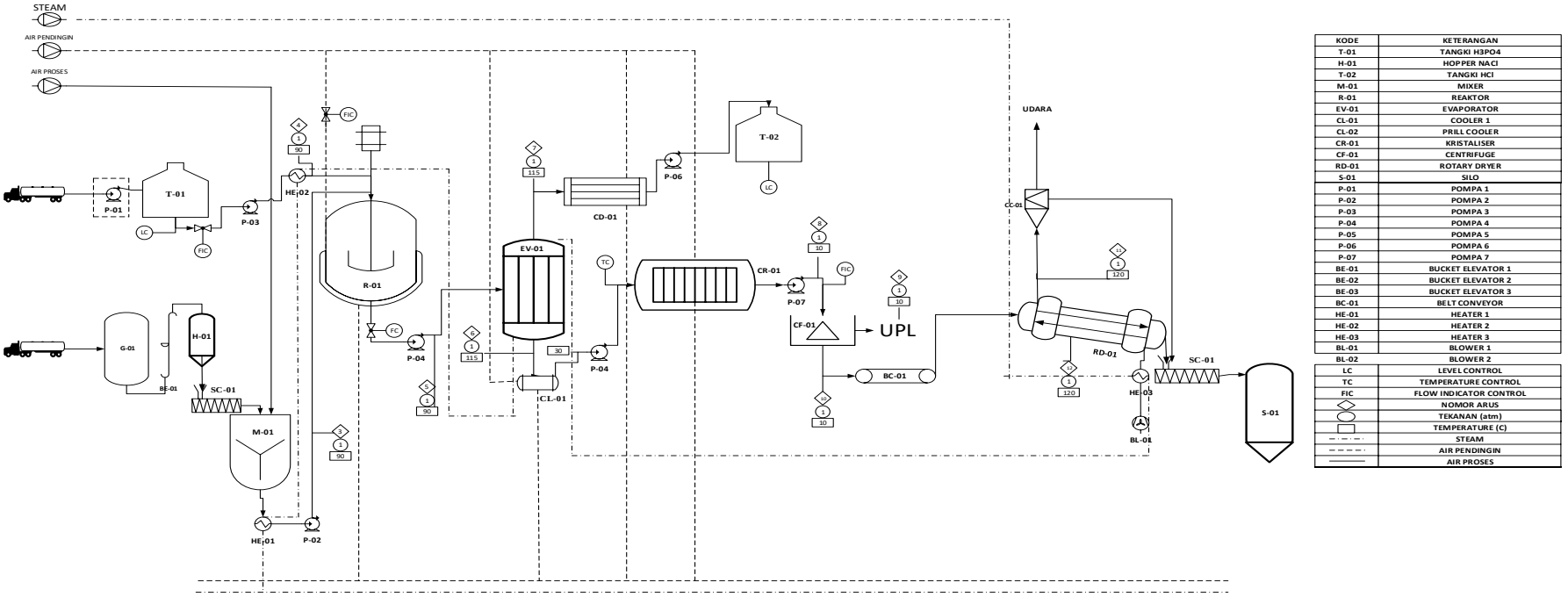
LAMPIRAN I. DIAGRAM ALIR PROSES

DIAGRAM ALIR PROSES PRARANCANGAN PABRIK NATRIUM DIFOSFAT HEPTAHIDRAT
DARI NATRIUM KLORIDA DAN ASAM FOSFAT
KAPASITAS 50.000 TON/TAHUN



KODE	KETERANGAN
T-01	TANGKI H3PO4
H-01	HOPPER NACl
T-02	TANGKI HCl
M-01	MIXER
R-01	REAKTOR
EV-01	EVAPORATOR
CL-01	COOLER 1
CL-02	PRILL COOLER
CR-01	KRISTALISER
CF-01	CENTRIFUGE
RD-01	ROTARY DRYER
S-01	SILO
P-01	POMPA 1
P-02	POMPA 2
P-03	POMPA 3
P-04	POMPA 4
P-05	POMPA 5
P-06	POMPA 6
P-07	POMPA 7
BE-01	BUCKET ELEVATOR 1
BE-02	BUCKET ELEVATOR 2
BE-03	BUCKET ELEVATOR 3
BC-01	BELT CONVEYOR
HE-01	HEATER 1
HE-02	HEATER 2
HE-03	HEATER 3
BL-01	BLOWER 1
BL-02	BLOWER 2
LC	LEVEL CONTROL
TC	TEMPERATURE CONTROL
FIC	FLOW INDICATOR CONTROL
	NOMOR ARUS
	TEKANAN (atm)
	TEMPERATURE (C)
	STEAM
	AIR PENDINGIN
	AIR PROSES

KOMPONE	ARUS 1	ARUS 2	ARUS 3	ARUS 4	ARUS 5	ARUS 6	ARUS 7	ARUS 8	ARUS 9	ARUS 10	ARUS 11	ARUS 12
NaCl	5390.32		5390.32		269.516	269.516		269.516	242.5644	26.9516	26.9516	
H3PO4				4518.831	225.9416	225.9416		225.9416	203.3474	22.59416	22.59416	
HCl					3194.348		3194.348					
Na2HPO4					6219.346	6219.346		30.0016	27.00144	3.00016	3.00016	
H2O	54.44768	12522.97	12577.41	707.4208	13284.83	4126.411	9158.424	4126.411	3713.77	412.6411	288.8542	123.7869
Na2HPO4.7H2O								6189.344		6189.344		6189.344

DIAGRAM ALIR PROSES PRARANCANGAN PABRIK NATRIUM DIFOSFAT HEPTAHIDRAT DARI NATRIUM KLORIDA DAN ASAM FOSFAT KAPASITAS 50.000 TON/TAHUN

Program Studi S1 Teknik Kimia
Fakultas Teknik
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Surakarta
2020

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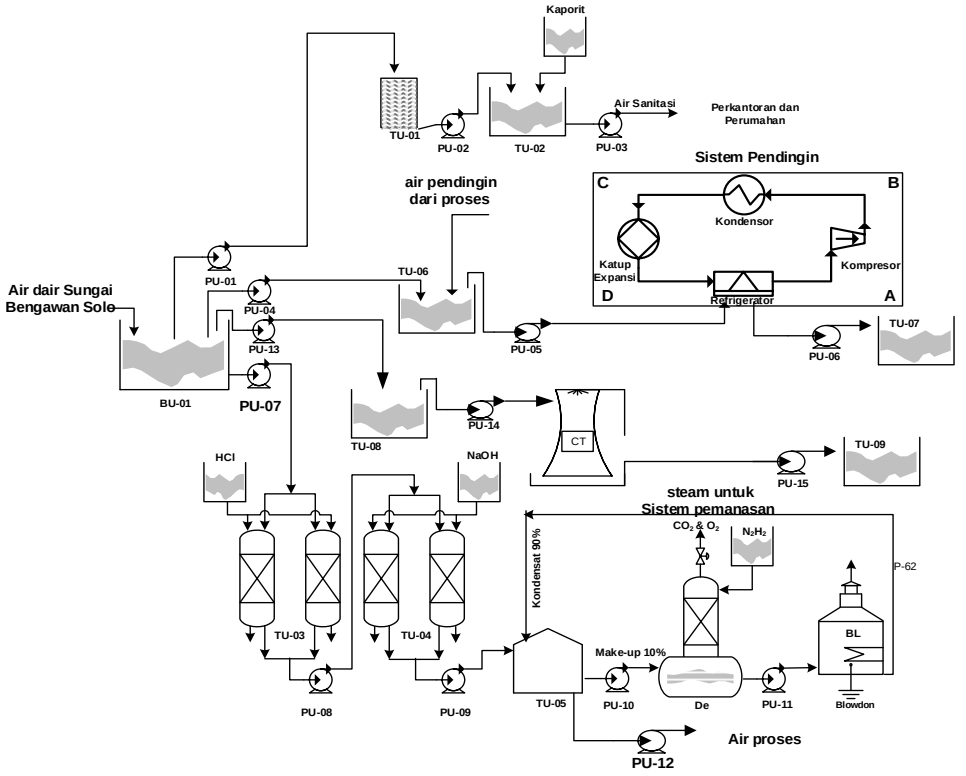
Dr.Sugiyono, S.T.,M.T	Gregorius Primaindra B.S.T., M.Eng

LAMPIRAN II. DIAGRAM ALIR UTILITAS

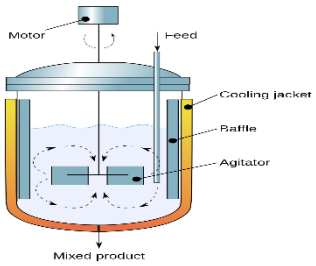
KETERANGAN

BU-01 : Bak Penampung Sementara
TU-01 : Tangki Karbon Aktif
TU-02 : Tangki Air Bersih
TU-03 : Tangki *Kation Exchanger*
TU-04 : Tangki *Anion Exchanger*
TU-05 : Tangki Air Umpan Boiler
TU-06 : Tangki Air Pendingin 1
TU-07 : Tangki Air Pendingin 2
TU-08 : Tangki Air Pendingin 3
TU-09 : Tangki Air Pendingin 4
PU 01-15 : Pompa Utilitas



LAMPIRAN III. PERHITUNGAN ALAT UTAMA

REAKTOR



Fungsi : Untuk mereaksikan NaCl dan H_3PO_4

Jenis : Reaktor Tangki Berpengaduk (RTB)

Kondisi operasi : T = 90 ^oC

P = 1 atm

Waktu Reaksi = 1 jam

Perhitungan Alat :

D = H

Tinggi shell = 3,03 m

Diameter shell = 3,03 m

V Shell = 21,84 m^3

V Thorisperical = 0,000049 x D^3

= 12,86 m^3

V Reaktor = V Shell + V Thorisperical

= 34,7 m^3

Desain Pemanas :

Q = 2816842,3 btu/jam

Diameter dalam jaket = Diameter dalam + (2 x ts)

D1 = 3,54 m

Tinggi jaket = 3,03 m

Asumsi jarak jaket = 0,127 m

Menghitung LMTD :

Suhu fluida direaktor = 194 ^{o}F

Suhu fluida masuk = 80,6 ^{o}F

ΔT LMTD = 194 – 80,6

= 113,4 ^{o}F

Untuk fluida panas aqueous solution dan steam berupa air UD : 250-500 Btu/ft².°F.jam

Diambil 250

Menghitung luas transfer panas :

A = Q/UD x ΔT

= 8,3 m^2

Menghitung luas selubung reaktor :

A = π x D x L

= 39,25 m^2

Luas transfer panas reaktor < dibandingkan dengan selubung reaktor sehingga digunakan jaket pemanas. (Moss, D., Ed.3th, 2004, Hal :35)

Diameter dalam jaket = diameter dalam + (2 x tebal dinding)

= 3,55 m

Tinggi jaket = Tinggi tangki

= 3,03 m

Diameter luas jaket (D2) = D1 + (2 x Jarak Jaket)

= 3,8 m

Luas yang dilalui steam (A) = π/4 (D22 - D12)

= 1,4680 m^2

kec. superficial pendingin (V)= 21,845 m/jam

h jaket = 5,22 m

Menghitung tebal jaket :

Dirancang 10 in / 0,2540 m

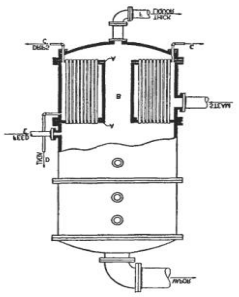
Karena reaksi berlangsung selama 1 jam, direncanakan jumlah reaktor ada 3 agar pabrik dapat berjalan secara kontinyu

pada jam ke-1			
	Reaktor 1	Reaktor 2	Reaktor 3
waktu pengisian			
waktu tinggal/reaksi			
waktu pengosongan			

pada jam ke-2			
	Reaktor 1	Reaktor 2	Reaktor 3
waktu pengisian			
waktu tinggal/reaksi			
waktu pengosongan			

pada jam ke-3			
	Reaktor 1	Reaktor 2	Reaktor 3
waktu pengisian			
waktu tinggal/reaksi			
waktu pengosongan			

EVAPORATOR



Perhitungan :

Q = 808988,90 Btu/jam

Suhu masuk = 194 ^{o}F

Suhu keluar = 239 ^{o}F

Delta T = 45 ^{o}F

UD = 250 btu/j.ft^{2}.^{o}F

Luas perpindahan panas :

A = Q/UDxDeltaT

= 6,68 m^{2}

Dipilih tube standar ukuran 4 in

Jumlah tube = Nt = A'/a't x L

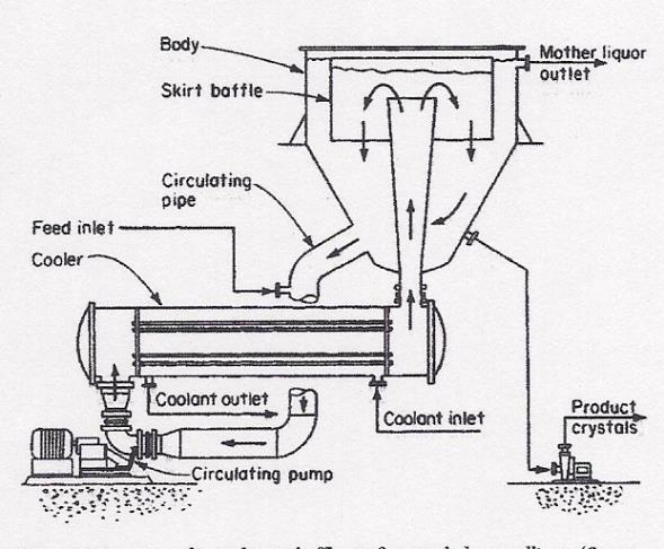
= 87 buah

Diameter Evaporator :

$$D_{evap} = \sqrt{4\,x\,\frac{A}{\pi}}$$

D = 1,85 m

KRISTALISER



V Kristaliser = 625,81 ft^3 / 317,72 m^3

Perhitungan dimensi :

$$\frac{m\,x\,D^3}{2} \times \left(1 + \frac{\pi}{4}\right)$$

(m x D^3)/2 = 350,59 ft

m x D^3 = 701,19 ft

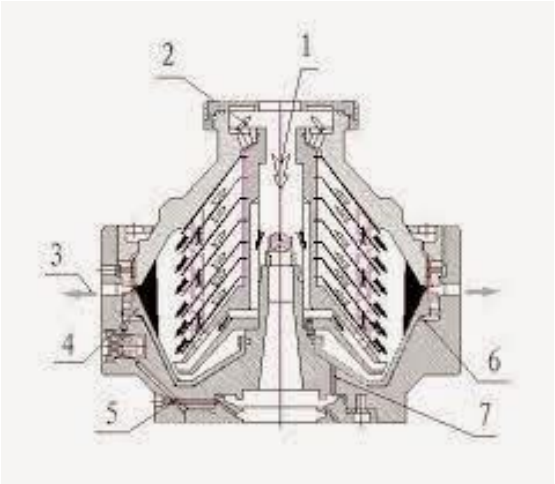
D^3 = 212,48 ft

D = 5,97 ft = 1,82 m

L = 3,3 x D

= 19,69 ft = 6 m

CENTRIFUGE



Perhitungan :

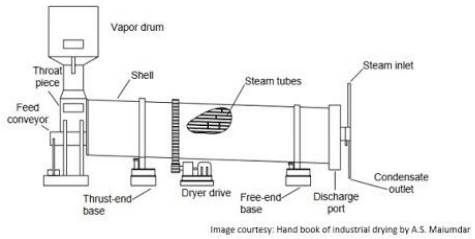
TABLE 18-12 Specifications and Performance Characteristics of Typical Sedimenting Centrifuges

Type	Bowl diameter	Speed, r/min	Maximum centrifugal force × gravity	Throughput		Typical motor size, hp
				Liquid, gal/min	Solids, tons/h	
Tubular	1.75	50,000*	62,400	0.05–0.25		*
	4.125	15,000	13,200	0.1–10		2
	5	15,000	15,900	0.2–20		3
Disk	7	12,000	14,300	0.1–10		⅓
	13	7,500	10,400	5–50		6
	24	4,000	5,500	20–200		7½
Nozzle discharge	10	10,000	14,200	10–40	0.1–1	20
	16	6,250	8,900	25–150	0.4–4	40
	27	4,200	6,750	40–400	1–11	125
	30	3,300	4,600	40–400	1–11	125
Helical conveyor	6	8,000	5,500	To 20	0.03–0.25	5
	14	4,000	3,180	To 75	0.5–1.5	20
	18	3,500	3,130	To 100	1–3	50
	24	3,000	3,070	To 250	2.5–12	125
	30	2,700	3,105	To 350	3–15	200
	36	2,250	2,590	To 600	10–25	300
	44	1,600	1,600	To 700	10–25	400
	54	1,000	770	To 750	20–60	250
Knife discharge	20	1,800	920	†	1.0‡	20
	36	1,200	740	†	4.1‡	30
	68	900	780	†	20.5‡	40

*Turbine drive, 100 lb/h (45 Kg/h) of steam at 40 lbf/in² gauge (372 KPa) or equivalent compressed air.
†Widely variable.
‡Maximum volume of solids that the bowl can contain, ft³.
NOTE: To convert inches to millimeters, multiply by 25.4; to convert revolutions per minute to radians per second, multiply by 0.105; to convert gallons per minute to liters per second, multiply by 0.063; to convert tons per hour to kilograms per second, multiply by 0.253; and to convert horsepower to kilowatts, multiply by 0.746.

Dari Table 18-12 Specifications and Performance Characteristics of Typical Sedimenting Centrifuges (Perry hal 1734). berdasarkan rate volumetrik (gallon per minutes), dipilih spesifikasi centrifuge sebagai berikut : Tubular, helical conveyor, knife discharge dan nozzle discharge tidak ada yg masuk. Dipilih **DISK 24**

ROTARY DRYER



Perhitungan Luas Penampang :

A = mass gas / mass velocity

= 0,738 m^2

Diameter :

D = ((4/pi)*A)^1/3

= 0,97 m

Suhu bahan masuk = 86 °F

Suhu bahan keluar = 248 °F

Suhu udara masuk = 320 °F

Suhu udara keluar = 130 °F

dt1 = 54 °F

dt2 = 162 °F

LMTD = (dt2-dt1)/ln(dt2/dt1)

= 98,3 °F

$$L = \frac{Qp}{0{,}125 . \pi . D . Gs^{0{,}67} . \Delta T\ LMTD}$$

Panjang (L) =

= 3,925 m

Perlengkapan Rotary Dryer :

1. Tebal dinding rotary = 0,1875 m
2. Kecepatan putaran rotary = 10 rpm
3. Flight :
   Tinggi Flight = 0,12 m
   Panjang flight = 2 m
   Jumlah flight 1 circle = 3 m
   Jumlah circle = 2 buah
   Total jumlah flight = 6 buah

4. Hold up padatan :

   Hold up = 0,1*(pi/4)*D^2*L

   = 10,23 ft^3

   Feed rata-rata = 6601,99 kg/jam

$$\theta = \frac{hold\ up}{\rho rata - rata}$$

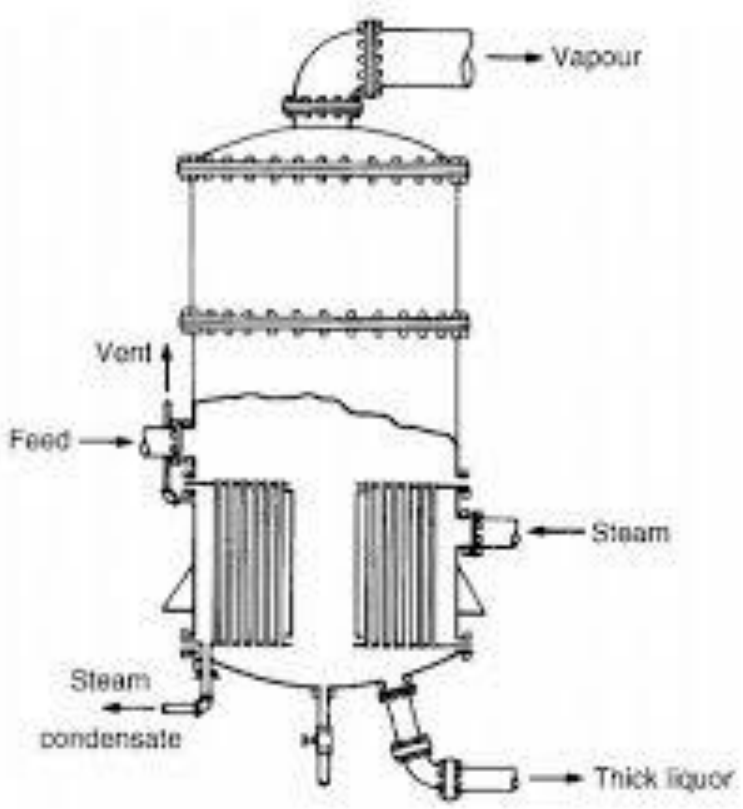
   = 50,1 detik

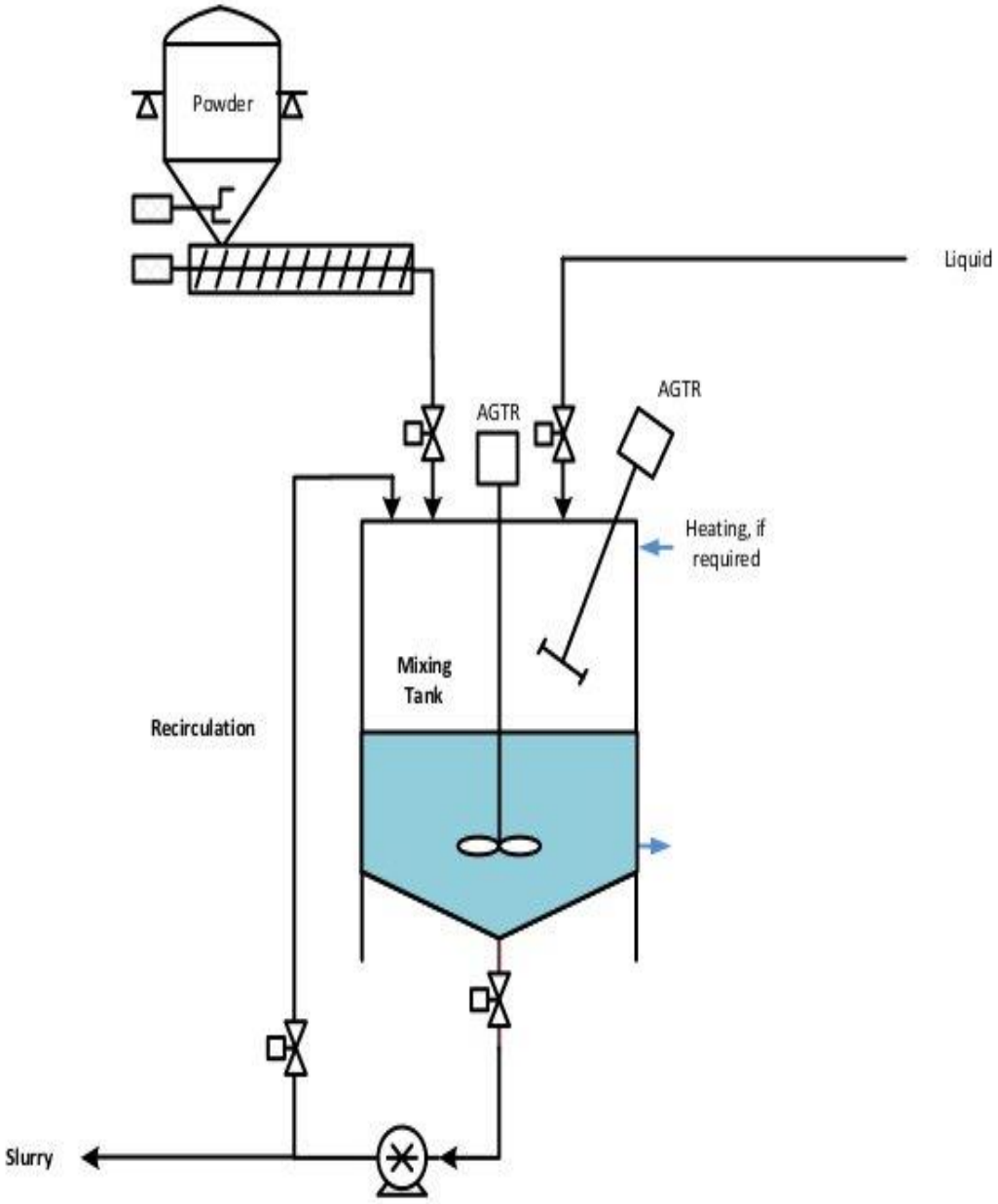
5. Slope/kemiringan rotary

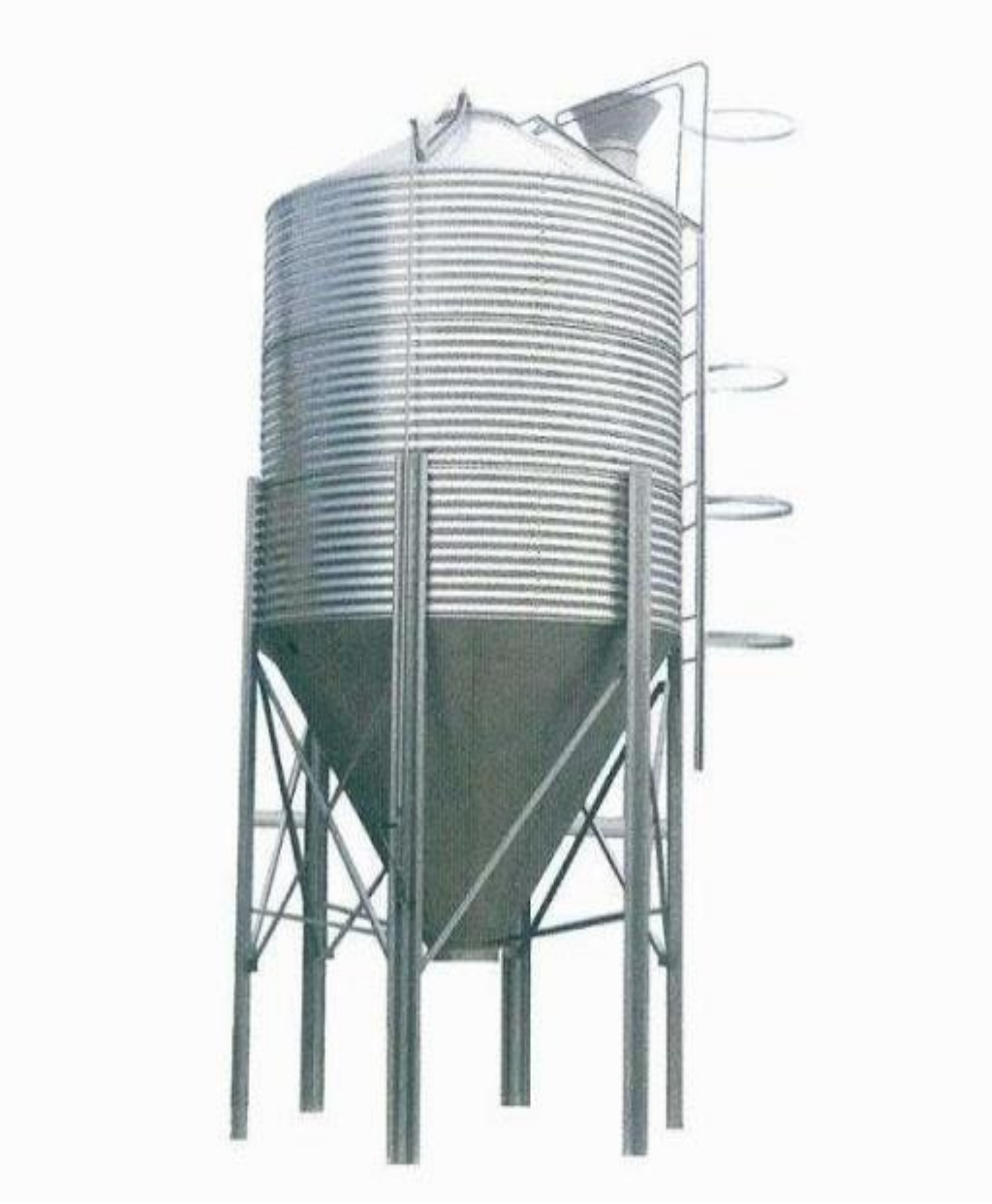
   persamaan friedman and marshall

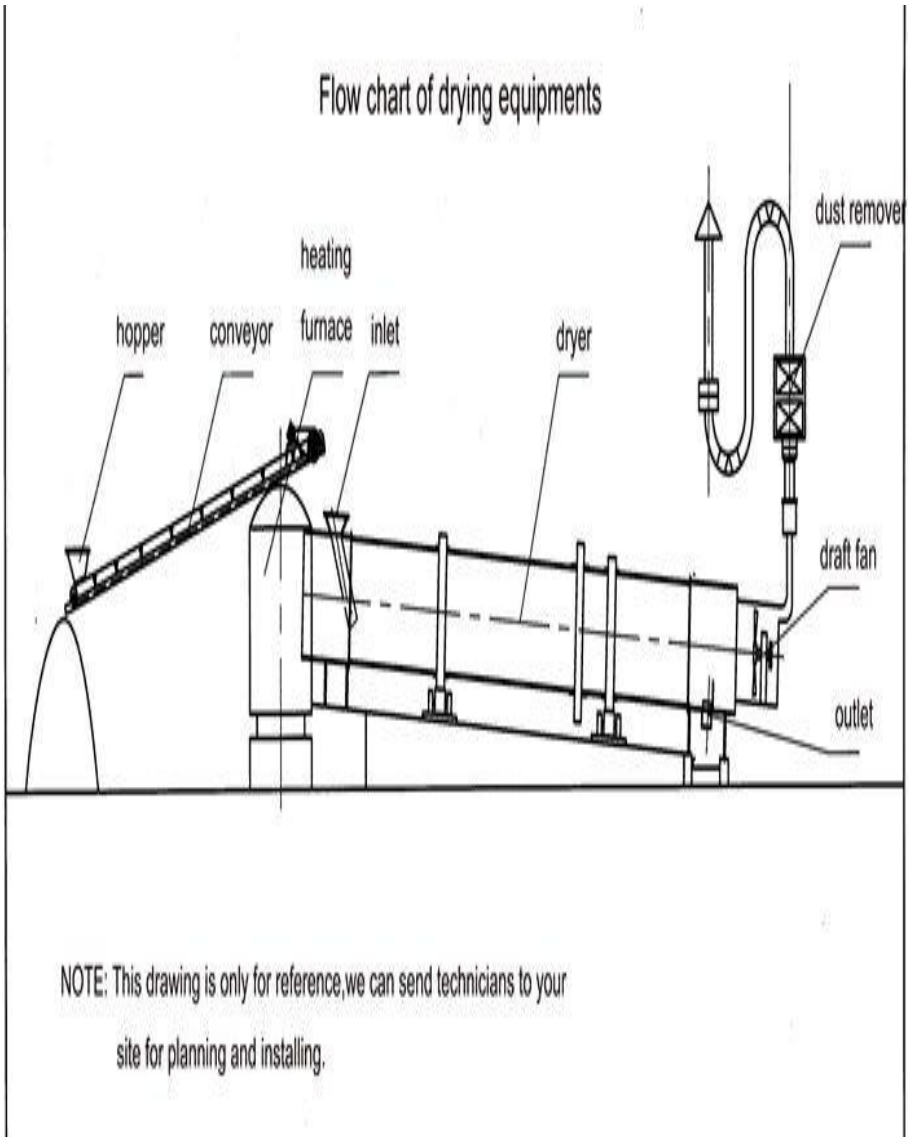
$$\theta = \frac{0,23\ L}{5.N^{0,9}.D} - 0,6\frac{B.L.G}{F}$$

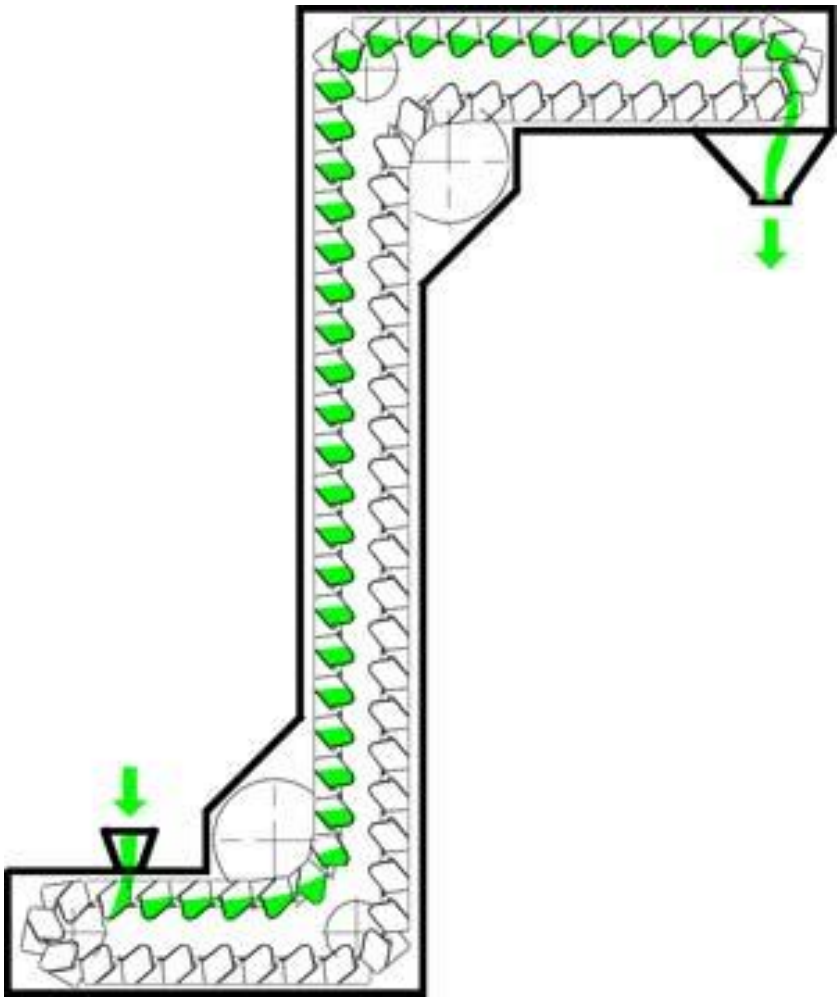
   = 1^o

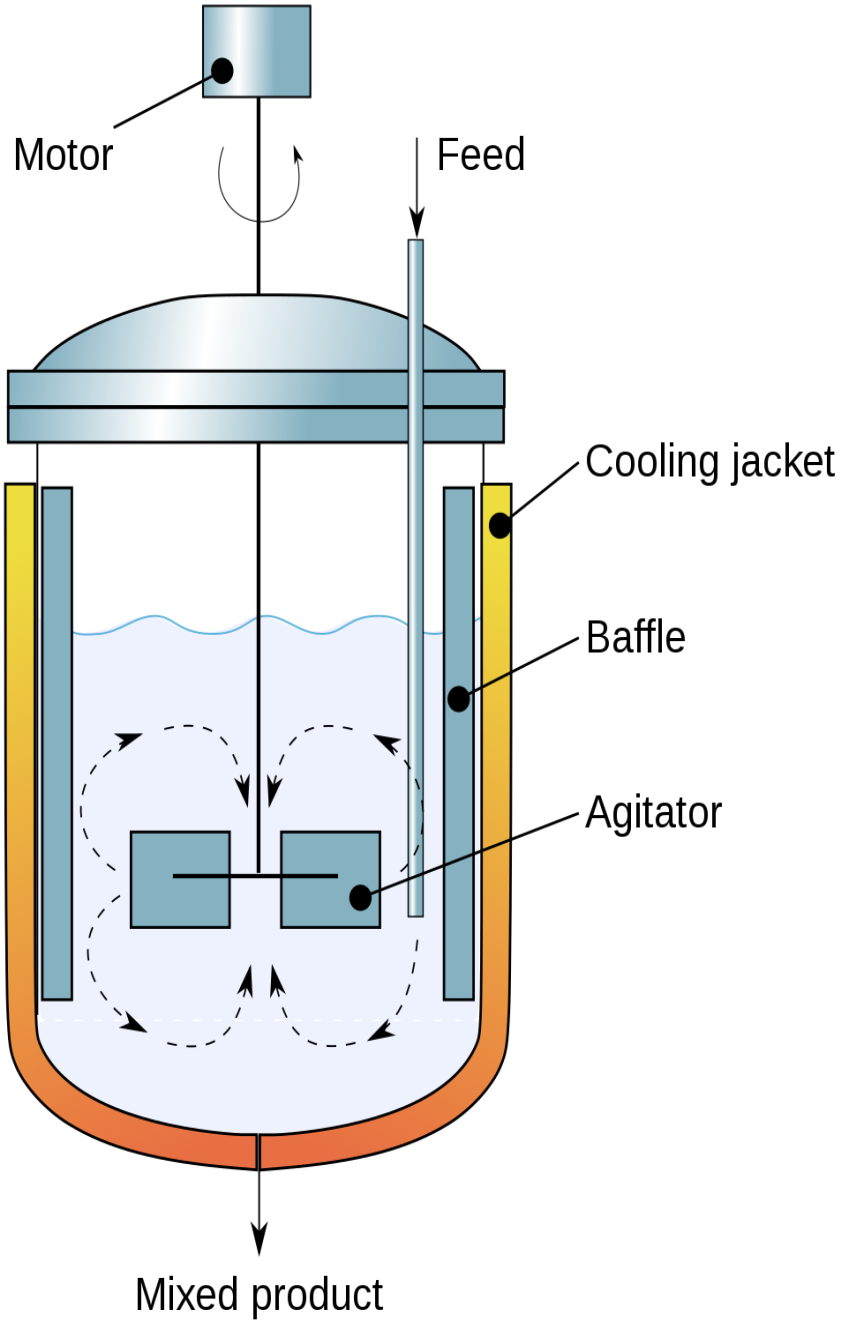

Vapour
Vent
Feed
Steam
Steam
condensate
Thick liquor


Powder
Liquid
AGTR
AGTR
Heating, if
required
Mixing
Tank
Recirculation
Slurry




Flow chart of drying equipments
dust remover
heating
hopper
conveyor
furnace
inlet
dryer
draft fan
outlet
NOTE: This drawing is only for reference,we can send technicians to your
site for planning and installing.




Motor
Feed
Cooling jacket
Baffle
Agitator
Mixed product