

STUDUY MATERIAL ON CENTRIFUGALS

Ashok Kumar Garg

Assistant Professor Sugar Technology

BATCH TYPE CENTRIFUGAL

- Centrifugal operation
- Process parameters
- Equipment details
- Basic principle of centrifugation
- Periodical cleaning schedule
- FBD operation
- Massecuite quality
- Sugar quality, temperature and moisture

CENTRIFUGAL OPERATION

- The massecuite are centrifuged to separate the grains and mother liquor.
- A massecuite is cured in vertical batch type fully automatic machines.
- The charge of massecuite is feed to the centrifugal basket when revolving at 150 rpm and then it is brought to full rpm.
- The massecuite then climbs up the vertical sides.

PROCESS PARAMETERS

- Air pressure should be 7 kg/cm² for proper operation of the pneumatic parts.
- Superheated wash water pressure should be 7-8 kg/cm².
- Superheated washwater temperature should be 110-115 °C.
- Live steam pressure should be 5-6

TIMERS

- T_2 - Maximum supply delay.
- T_3 - Chute wash duration.
- T_4 - Acceleration.
- T_5 - C uring time.
- T_6 - First wash delay.
- T_7 - First wash duration.
- T_8 - Second wash delay.
- T_1 - Masecuite supply delay.
- T_9 - Second wash duration
- T_{10} - Steam wash delay.
- T_{11} - Steam wash delay.
- T_{12} - Syrup delay
- T_{13} - Retardation (1200 rpm to 50 rpm).
- T_{14} - Plough delay.
- T_{15} - Plough duration.
- T_{16} - Plough back delay
- T_{17} - Basket wash delay.
- T_{18} - Basket wash duration.
- T_{19} - Reset & recycling.

EQUIPMENT DETAILS

Various Components of Machine

- Driving motor.
- Shaft.
- Lifting hood (Basket closing valve).
- Basket.
- Monitor casing.
- Discharge chute.
- Syrup seperator.
- Pugmill.
- Masecuite feed pipe.
- A-heavy/A-light molasses gutter.
- Emergency brake.
- Tachometer.

Basic Principle Of Centrifugation

In a centrifugal machine revolving at high speed , the centrifugal force exerted on the mass consisting of sugar crystals surrounded by various liquor brings about the separation the mother liquor from the sugar crystals. The mother liquor passes through the perforations of screen & basket, while the sugar crystals are retained on the wall of the basket lining.

The centrifugal varies directly as the square of the periferal speed and mass but it is inversely proportional to raiious .

This expressed as

$$F = mv^2/r$$

Where

F= Centrifugal force

r=Radius of rotation in meter

m= Mass=w/g or w=mg

g=Force of gravity=9.8 mtr/sec²

w=Weight in kg

V= r ω =angular velocity

$$\omega = 2\pi n/60$$

n= Revolution / minute (RPM)

Hence $F = mr\omega^2$

Gravity Factor

Gravity Factor= Centrifugal force/ Gravitational force

$$= m\omega^2 R_m / mg = \omega^2 R_m / g$$

Where R_m = Mean equivalent Radius

$$= \frac{2(R^3 - r^3)}{3(R^2 - r^2)}$$

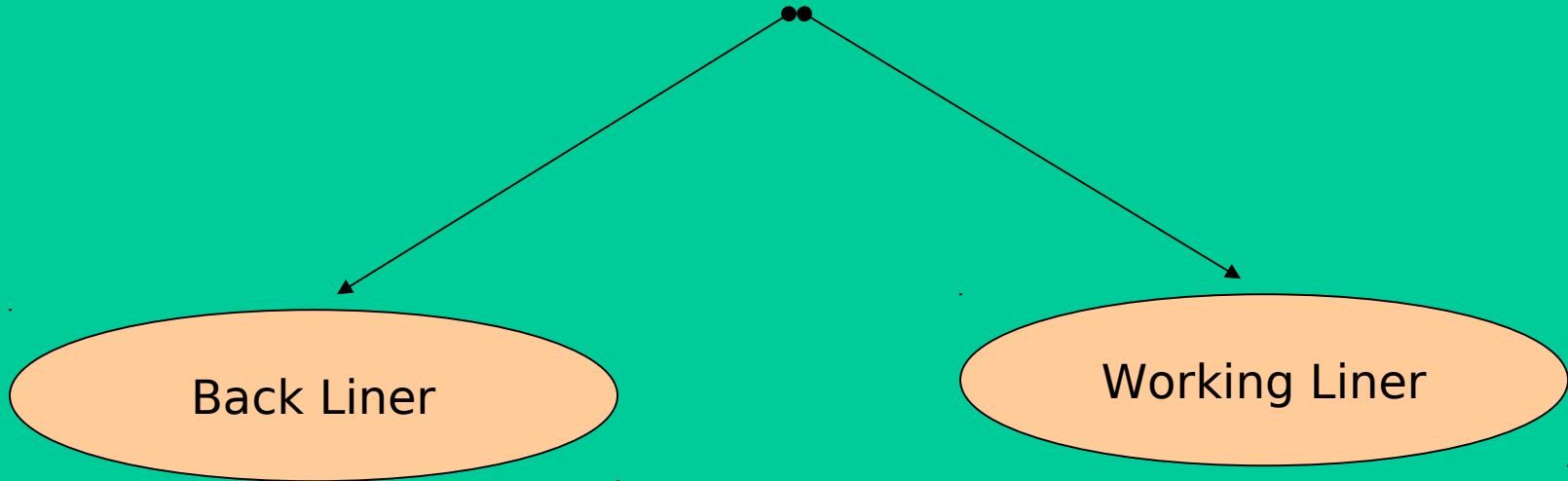
R= Radius of basket

r= Distance of inner layer of masecuite from centre

Thickness of masecuite layer= 0.14D

D = Basket dia meter

LINER



A back liner is 4 mesh /inch of wire 1.2 mm in dia meter

These are perforated sheet of pure copper , stainless steel are special alloy.

These are provided with horizontal slots of 4mm in length 0.3 to 0.4 mm in width generally 0.35 mm

The thickness of perforated sheet varies from 0.45 to 0.8 mm S.S.& for brass 0.7mm

The pitch of these perforations in the vertical direction is 1 mm (100 slots/100mm)

The opening area is 24-26% of the total area

CAPACITY OF BATCH TYPE CENTRIFUGAL

Capacity of batch type centrifugal is given by quantity/charge and upon the size of basket.

$$Q = \pi e H (D - e) \text{ cuft.}$$

Where

Q = Volume of masecuite

D = Interior dia of basket

H = Interior hieght of basket

e = Thickness of masecuite layer (100 to 150 mm).
(0.125D – 0.14D)

PERIODICAL CLEANING SCHEDULE

- Centrifugal machine & platform should be cleaned per shift for oil , grease & sugar dust.
- Discharge chute should be cleaned.
- Blower filter should be cleaned.

F.B.D.OPERATION (Fluidised Bed Dryer)

- The sugar is distributed on a perforated plate. In 50% aera hot air passes through this plate and in 50% aera cold air passes through this plate and through the sugar layer.
- Hot air is passed for reduced the moisture content in sugar.
- Cold air is passed for reduced the temperature.
- The sugar discharge from centrifugal machine generally contain 0.5% to 2% moisture and 65 °c to 70 °c temp. after passing through F.B.D.sugar contain 0.03% to 0.04% moisture and 35 °c to 40 °c temp.

MASSECUITE QUALITY

- For better centrifugation massecuite quality is important factor for centrifugal machine running at full load & better sugar quality.
- Massecuite should contain low viscosity.
- Massecuite should not contain false grain.
- Massecuite should contain regular grain size.
- Massecuite brix should be maintain 88 °Bx – 90 °Bx.

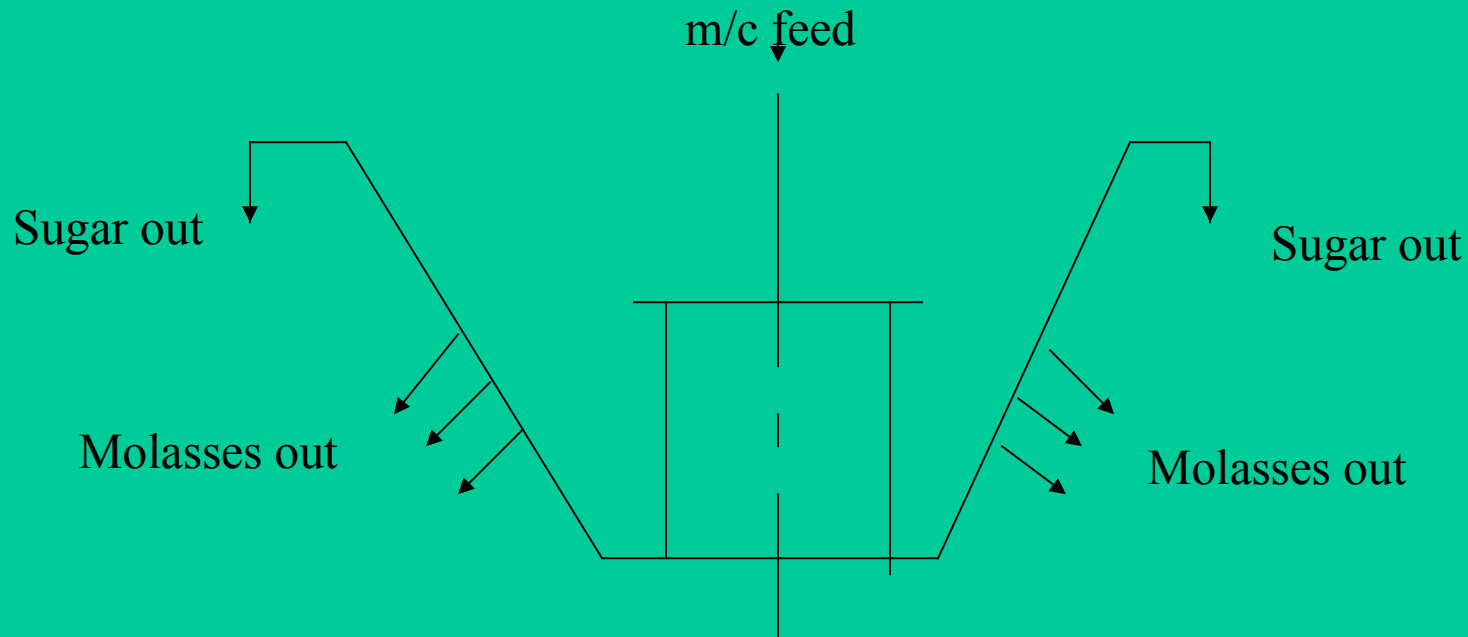
CONTINUOUS CENTRIFUGAL MACHINE

As this name implies this type of centrifugal machines are used to cure continuously low grade massecuite of high viscosity at constant speed of 1500 – 2000 rpm. The centrifugal is fed continuously by the massecuite and the cured sugar is discharged continuously at high speed.

Thus it avoids wastage of time and power, in frequent stoppage, starting the machine, charging & discharging less accelerating power is required.

PRINCIPLE OF OPERATION OF CONTINUOUS C/F MACHINE

This works on the layer principle as the massecuite centrifuged with center point and disintegrate molasses and sugar from massecuite by the action of developed centrifugal force at high rpm.



CENTRIFUGAL FORCE

Centrifugal force = mv^2/r

Gravity factor = centrifugal force/gravitational

force

$$G = (mv^2/r)/mg$$

Where

$$V = r\omega$$

$$\omega = 2\pi n/60$$

= angular velocity

r = radius of basket

CAPACITY OF CONTINUOUS C/ F MACHINE

$$Q = 2K\omega^2V \text{ Ton/hr}$$

Where

V = Volume

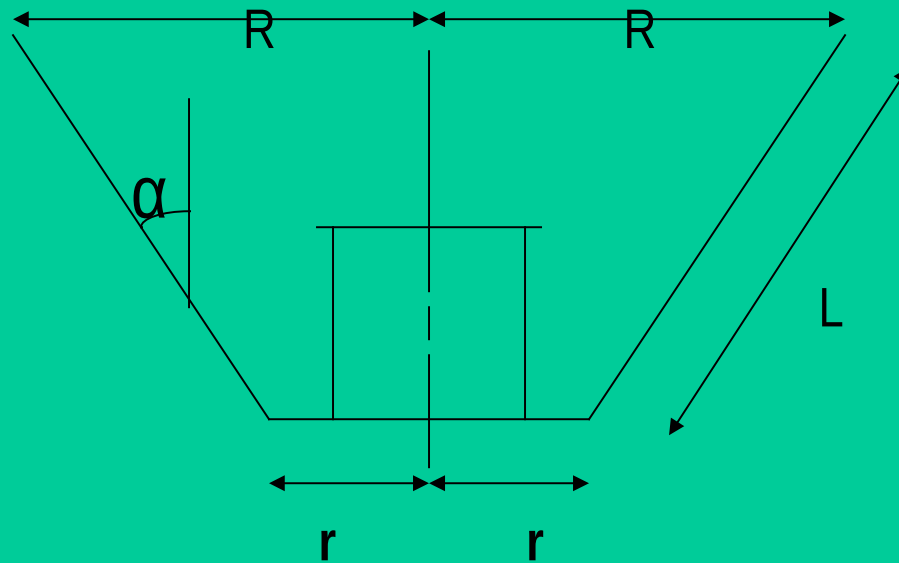
$$= \pi(R^3 - r^3)/3 \tan \alpha \text{ cuft.}$$

K = numerical coefficient.

	CFW	CAW
O.D.		
1100 MM	3 Ton/hr	5Ton/hr

BASKET CONE ANGLE

Generally basket cone angle is 34°



DISCRISPTION OF PARTS

- Masecuite feed pipe (inside).
- Distributor.
- Bearing housing.
- Baskect (s.s).
- Monitor casing.
- Inner cell for seperation of molasses.
- Feed pipe (out side) below trasient heater.
- Pully machne.
- Pully belt (V-grooves).
- Pully motor.

OPERATION

To get the desired quality and capacity of machine, the quantity of masecuite can be regulated by means of pulp valve. Accordingly, we must regulate the steam and water or diluted molasses to achieve the best results.

PROCESS PARAMETER

- Wash water temp. 75°C to 80°C
- Live steam pressure 5 - 6 kg/cm^2
- Curing m/c temp. $45 - 50^{\circ}\text{C}$

SCREEN

The screens for continuous C/F machine are of chrome nickle sheets with perforations (in mm.)

0.06 x 1.66 sheet thickness 0.23 – 0.25

0.06 x 2.2 sheet thickness 0.28 – 0.30

0.09 x 2.3 sheet thickness 0.24

The screen opening area is arround 7% - 10% of
total area.

MASSECUITE CONDITIONING

It is very difficult to dilute a m/c without causing a certain re-resolution of crystals, by this means decreasing viscosity and improves exhaustion.

Cooling 40 -50 c

Reheating 50 – 55 c

Reduction in final molasses purity 1 – 1.5 unit

Increase in c sugar purity 2 – 3 unit.

REASONS FOR RISE IN FINAL MOLASSES PURITY

The general complaint against continuous C/F machine is that there is an increase in the purity of final molasses. This problem depends upon the –

- Design of the working screen screening aperture.
- Feed. rate of massecuite.
- Application of steam & wash water.
- Massecuite quality
- Massecuite curing temp.
- Wash water temp. & pr.
- Operation techniques.

THANK YOU