar $H_2SO_4$ 98% menjadi 11,4 % dengan $H_2O$ |
| Tipe | = | Silinder Tegak Lurus dengn alas dan tutup ellipsoidal |
| Jumlah | = | 1 unit |
| Bahan konstruksi | = | Carbon steel SA-283 Grade C, dilapisi *Fiberglass Reinforced Plastics* |

| | | | | | |
|---|---|---|---|---|---|
| Suhu operasi | = | 30 | °C | | |
| Tekanan operasi | = | 1 | Atm | | |
| Volume | = | 32,91 | $m^3$ | | |
| Diameter | = | 2,84 | m | | |
| Tinggi tangki | = | 5,68 | m | | |
| Tebal dinding shell | = | 0,31 | inch | 0,01 | m |
| Tebal head | = | 0,31 | inch | 0,01 | m |
| Tinggi head | = | 0,71 | m | | |

| | | | | | |
|---|---|---|---|---|---|
| Tinggi mixer | = | 0,95 | m | | |
| Kecepatan putaran | = | 476,71 | rpm | 9,39 | rps |
| Daya pengaduk | = | 55 | Hp | 24,61 | kW |

**10. Heater (HE-01)**




**Gambar 7.6 Heater Double Pipe**

| | | |
|---|---|---|
| Kode alat | = | HE-01 |
| Fungsi | = | Memanaskan Sodium Silika ($Na_2O.3,2SiO_2$) keluaran mixer (M-01) |
| Bahan konstruksi | = | *Carbon Steel SA-283 Grade C* |
| Tipe | = | *Double Pipe Heat Exchanger* |

**Data Desain**

| | | | |
|---|---|---|---|
| Temperatur fluida panas masuk | = | 150 | °C |
| Tempartaur fluida panas keluar | = | 120 | °C |
| Temperatur fluida dingin masuk | = | 30 | °C |
| Temperatur fluida dingin keluar | = | 65 | °C |

| | | | |
|---|---|---|---|
| Aliran fluida | = | *Counter Current* | |
| **Annulus** | | | |
| *Outside diameter (*OD) | = | 3,50 | inch |
| *Inside diameter (*ID) | = | 3,068 | inch |
| *Heat transfer area* | = | 35,20 | $ft^2$ |
| *Heat transfer coefficient* | = | 473,2 | $Btu/h.ft^2\ ^oF$ |
| *Fouling factor* | = | 0,002 | $h.ft^2\ ^oF/Btu$ |
| *Pressure drop,* ΔP | = | 0,27 | Psi |
| **Inner pipe** | | | |
| *Outside diameter (*OD) | = | 2,38 | inch |
| *Inside diameter (*ID) | = | 2,067 | inch |
| *Pressure drop,* ΔP | = | 3,71 | Psi |

**11. Heater (HE-02)**

| | | |
|---|---|---|
| Kode alat | = | HE-02 |
| Fungsi | = | Memanaskan Asam Sulfat ($H_2SO_4$) keluaran mixer (M-02) |
| Bahan konstruksi | = | *Carbon Steel SA-283 Grade C* |
| Tipe | = | *Double Pipe Heat Exchanger* |
| **Data Desain** | | |
| Temperatur fluida panas masuk | = | 150 °C |

| | | | |
|---|---|---|---|
| Tempartaur fluida panas keluar | = | 120 | °C |
| Temperatur fluida dingin masuk | = | 30 | °C |
| Temperatur fluida dingin keluar | = | 65 | °C |
| Aliran fluida | = | *Counter Current* | |

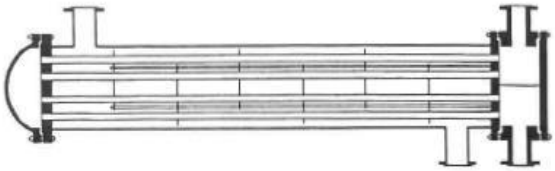
**Annulus**

| | | | |
|---|---|---|---|
| *Outside diameter (*OD) | = | 3,50 | inch |
| *Inside diameter (*ID) | = | 3,068 | inch |
| *Heat transfer area* | = | 70,40 | $ft^2$ |
| *Heat transfer coefficient* | = | 382,9 | $Btu/h.ft^2\ ^oF$ |
| *Fouling factor* | = | 0,002 | $h.ft^2\ ^oF/Btu$ |
| *Pressure drop,* ΔP | = | 0,60 | Psi |

**Inner pipe**

| | | | |
|---|---|---|---|
| *Outside diameter (*OD) | = | 2,38 | Inch |
| *Inside diameter (*ID) | = | 2,067 | Inch |
| *Pressure drop,* ΔP | = | 8,69 | Psi |

**12. Heater (HE-03)**



**Gambar 7.7 Heater Shell and Tube**

| | | | | |
|---|---|---|---|---|
| Kode alat | | = | HE-03 | |
| Fungsi | | = | Memanaskan udara untuk masuk ke Rotary Dryer (RD-01) | |
| Bahan konstruksi | | = | *Carbon Steel SA-283 Grade C* | |
| Tipe | | = | *Shell and Tube Heat Exchanger* | |
| Fluida: | Shell side | = | Steam | |
| | Tube side | = | Udara | |
| Heat transfer area | | = | 546,50 | $ft^2$ |
| Laju alir: | Steam | = | 142.540,76 | kg/jam |
| | Liquid produk | = | 168.624,80 | kg/jam |
| Temperatur masuk: | - *Shell side* | = | 423,15 | K |
| | - *Tube side* | = | 303,15 | K |
| Temperatur keluar: | - *Shell side* | = | 393,15 | K |
| | - *Tube side* | = | 393,15 | K |
| Jumlah *passes:* | - *Shell side* | = | 1,00 | *passes* |

| | | | | |
|---|---|---|---|---|
| | - *Tube side* | = | 2,00 | *passes* |
| *Pressure drop:* | - *Shell side* | = | 7,51 | psi |
| | - *Tube side* | = | 8,64 | psi |

***Shell Side:***

| | | | | |
|---|---|---|---|---|
| | ID | = | 0,39 | m |

***Tube side:***

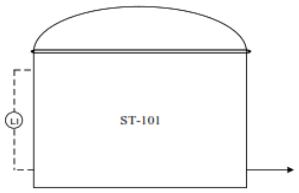
| | | | | |
|---|---|---|---|---|
| | OD | = | 0,02 | m |
| | BWG | = | 15,00 | |
| | Pitch | = | 1,00 | inch square pitch |
| | (Nt) | = | 116,00 | buah |
| | L | = | 7,32 | m |

**13. Heater (HE-04)**

| | | | |
|---|---|---|---|
| Kode alat | | = | HE-04 |
| Fungsi | | = | Memanaskan udara untuk masuk ke Spray Drayer (SD-01) |
| Bahan konstruksi | | = | *Carbon Steel SA-283 Grade C* |
| Tipe | | = | *Shell and Tube Heat Exchanger* |
| Fluida: | Shell side | = | Steam |
| | Tube side | = | Udara |
| Heat transfer area | | = | 546,50 $ft^2$ |

| | | | | |
|---|---|---|---|---|
| Laju alir: | Steam | = | 142.540,76 | kg/jam |
| | Liquid produk | = | 52.740,15 | kg/jam |
| Temperatur masuk: | - *Shell side* | = | 423,15 | K |
| | - *Tube side* | = | 303,15 | K |
| Temperatur keluar: | - *Shell side* | = | 393,15 | K |
| | - *Tube side* | = | 393,15 | K |
| Jumlah *passes:* | - *Shell side* | = | 1,00 | *passes* |
| | - *Tube side* | = | 2,00 | *passes* |
| *Pressure drop:* | - *Shell side* | = | 5,28 | psi |
| | - *Tube side* | = | 7,44 | psi |
| ***Shell Side:*** | | | | |
| | ID | = | 0,39 | m |
| ***Tube side:*** | | | | |
| | OD | = | 0,02 | m |
| | BWG | = | 15,00 | |
| | Pitch | = | 1,00 | inch square pitch |
| | (Nt) | = | 116,00 | buah |
| | L | = | 7,32 | m |

**14. Tangki (T-01)**



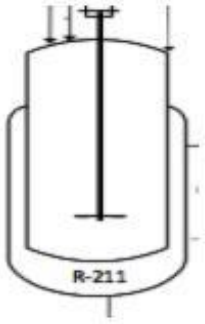

**Gambar 7.8 Tangki**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | T-01 | | | |
| Fungsi | = | Untuk menyimpan Asam Sulfat 98% | | | |
| Tipe | = | Tangki silinder tegak lurus dengan tutup ellipsoidal | | | |
| Jumlah | = | 1 | Unit | | |
| Bahan konstruksi | = | Carbon Steel SA-283 Grade C, dilapisi *Fiberglass Reinforced Plastics* | | | |
| Kondisi penyimpanan | = | Cair | | | |
| Suhu operasi | = | 30 | $^0$C | | |
| Tekanan operasi | = | 1 | atm | | |
| Volume | = | 427,29 | m$^3$ | 112.877,16 | gallon |
| Diameter | = | 7,42 | m | | |
| Tinggi tangki | = | 11,75 | m | | |
| Tebal dinding shell | = | 0,88 | inch | 0,02 | m |
| Tebal head | = | 0,63 | inch | 0,02 | m |
| Tinggi head | = | 1,99 | m | | |

**15. Tangki (T-02)**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | T-02 | | | |
| Fungsi | = | Untuk menyimpan filtrat cairan dari rotary drum vacuum filter (RDV-01) | | | |
| Tipe | = | Tangki berpengaduk tegak lurus dengan tutup ellipsoidal | | | |
| Jumlah | = | 1 | unit | | |
| Bahan konstruksi | = | Carbon Steel SA-283 Grade C, dilapisi *Fiberglass Reinforced Plastics* | | | |
| Kondisi penyimpanan | = | Cair | | | |
| Suhu operasi | = | 45 | $^0$C | | |
| Tekanan operasi | = | 1 | atm | | |
| Volume | = | 580,54 | m$^3$ | 153.363,30 | gallon |
| Diameter | = | 8,22 | m | | |
| Tinggi tangki | = | 13,01 | m | | |
| Tebal dinding shell | = | 0,75 | inch | 0,02 | m |
| Tebal head | = | 0,63 | inch | 0,02 | m |
| Tinggi head | = | 2,65 | m | | |
| Kecepatan putaran | = | 164,41 | rpm | | |
| Daya | = | 1 | Hp | | |

**16. Reaktor (R-01)**

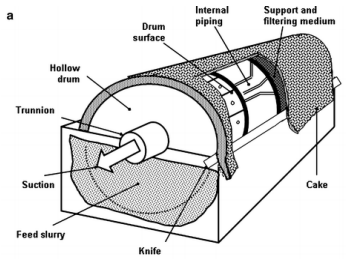



**Gambar 7.9 Reaktor**

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | R-01 | | | |
| Jumlah | = | 1 | Buah | | |
| Fungsi | = | Tempat reaksi bahan baku Sodium Silikat dengan Asam Sulfat | | | |
| Bahan konstruksi | = | *Stainless steel SA-285, grade A* | | | |
| Tekanan operasi | = | 1 | Atm | | |
| Tekanan design | = | 2,02 | Atm | | |
| Temperatur | = | 65 | $^0$C | | |
| Volume reaktor | = | 125,81 | $m^3$ | 33.236,06 | gallon |
| Diameter reaktor | = | 4,74 | M | | |
| Tinggi reaktor | = | 7,12 | M | | |
| Tebal shell | = | 0,44 | Inch | | |
| Tinggi tutup alas | = | 0,80 | M | | |

| | | | | | |
|---|---|---|---|---|---|
| Tebal head | = | 0,44 | Inch | | |
| Jenis pengaduk | = | flate blade turbine | | | |
| Diameter pengaduk | = | 1,58 | m | | |
| Panjang blade | = | 0,40 | m | | |
| Kecepatan putaran | = | 55 | rpm | | |
| Daya motor | = | 50 | Hp | 37.285 | watt |
| Jenis pendingin | = | Jaket Pendingin konvensional | | | |
| Id jaket | = | 4,76 | m | | |
| Tinggi jaket | = | 7,92 | m | | |
| Tebal jaket | = | 0,41 | inch | | |
| Jumlah buffle | = | 4 | buah | | |

**17. Rotary Drum Vacuum Filter (RDV-01)**




**Gambar 7.10 Rotary Drum Vacuum Filter**

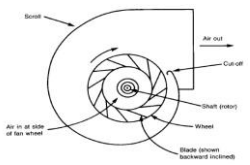
| | | |
|---|---|---|
| Kode | = | RDV-01 |
| Fungsi | = | Memisahkan partikel $SiO_2$ padat dan cair |

| | | | | |
|---|---|---|---|---|
| Bahan | = | Carbon steel, SA-285 Grade C | | |
| Panjang | = | 7,69 | m | |
| Diameter | = | 3,85 | m | |
| Daya | = | 14,00 | Hp | |
| Tebal tangki | = | 0,31 | inch | |
| Luas area | = | 92,94 | $m^2$ | 1.000,05 $ft^2$ |

**18. Rotary Drum Vacuum Filter (RDV-02)**

| | | | | |
|---|---|---|---|---|
| Kode | = | RDV-02 | | |
| Fungsi | = | Memisahkan partikel $Na_2SO_4$ padat dan cair | | |
| Bahan | = | Carbon steel, SA-285 Grade C | | |
| Panjang | = | 4,89 | m | |
| Diameter | = | 2,45 | m | |
| Daya | = | 9,00 | Hp | |
| Tebal tangki | = | 0,25 | inch | |
| Luas area | = | 37,61 | $m^2$ | 404,70 $ft^2$ |

**19. Blower (BL-01)**




**Gambar 7.11 Blower**

Kode = BL-01

Fungsi = Mengalirkan udara menuju Rotary Dryer (RD-01)

Bahan = Commercial steel

Tipe = Centrifugal blower

Laju volumetrik = 100.760,25 $ft^3$/menit

Daya = 20 Hp

**20. Blower (BL-02)**

Kode = BL-02

Fungsi = Mengalirkan udara menuju Spray Dryer (SD-01)

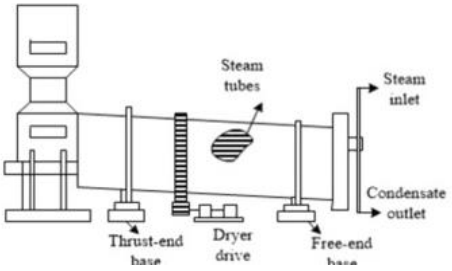
Bahan = Commercial steel

Tipe = Centrifugal blower

Laju volumetrik = 31.514,41 $ft^3$/menit

Daya = 7 Hp

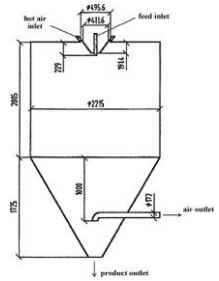
**21. Rotary Dryer (RD-01)**




**Gambar 7.12 Rotary Dryer**

| | | | |
|---|---|---|---|
| Kode | = | RD-01 | |
| Fungsi | = | Mengeringkan padatan produk $SiO_2$ | |
| Bahan | = | Carbon steel, SA-283 Grade C | |
| Suhu | = | 80 | $^0C$ |
| Tekanan | = | 1 | Atm |
| Jumlah | = | 1 | unit |
| Volume | = | 3,114 | $m^3$ |
| Diameter dryer | = | 0,997 | M |
| Panjang dryer | = | 3,989 | M |
| Kecepatan putaran | = | 62,518 | Rpm |
| Waktu tinggal | = | 1,738 | Menit |
| Daya | = | 6 | Hp |

## 22. Spray Dryer (SD-01)




**Gambar 7.13 Spray Dryer**

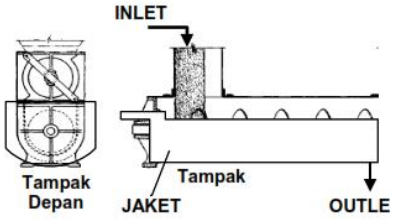
| | | |
|---|---|---|
| Kode | = | SD-01 |
| Fungsi | = | Mengeringkan padatan produk $Na_2SO_4$ |

Tinggi = 10,89 M

Diameter = 2,72 m

Tebal tangki = 0,75 inch

**23. Cooling Conveyor (CC-01)**




**Gambar 7.14 Cooling Conveyor**

Kode = CC-01

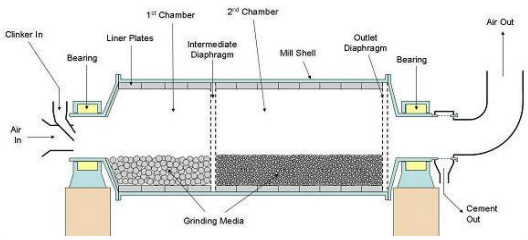
Fungsi = Memindahkan sekaligus mendinginkan $SiO_2$ keluaran Rotary Dryer (RD-01)

| | | | | | |
|---|---|---|---|---|---|
| Kapasitas | = | 6,95 | ton/jam | | |
| Diameter | = | 6 | inch | | |
| Panjang | = | 20 | Ft | 6,10 | m |
| Ketinggian | = | 5 | Ft | 1,52 | m |
| Kecepatan | = | 62 | rpm | | |
| Daya | = | 5 | Hp | | |

## 24. Cooling Conveyor (CC-02)

| | | | | | |
|---|---|---|---|---|---|
| Kode | = | CC-02 | | | |
| Fungsi | = | Memindahkan sekaligus mendinginkan $Na_2SO_4$ keluaran Spray Dryer (SD-01) | | | |
| Kapasitas | = | 9,31 | ton/jam | | |
| Diameter | = | 9 | inch | | |
| Panjang | = | 20 | ft | 6,10 | m |
| Ketinggian | = | 5 | ft | 1,52 | m |
| Kecepatan | = | 121 | rpm | | |
| Daya | = | 7 | Hp | | |

## 25. Ball Mill (BM-01)

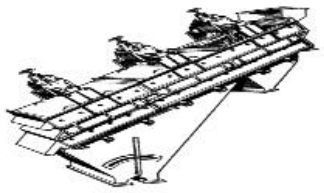



**Gambar 7.15 Ball Mill**

| | | | |
|---|---|---|---|
| Kode | = | BM-01 | |
| Fungsi | = | Memperkecil ukuran padatan $SiO_2$ ± 200 mesh | |
| Kapasitas | = | 208,44 | ton/ hari |

| | | | |
|---|---|---|---|
| Kapasitas max | = | 225,00 | ton / hari |
| Panjang | = | 7,00 | Ft |
| Diameter | = | 5,00 | Ft |
| Power | = | 135,00 | Hp |
| Kecepatan putaran | = | 22,50 | Rpm |

**26. Screening (SR-01)**



**Gambar 7.16 Screening**

| | |
|---|---|
| Kode | = SC-01 |
| Fungsi | = Untuk memisahkan feed $SiO_2$ ukuran 200 mesh dari ball mill |
| Kapasitas | = 41,56 ton/hari |
| Tipe | = electrically vibrated scree |
| Dasar pemilihan | = sesuai dengan bahan dan kapasitas |
| Ty equivalent design | = 20 mesh |
| No. sieve | = 20 |
| Sieve design | = standart 841 micron |

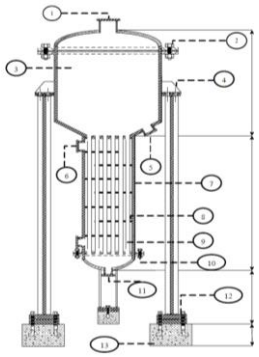
Sieve opening = 0,841 mm

Efisiensi = 94,78 %

Power = 3 Hp

Jumlah = 1 buah

**27. Evaporator (EV-01)**



**Gambar 7.17 Evaporator**

Kode = EV-01

Fungsi = Untuk menguapkan $H_2O$ dan $H_2SO_4$

Bahan kontruksi = *Carbon Steell 283 grade C, dilapisi FRP* (Fiberglass Reinforced Plastics)

Jenis = *Long Tube Vertical Evaporator*

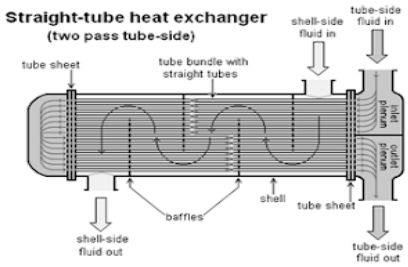
Temperatur = 60 $^0C$

Tekanan = 400 mbar 0,39 atm

Luas evaporator = 766,16 $ft^2$ 71,18 $m^2$

| | | | | | |
|---|---|---|---|---|---|
| Luas ruang uap | = | 0,005 | $ft^2$ | 0,0005 | $m^2$ |
| Jumlah *tube* | = | 122 | buah | | |
| Panjang *tube* | = | 16 | ft | 4,88 | m |
| Diameter *tube* | = | 0,02 | m | | |
| Diameter ruang uap | = | 5,36 | m | | |
| Tinggi *shell* | = | 8,05 | m | | |
| Tebal *shell* | = | 0,01 | m | | |
| Tebal *head* | = | 0,01 | m | | |
| Tinggi total evaporator | = | 10,39 | m | | |
| Jumlah | = | 1 | unit | | |

**28. Kondensor (CD-01)**




**Gambar 7.18 kondensor**

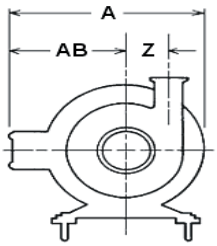
| | | |
|---|---|---|
| Kode alat | = | CD-01 |
| Fungsi | = | Mengubah fasa dan menurunkan temperatur |
| Bahan konstruksi | = | *Carbon steel SA-167 tipe 304* |
| Tipe | = | *Shell and tube heat exchanger* |

Data desain:

| | | | | | |
|---|---|---|---|---|---|
| Temperatur fluida panas masuk | = | 60 | °C | | |
| Tempartaur fluida panas keluar | = | 30 | °C | | |
| Temperatur fluida dingin masuk | = | 20 | °C | | |
| Temperatur fluida panas keluar | = | 30 | °C | | |
| *Heat transfer area* (A) | = | 571,77 | $ft^2$ | | |
| Aliran fluida | = | *Co-current* | | | |
| **Tube Side:** | | | | | |
| Jumlah tube | = | 91 | tubes | | |
| Panjang tube | = | 24 | ft | 7,30 | m |
| OD tube | = | 1,00 | inch | | |
| ID tube | = | 0,83 | inch | | |
| *Lay out tube* | = | *Triangle pitch* | | | |
| *Tube pitch* | = | 1,25 | inch | | |
| *Passes* | = | 1 | | | |
| *Heat transfer coefficient* | = | 47,43 | $Btu/h.ft^2\ ^oF$ | | |
| *Fouling factor* | = | 0,02 | | | |
| ΔP | = | 0,01 | Psi | | |
| **Shell Side:** | | | | | |
| ID shell | = | 15,25 | inch | | |
| *Buffle space* | = | 3,81 | inch | | |

| | | | |
|---|---|---|---|
| *Passes* | = | 1 | |
| ΔP | = | 0,64 | Psi |

**29. Pompa (P-01)**




**Gambar 7.19 Pompa**

| | | | |
|---|---|---|---|
| Kode | = | P-01 | |
| Fungsi | = | Mengalirkan larutan $Na_2O.3,2SiO_2$ dari Mixer (M-01) menuju Reaktor (R-01) | |
| Jenis | = | Sentrifugal | |
| Bahan konstruksi | = | *Commercial steel* | |
| Kapasitas pompa | = | 7,27 | Kg/s |
| P *suction* | = | 1,00 | Atm |
| P *discharge* | = | 4,01 | Atm |
| Power pompa | = | 3,00 | Hp |
| $NPSH_A$ | = | 11,08 | M |
| Ukuran pipa | = | 6,00 | inch, schedule no. 40 |

**30. Pompa (P-02)**

| | | |
|---|---|---|
| Kode | = | P-02 |
| Fungsi | = | Mengalirkan $H_2SO_4$ ke dalam Mixer (M-02) |
| Jenis | = | Sentrifugal |
| Bahan konstruksi | = | *Commercial steel* |
| Kapasitas pompa | = | 1,07 Kg/s |
| P *suction* | = | 1,00 Atm |
| P *discharge* | = | 4,00 Atm |
| Power pompa | = | 1,00 Hp |
| $NPSH_A$ | = | 1,61 M |
| Ukuran pipa | = | 6,00 inch, schedule no. 40 |

**31. Pompa (P-03)**

| | | |
|---|---|---|
| Kode | = | P-03 |
| Fungsi | = | Mengalirkan $H_2SO_4$ dari Mixer (M-01) ke dalam Reaktor (R-01) |
| Jenis | = | Sentrifugal |
| Bahan konstruksi | = | *Commercial steel* |
| Kapasitas pompa | = | 9,19 Kg/s |
| P *suction* | = | 1,00 Atm |
| P *discharge* | = | 4,02 atm |

| | | | |
|---|---|---|---|
| Power pompa | = | 1,00 | Hp |
| $NPSH_A$ | = | 13,89 | m |
| Ukuran pipa | = | 6,00 | inch, schedule no. 40 |

**32. Pompa (P-04)**

| | | |
|---|---|---|
| Kode | = | P-04 |
| Fungsi | = | Mengalirkan keluaran dari Reaktor (R-01) menuju RDV-01 |
| Jenis | = | Sentrifugal |
| Bahan konstruksi | = | *Commercial steel* |
| Kapasitas pompa | = | 16,46 Kg/s |
| P *suction* | = | 1,00 atm |
| P *discharge* | = | 4,06 atm |
| Power pompa | = | 8,00 Hp |
| $NPSH_A$ | = | 13,36 m |
| Ukuran pipa | = | 6,00 inch, schedule no. 40 |

**33. Pompa (P-05)**

| | | |
|---|---|---|
| Kode | = | P-05 |
| Fungsi | = | Mengalirkan filtrat keluaran RDV-01 menuju Tsngki (T-02) |
| Jenis | = | Sentrifugal |

| | | | |
|---|---|---|---|
| Bahan konstruksi | = | *Commercial steel* | |
| Kapasitas pompa | = | 13,11 | Kg/s |
| P *suction* | = | 1,00 | atm |
| P *discharge* | = | 4,04 | atm |
| Power pompa | = | 8,00 | Hp |
| $NPSH_A$ | = | 2,20 | m |
| Ukuran pipa | = | 6,00 | inch, schedule no. 40 |

**34. Pompa (P-06)**

| | | | |
|---|---|---|---|
| Kode | = | P-06 | |
| Fungsi | = | Mengalirkan larutan $Na_2SO_4$ menuju Evaporator (EV-01) | |
| Jenis | = | Sentrifugal | |
| Bahan konstruksi | = | *Commercial steel* | |
| Kapasitas pompa | = | 13,11 | Kg/s |
| P *suction* | = | 1,00 | atm |
| P *discharge* | = | 4,04 | atm |
| Power pompa | = | 7,00 | Hp |
| $NPSH_A$ | = | 8,75 | m |
| Ukuran pipa | = | 6,00 | inch, schedule no. 40 |

**35. Pompa (P-07)**

| | | |
|---|---|---|
| Kode | = | P-07 |
| Fungsi | = | Mengalirkan larutan $Na_2SO_4$ dari Evaporator (EV-01) menuju RDV-02 |
| Jenis | = | Sentrifugal |
| Bahan konstruksi | = | *Commercial steel* |
| Kapasitas pompa | = | 7,24 Kg/s |
| P *suction* | = | 1,00 atm |
| P *discharge* | = | 4,01 atm |
| Power pompa | = | 4,00 Hp |
| $NPSH_A$ | = | 2,79 m |
| Ukuran pipa | = | 6,00 inch, schedule no. 40 |

**36. Pompa (P-08)**

| | | |
|---|---|---|
| Kode | = | P-08 |
| Fungsi | = | Mengalirkan larutan keluaran dari RDV-02 |
| Jenis | = | Sentrifugal |
| Bahan konstruksi | = | *Commercial steel* |
| Kapasitas pompa | = | 4,65 Kg/s |

| | | | |
|---|---|---|---|
| P *suction* | = | 1,00 | atm |
| P *discharge* | = | 4,01 | atm |
| Power pompa | = | 4,00 | Hp |
| $NPSH_A$ | = | 26,46 | m |
| Ukuran pipa | = | 6,00 | inch, schedule no. 40 |