Diploma in
Sugar Cane Productivity and Maturity Management
(DSPMM)

Sugar Technology (Theory)

Max. Marks - 100

Examination in MAY

	SUBJECT	MAXIMUM MARKS
THEORY	1. Sugarcane Agronomy .	100
	2. Post-Harvest Deterioration and Procurement of Sugarcane .	100
	3. Sugarcane Varietal Distribution and Insect Pest Management	100
	4. Sugar Technology(theory)	**100**
PRACTICAL	Sugarcane Analysis .	100
SESSIONAL	In plant Factory Training (Factory Practice)	50
	Educational Tour	50
	Class marks	50
	Total	650

Syllabus

SUBJECT : SUGAR TECHNOLOGY(THEORY)

CODE : SM/104 MAX. MARKS : 100

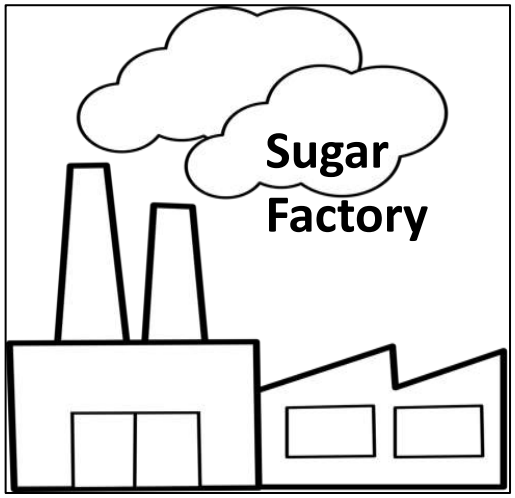
1. **My topics:**
   - **General idea about sugar factories, their capacities and type of sugars produced,**
   - **Flow diagram of process of plantation white sugar,**
   - **Simple calculations for determining-**
   - **Pol % cane,**
   - **Bagasse % cane,**
   - **Java Ratio,**
   - **DMF,**
   - **Fibre % cane.**
   - **General idea about the by-product of the sugar Industry and their utilization for value addition.**

2. Apparent and true purity ,refractrometric and hydrometric brix, effect of dextron on sugar estimation and on processing, removal of dextron, colouring bodies present in sugar cane juice, determination of colour value of sugar cane juice (ICUMSA) , effect of staling of cane on processing.

Sugar Factory ?

Electricity

Sugar Cane



Sugar

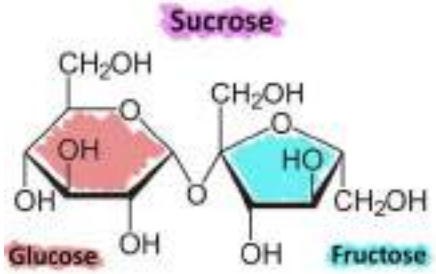
Press Mud

Bagasse

Final Molasses

By-Products

What is Sugar ?



Sugar is a carbohydrate and sweet in taste





it is present in fruits, vegetables, cane, sugar beet & plants.

Generally sugar is manufactured by sugar cane in India.

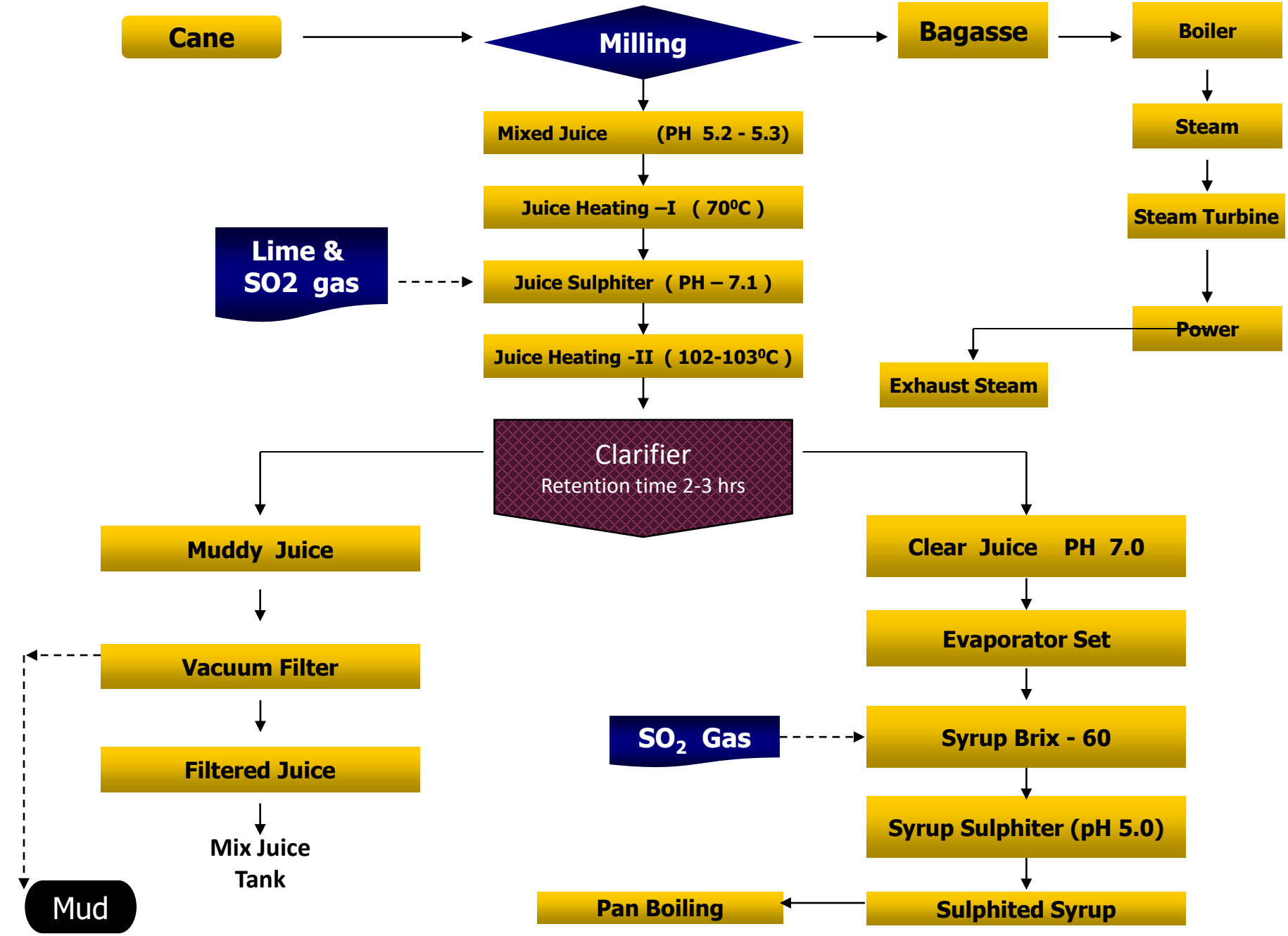
Sugar is a source of energy for human being.

The formula of Sucrose is $\mathbf{C_{12}H_{22}O_{11}}$ & molecular weight is 342.

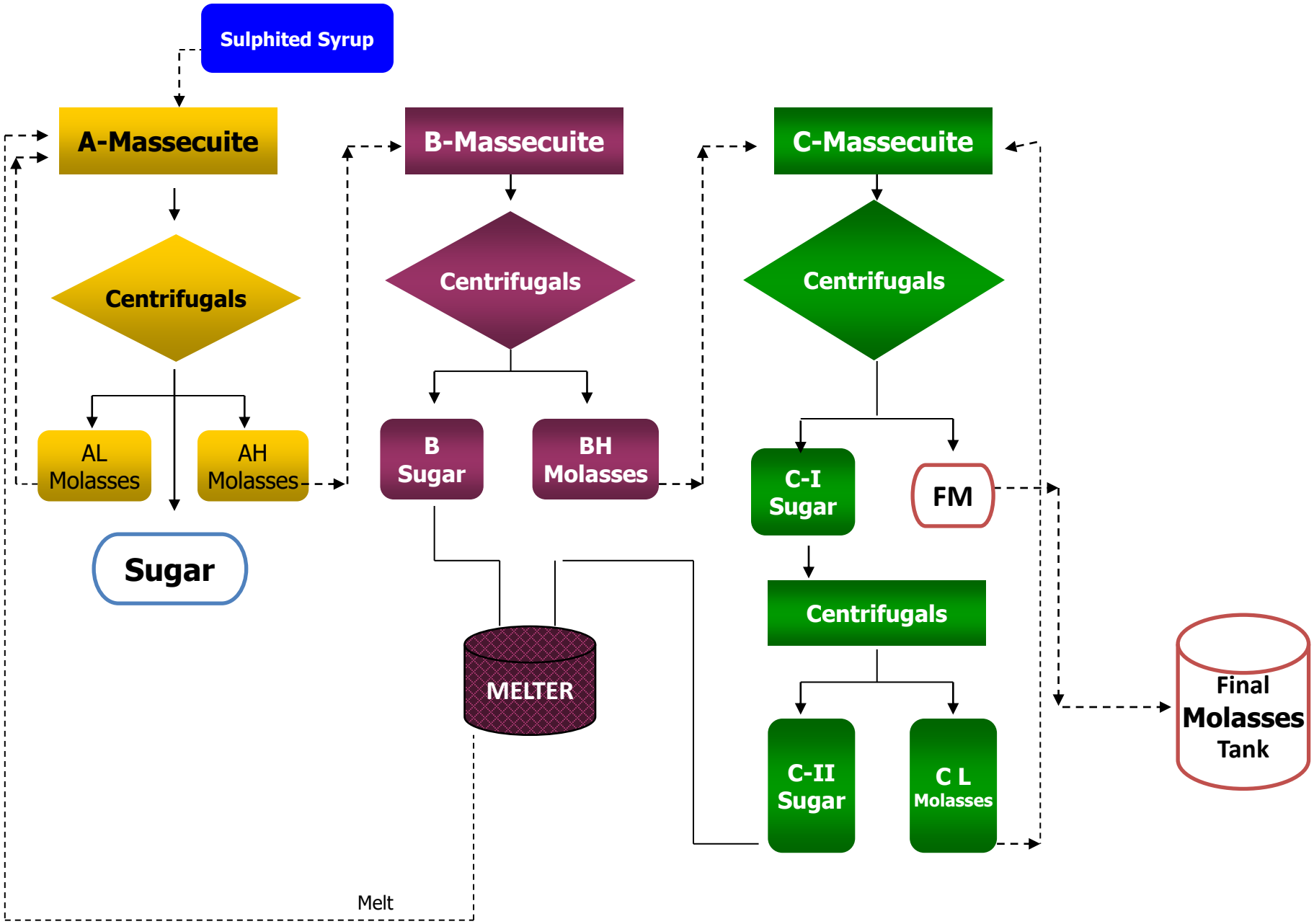
The melting point of Sucrose is 186 °C.

It is a disaccharide, a molecule composed of glucose & fructose.

Process Flow Diagram for Plantation White Sugar



Process Flow Diagram for Plantation White Sugar



About sugar factories, their capacities and type of sugars produced

- Operational sugar mills – 526 operational in India
- Private & Public –309 units
- Cooperative – 217 units
- Average crushing capacity - 4000 TCD (tons per day) per unit
- **Plant capacities in India**

<1250 TCD	3 %
1250 TCD	10 %
1250 - <2500 TCD	9 %
2500 TCD	**35 %**
2500 - < 5000 TCD	17 %
5000 TCD	7 %
5000-1000 TCD	14 %
>1000 TCD	5 %

Sugar Factory Capacity denoted by TCD or TCH

TCD =
Ton cane crushed /day

TCH =
Ton cane crushed /hr

$$TCH = \frac{TCD}{24}$$

Types of Sugars…

- All sugar is made by juice of sugar cane or sugar beet.
- Different types of sugar can be produced by slight adjustments in the process of clarification, crystallizing and drying of sugar.
- Different types of sugar can be produced by varying the level of molasses in sugar.
- Different types of sugar can be produced by different sizes of sugar crystals. Sugars of various crystal sizes provide unique functional characteristics that make the sugar suitable for different foods and beverages.
- Different types of sugar can be produced by variation in sugar colour. Sugar colour is primarily determined by the amount of molasses remaining on or added to the crystals, giving pleasurable flavors and altering moisture.

1. White Sugar

2. Raw Sugar

3. Refined Sugar

4. Cube Sugar

Types of Sugars…

5. Icing Sugar

6. Demerara Sugar

7. Liquid Sugar

8. Khandsaari Sugar

9. Palm Jaggery Sugar

10. Organic Sugar

Pol % Cane…

Brix Hydrometer

What is Brix?

Brix is percentage of dissolved solids in a sugar solution. Brix is measured by brix hydrometer.

What is Pol?

Pol is the value determined by polarimeter. Pol represent the quantity of sugar in the sugar solution.

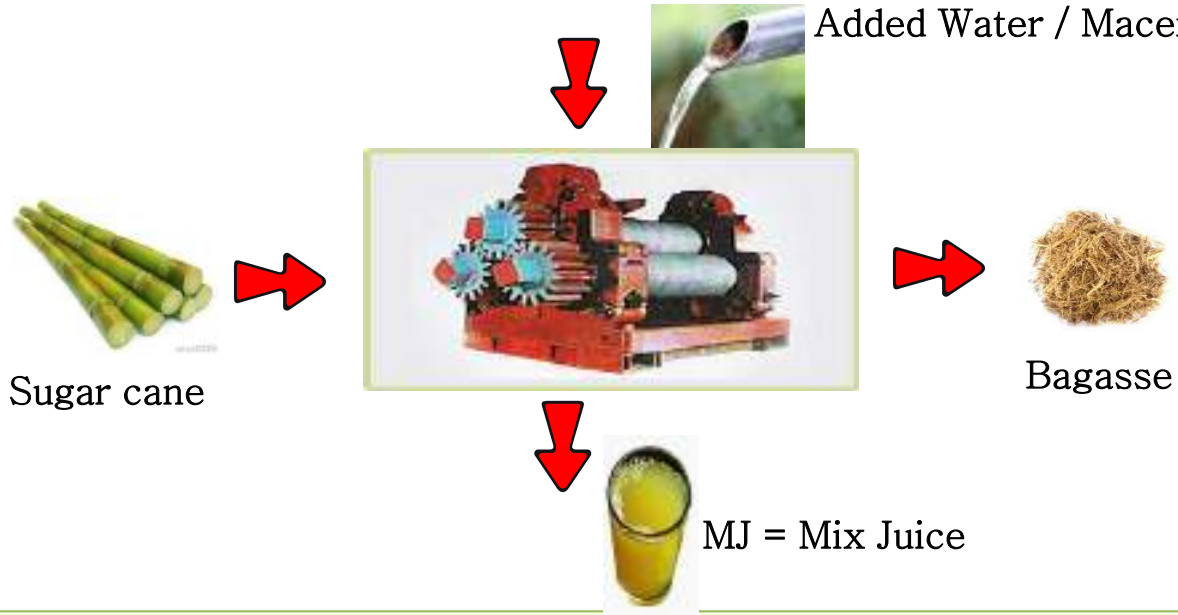
What is Purity?

Brix is ratio of pol% to the brix%.

$$\text{Purity} = \frac{\text{pol\%}}{\text{brix\%}} \times 100$$

Polarimeter

Pol % Cane…



Formula.

Cane + Added Water = Mix Juice + Bagasse

100 + Add water % cane = Mix Juice % cane + Bagasse % cane

Pol % cane = Pol in MJ % cane + Pol in Bagasse % cane

Pol in MJ % cane = (Pol % MJ x MJ % cane) / 100

Pol % MJ = (Brix % x Purity %) / 100

Pol in Bagasse % cane = (Pol % Bagasse x Bagasse % cane) / 100

$$\text{Mix juice \% cane} = \frac{\text{Quantity of mix juice (ton)}}{\text{Quantity of cane crushed (ton)}} \times 100$$

$$\text{Maceration \% cane} = \frac{\text{Quantity of added water (ton)}}{\text{Quantity of cane crushed (ton)}} \times 100$$

$$\text{Bagasse \% cane} = \frac{\text{Quantity of bagasse (ton)}}{\text{Quantity of cane crushed (ton)}} \times 100$$

Pol % Cane…

Problem : 1

Given-

MJ Bx	– 12.50
MJ Py	– 80.00
Bagasse Pol %	– 2.00
Bagasse % cane	– 30.00
MJ % cane	– 110

Calculate the Pol % cane ?

Pol % cane	=	Pol in MJ % cane + Pol in Bagasse % cane	
Pol in MJ % cane	=	(Pol % MJ x MJ % cane) / 100	
Pol % MJ	=	(Brix % x Purity %) / 100	
Pol % MJ	=	(12.50 x 80.00)/100	= 10.00
Pol in MJ % cane	=	(10.00 x 110) / 100	= 11.00
Pol in Bagasse % cane	=	(2.00 x 30.00) / 100	= 0.60
Pol % cane	=	11.00 + 0.60	= 11.60

Pol % Cane…

Problem : 2

Given-

MJ Bx	– 15
MJ Py	– 85
Bagasse Pol %	– 1.5
Bagasse % cane	– 29
MJ % cane	– 105

Calculate the Pol % cane ?

Pol % cane	=	Pol in MJ % cane + Pol in Bagasse % cane	
Pol in MJ % cane	=	(Pol % MJ x MJ % cane) / 100	
Pol % MJ	=	(Brix % x Purity %) / 100	
Pol % MJ	=	(15 x 85)/100	= 12.75
Pol in MJ % cane	=	(12.75 x 105) / 100	= 13.39
Pol in Bagasse % cane	=	(1.5 x 29) / 100	= 0.44
Pol % cane	=	13.39 + 0.44	= 13.83

Pol % Cane…

Problem : 2

Given-

MJ Brix	– 14.00
MJ Py	– 82.00
Bagasse Pol %	– 1.50
MJ quantity	– 4400 T
Cane crushed	– 4000 T
Bagasse quantity	– 1120 T

Calculate the Pol % cane ?

Pol % cane	=Pol in MJ % cane + Pol in Bagasse % cane
Pol in MJ % cane	=(Pol % MJ x MJ % cane) / 100
Pol % MJ	= (Brix % x Purity %) / 100
Pol % MJ	=(14.00 x 82.00) / 100 = 11.48
Mix juice % cane	=[Mix juice quantity (T) / Cane crushed (T)] x 100
	= [4400/4000] x 100 = 110
Pol in MJ % cane	=(11.48 x 110) / 10 = 12.63
Bagasse % cane	=[Bagasse quantity (T) / Cane crushed (T)] x 100
	=[1120/4000] x 100 = 28.00
Pol in Bagasse % cane	=(1.50 x 28.00) / 100 = 0.42
Pol % cane	= 12.63 + 0.42 = 13.05

Bagasse % Cane…

$$\text{Bagasse \% cane} = \frac{\text{Quantity of bagasse (ton)}}{\text{Quantity of cane crushed (ton)}} \times 100$$

Bagasse % cane
Range 28–32

Problem : 1

Given-

Bagasse quantity – 1200 T

Cane crushed – 3800 T

Calculate the Bagasse % cane ?

$$\text{Bagasse \% cane} = \frac{\text{Quantity of bagasse (ton)}}{\text{Quantity of cane crushed (ton)}} \times 100$$

$$= 1200/3800 \times 100$$

$$\text{Bagasse \% cane} = 31.58$$

Bagasse % Cane…

100 + Add water % cane = Mix Juice%cane + Baggase%cane

Bagasse

Problem : 1

Given-

Added water % cane – 40

Mix juice % cane - 108

Calculate the Bagasse % cane ?

100 +Add water % cane = Mix Juice%cane + Baggase%cane

100 + 40 = 108 + Baggase%cane

140= 108 + Baggase%cane

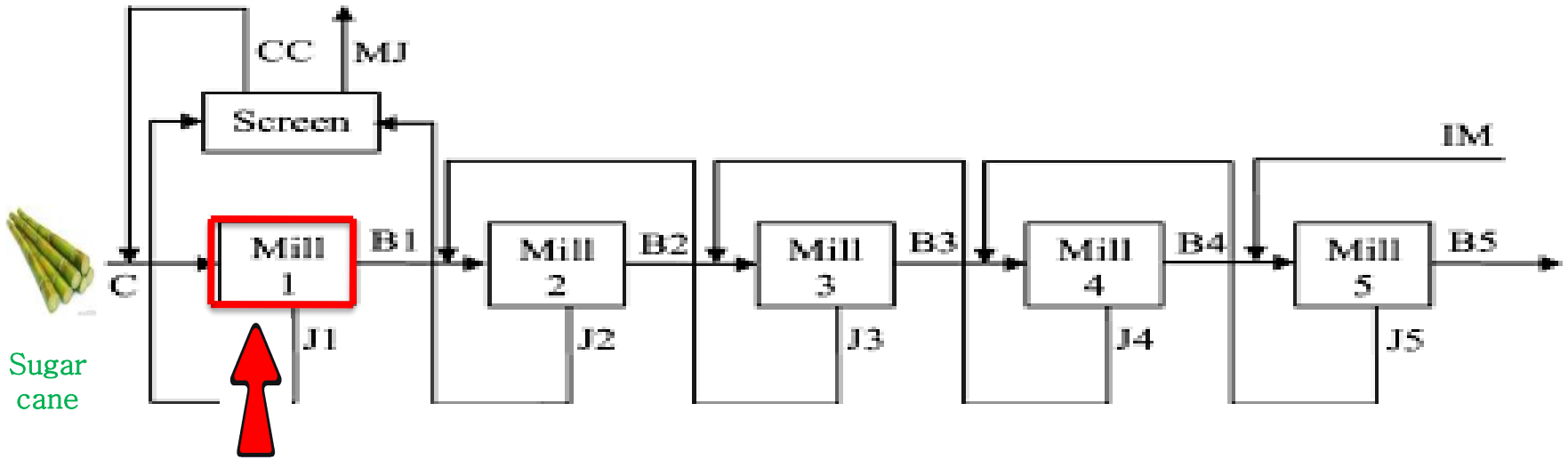
Baggase%cane = 140-108

Baggase%cane = 32

JAVA Ratio…

The percentage ratio of pol % cane to pol % first expressed juice (primary juice)

$$\text{Java Ration} = \frac{\text{Pol \% cane}}{\text{Pol \% Primary Juice}} \times 100$$



What is Primary Juice?

Juice extracted before dilution. Generally first mill juice is primary juice.

The use of the Java Ratio, relating the sucrose content of the cane to the quality of the crusher juice, is probably the simplest method of indirect cane quality evaluation. The South African system uses the Java Ratio to determine the sucrose content of the cane directly from the sucrose content of a crusher juice sample.

JAVA Ratio…

Problem : 1

Given- Brix % primary juice = 19.10
Purity of PJ = 80.88
Pol % cane = 12.80

Calculate the Java Ratio ?

$$\text{Java Ration} = \frac{\text{Pol \% cane}}{\text{Pol \% Primary Juice}} \times 100$$

Pol % primary juice = (Brix % PJ x Purity of PJ) / 100
= (19 .10x 80.88) / 100
= 15.45

Java Ration = (12.80/15.45) x 100
= 82.85

JAVA Ratio…

Problem : 2

Given- Brix % primary juice = 18
Purity of PJ = 80
Pol % cane = 12

Calculate the Java Ratio ?

$$\text{Java Ration} = \frac{\text{Pol \% cane}}{\text{Pol \% Primary Juice}} \times 100$$

Pol % primary juice = (Brix % PJ x Purity of PJ) / 100
= (18x 80) / 100
= 14.40

Java Ration = (12/14.40) x 100
= 83.33

DMF…

Fiber % cane…

The fiber in cane is a complex mixture of cellulose, hemicelluloses, lignin and originates from the cell walls.

$$\text{Fiber \% cane} = \frac{\text{Fiber \% bagasse} \times \text{Bagasse \% cane}}{100}$$

Bagasse = Fiber + Moisture + Brix

Fibre % bagasse = 100 – Moisture % bagasse – Brix % bagasse

$$\text{Brix \% bagasse} = \frac{\text{Pol \% bagasse}}{\text{Purity of last expressed juice (LEJ/LMJ)}} \times 100$$

Range of Fiber % cane 13-15

Fiber % cane…

Problem : 1

Given- Fiber % bagasse = 50

Bagasse % cane = 29

Calculate the Fiber % cane ?

$$\text{Fiber \% cane} = \frac{\text{Fiber \% bagasse} \times \text{Bagasse \% cane}}{100}$$

$$= 50 \times 29 / 100$$

$$= 14.5$$

Range of Fiber % cane 13-15

Fiber % cane…

Problem : 2

Given- Moisture % bagasse = 50
Bagasse % cane = 30
Pol % bagasse = 2
Purity of LMJ = 70

Calculate the Fiber % cane ?

$$\text{Fiber \% cane} = \frac{\text{Fiber \% bagasse} \times \text{Bagasse \% cane}}{100}$$

Fibre % bagasse = 100 – Moisture % bagasse – Brix % bagasse

$$\text{Brix \% bagasse} = \frac{\text{Pol \% bagasse}}{\text{Purity of last expressed juice (LEJ/LMJ)}} \times 100$$

$= 2 / 70 \times 100$

$= 2.85$

Fiber % bagasse $= 100 - 50 - 2.85$

$= 47.15$

Fiber % cane $= 47.15 \times 30 / 100$

$= 14.15$

Range of Fiber % cane 13-15

by-product of the sugar Industry and their utilization for value addition...

In sugar manufacturing three important by-products are –

1. Bagasse

Bagasse is the fibrous matter that remains after sugar cane are crushed to extract the cane juice in mill house of sugar factory.

2. Final Molasses

Final molasses is the dark colour and thickly syrup from the final stage of crystallization, from which no more sugar can be obtained by further crystallization.

3. Press Mud.

Press mud is the residual output after the filtration of the muddy juice. Press mud also known as **Filter Cake** or **Press Cake** or **Mud**,

by-product of the sugar Industry and their utilization for value addition...



Sugar Cane
100 Kg

Sugar	Bagasse	Molasses	Press Mud
10 Kg	30 Kg	5 Kg	40 Kg
(10 % Cane)	(30 % cane)	(5 % cane)	(4 % cane)




By-Products

by-product of the sugar Industry and their utilization for value addition...

Use of Bagasse

Dietary Fiber

Electricity

Detergent

Board

Charcoal

Paper

Activated Carbon

Furfural Acid

by-product of the sugar Industry and their utilization for value addition...

Use of Press Mud

- Bio CNG gas
- Wax
- Bio Manure
- Fuel

Press Mud

by-product of the sugar Industry and their utilization for value addition…

Use of Final Molasses

Alcohol

Vinegar

Ethanol

Oxalic Acid

Cattle Feed