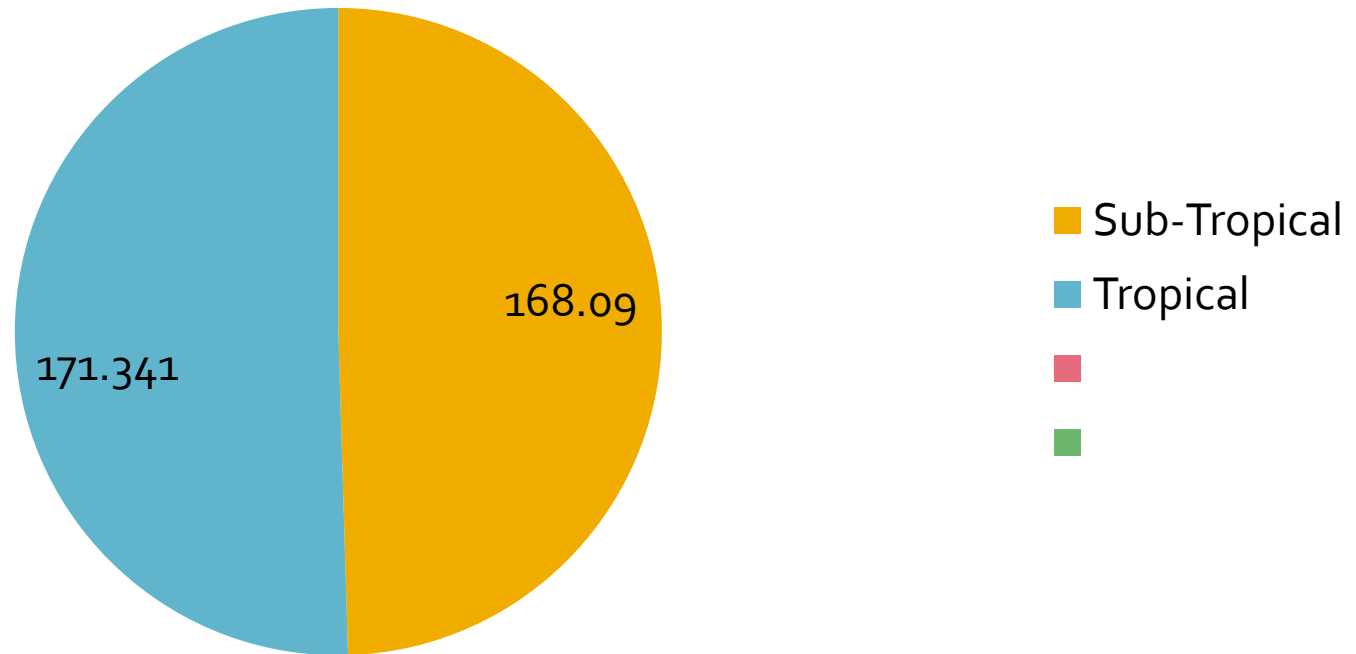


# **WATER CONSERVATION & WATER MANAGEMENT IN INDIAN SUGAR INDUSTRY- AN INNOVATIVE APPROACH**

J P SRIVASTAVA  
SEEMA PAROHA  
M K BANERJEE  
**National Sugar Institute, Kanpur , India**

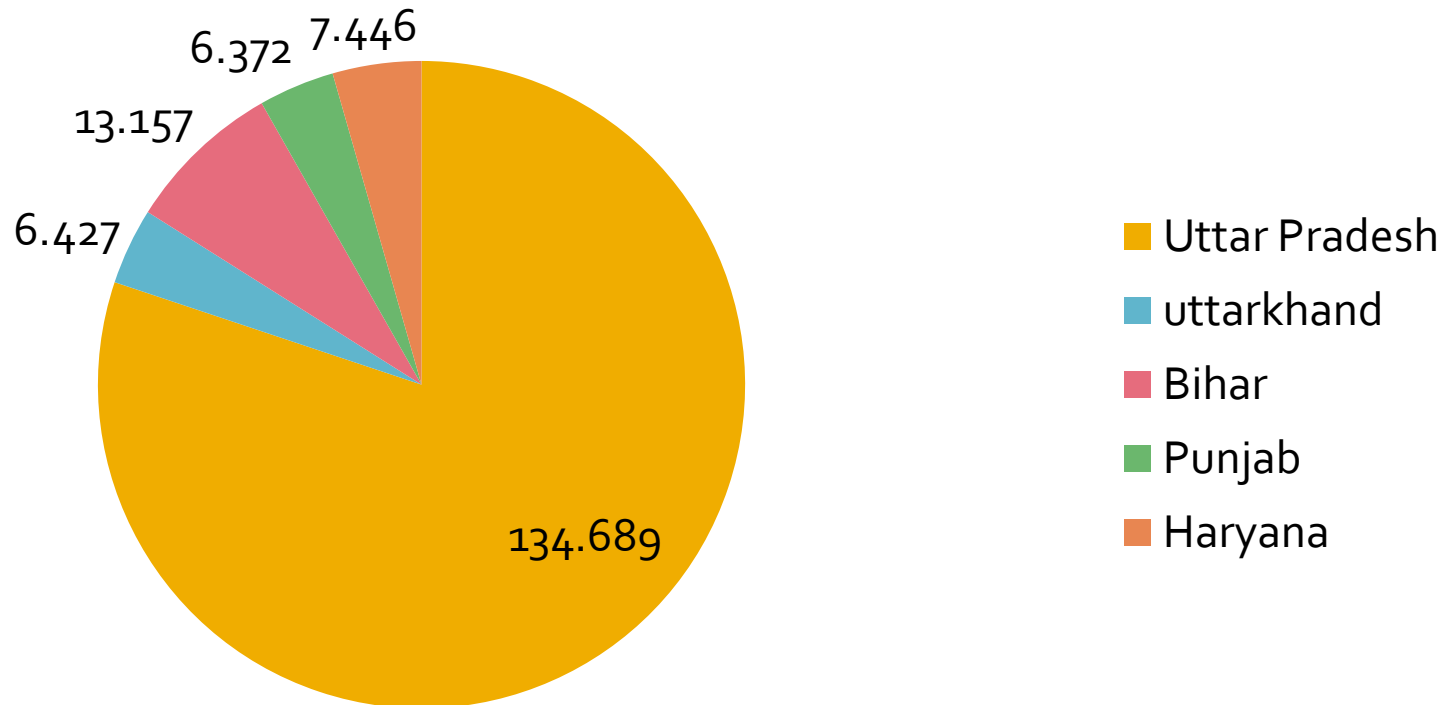
# INDIAN SUGAR INDUSTRY OUTLOOK

Total Sugarcane Production, 348.384 millionTonnes  
Season 2013-14



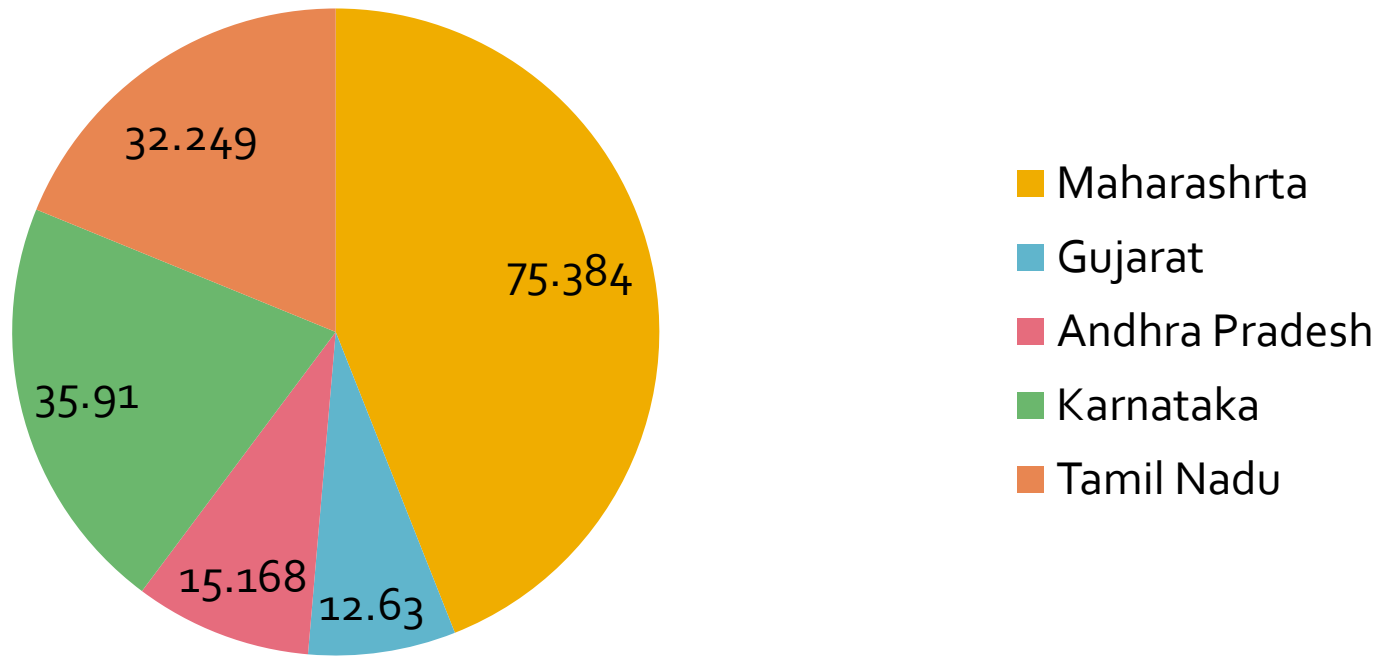
# INDIAN SUGAR INDUSTRY OUTLOOK

Sugarcane Production ( Sub-tropical ) ,  
168.09 millionTonnes



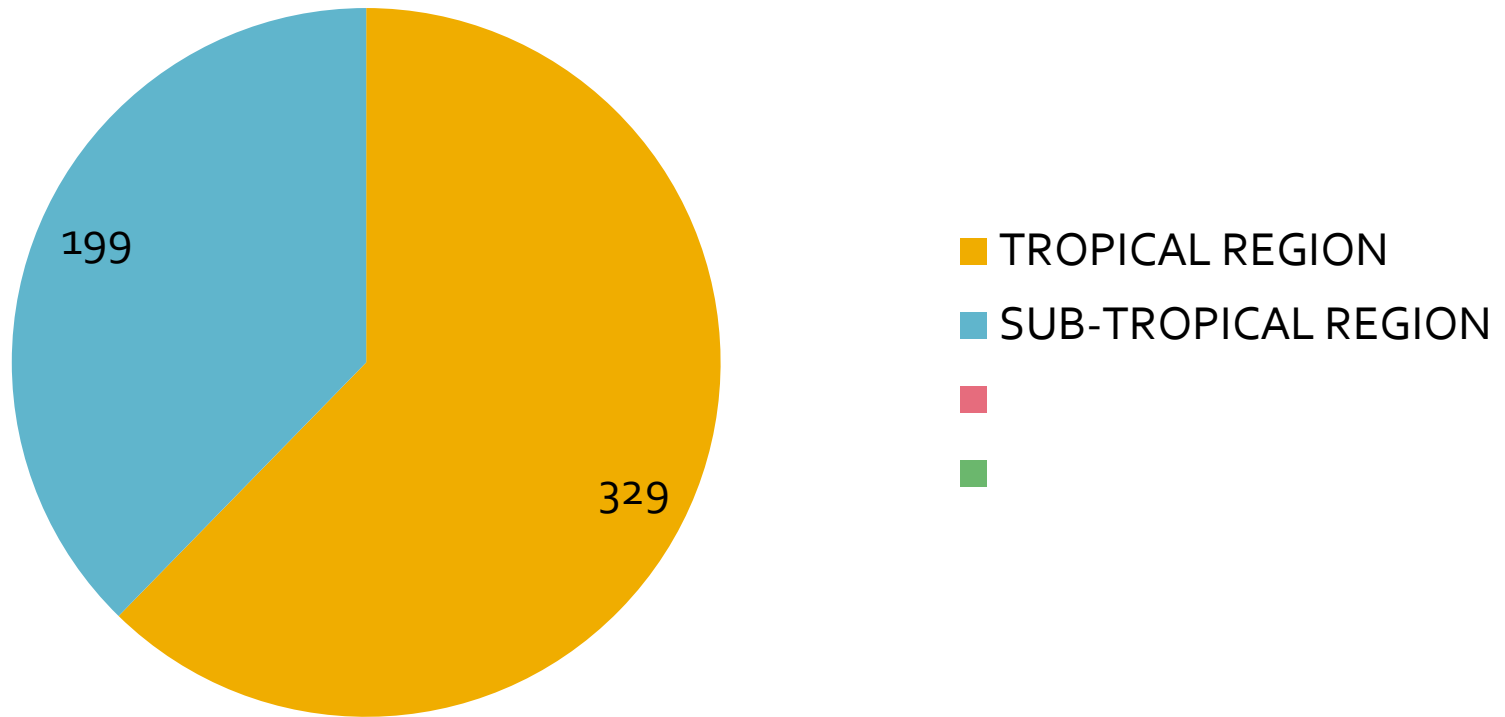
# INDIAN SUGAR INDUSTRY OUTLOOK

Sugarcane Production ( Tropical ) ,  
171.341 million Tonnes



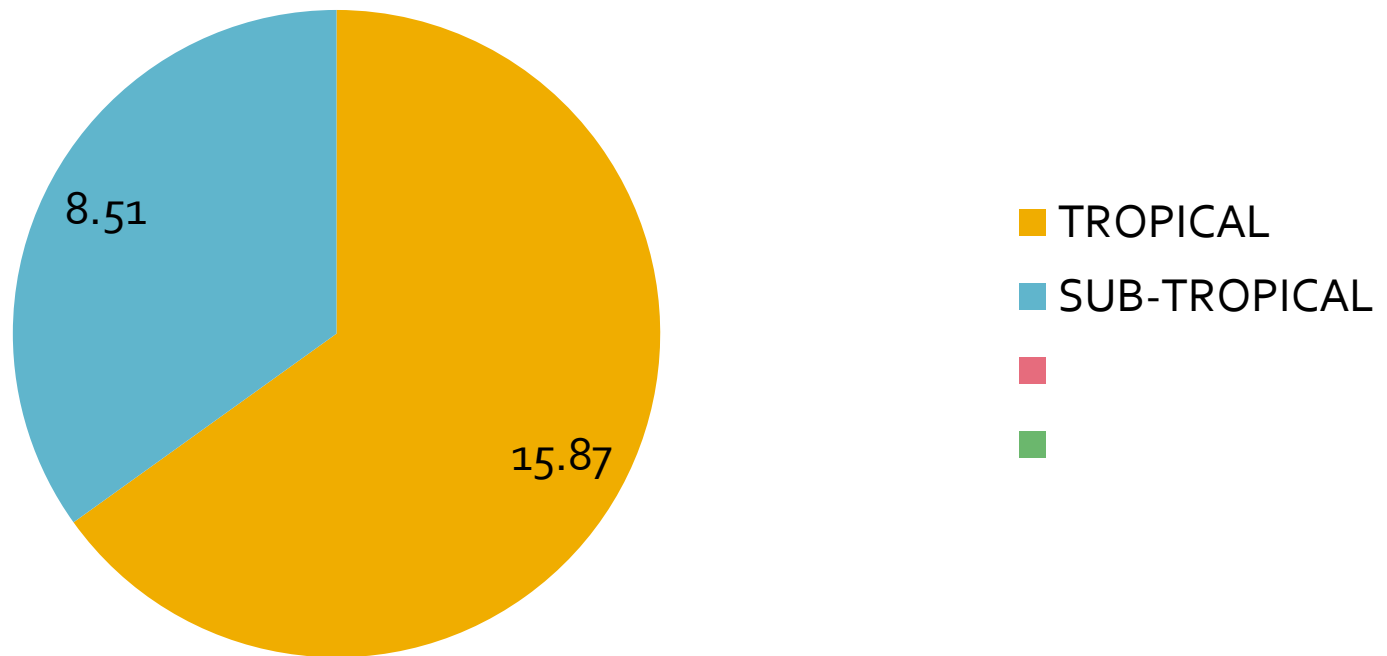
# INDIAN SUGAR INDUSTRY OUTLOOK

TOTAL NO OF SUGAR FACTORIES IN OPERATION 528



# INDIAN SUGAR INDUSTRY OUTLOOK

Total Sugar Production, 24.38 million Tonnes  
in season 2013-14



# FACTS

- Sugarcane contains around 70% water in it
- It will be sufficient to carry out various unit operations in sugar process
- Even surplus water will be available after various unit operation
- Most of the sugar factories use fresh water in addition to water available in sugarcane
- Huge waste water generation

# SUGARCANE COMPOSITION

1. Water      69 to 71 %
2. Sucrose    12 to 15%
3. Fibre      12.5 to 15%
4. others      02 to 03%

Reducing sugars, other organic materials, ash and waxes etc.



# PRODUCT & BY PROUCT

- INPUT

1. Sugarcane

2. Fresh water                      5 to 20 % on cane

3. Others

- OUTPUT

1. Sugar                                10 to 11%

2. Bagasse                            28 to 32 %

3. Final molasses                  4.5 to 5.0 %

4. Waste water                      20 to 35 %

# FRESH WATER CONSUMPTION

- **SUB-TROPICAL REGION**
  1. Fresh water consumption in one season by all sugar factories ( 199 ) is estimated about 18.5 million cubic meters
- **TROPICAL REGION**
  1. Fresh water consumption in one season by all sugar factories ( 329 ) is estimated about 14 million cubic meters
- **Total fresh water consumption in one season in sugar industry in India is estimated around 32.5 million cubic meters**

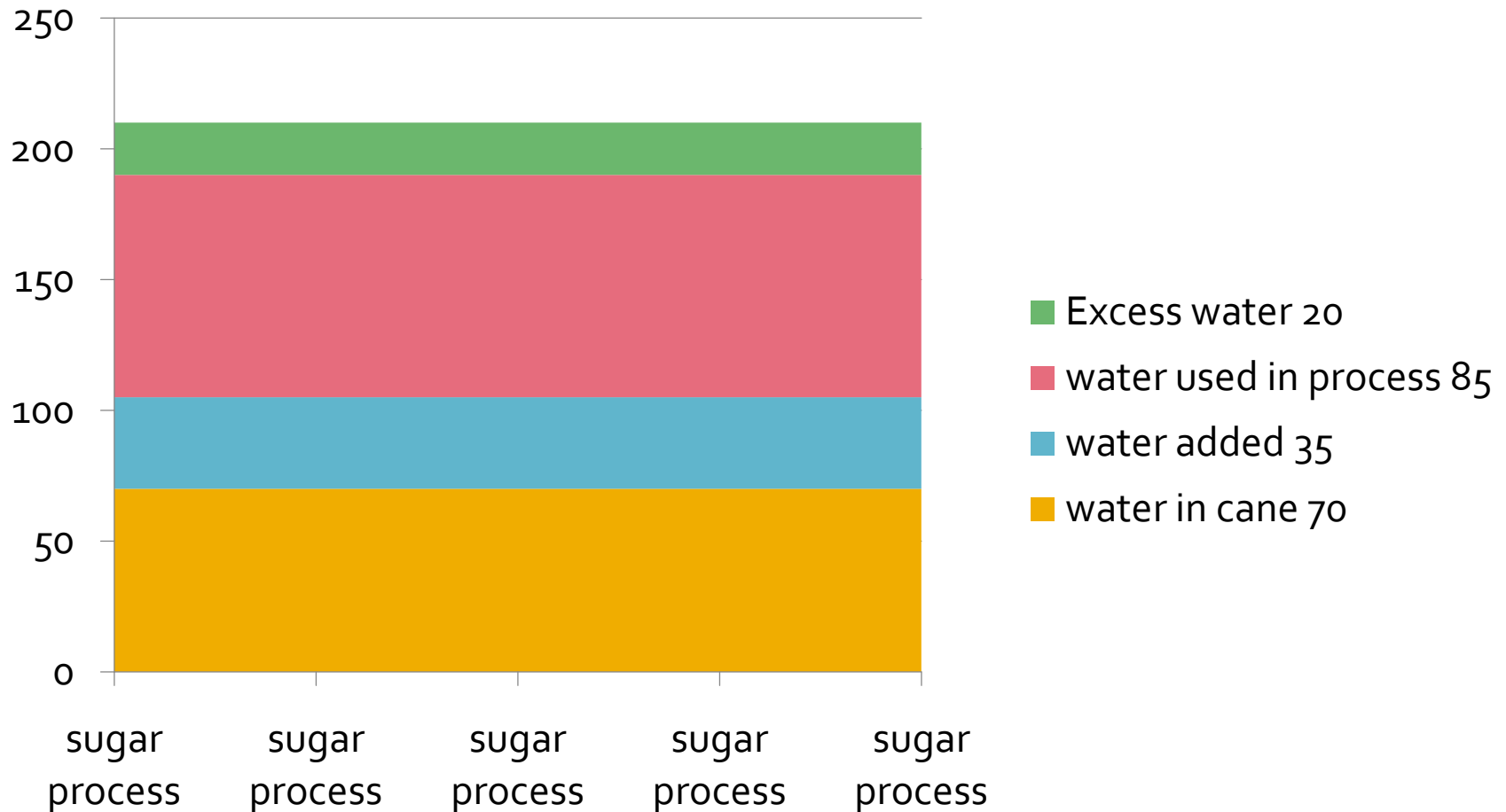
# PROJECT FOCUS

- To develop model Condensate Conservation and Management System to minimize fresh water requirement
- To collect the data on condensate utilization and fresh water usage
- To analyze waste water and condensate available from various streams
- To develop appropriate technology for treatment of waste water and condensate

# SUGARCANE WATER BALANCE

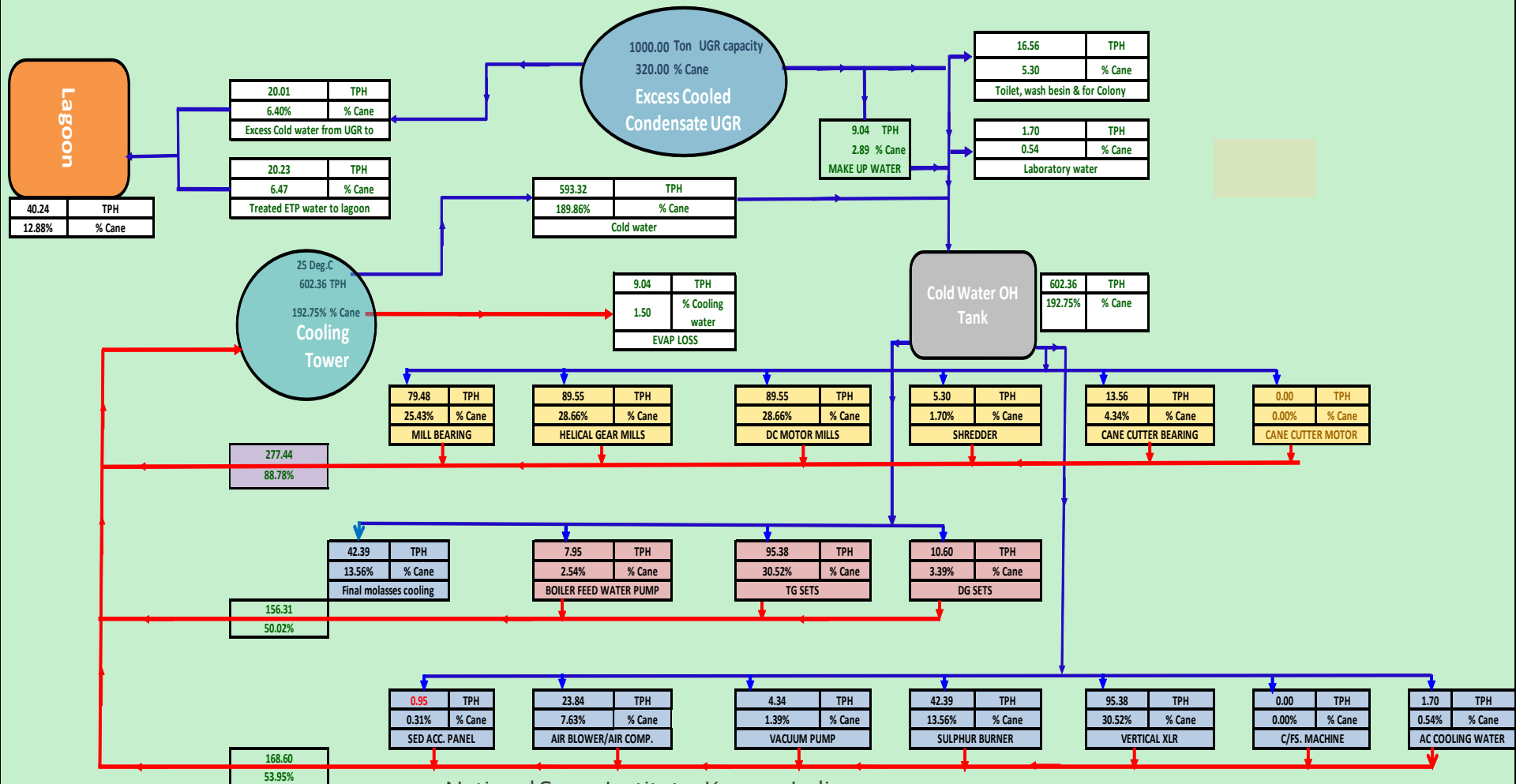
■	Quantity of sugarcane	100	MT	
■	Quantity of water (70%)	70	MT	
■	Water added	35	MT	105MT
1.	Water loss in bagasse	15	MT	
2.	Water loss in molasses	0.6	MT	
3.	Water loss in press cake	2.5	MT	
4.	Water loss in sugar	0.004	MT	18.1MT
5.	Water evaporated	81.0	MT	
6.	Water in syrup	6.5	MT	
7.	Water loss due to flashing	1.0	MT	
8.	Net hot condensate available	80	MT	
9.	Hot condensate used in process	60	MT	
10.	<b>Excess hot condensate</b>	<b>20</b>	<b>MT</b>	

# WATER BALANCE



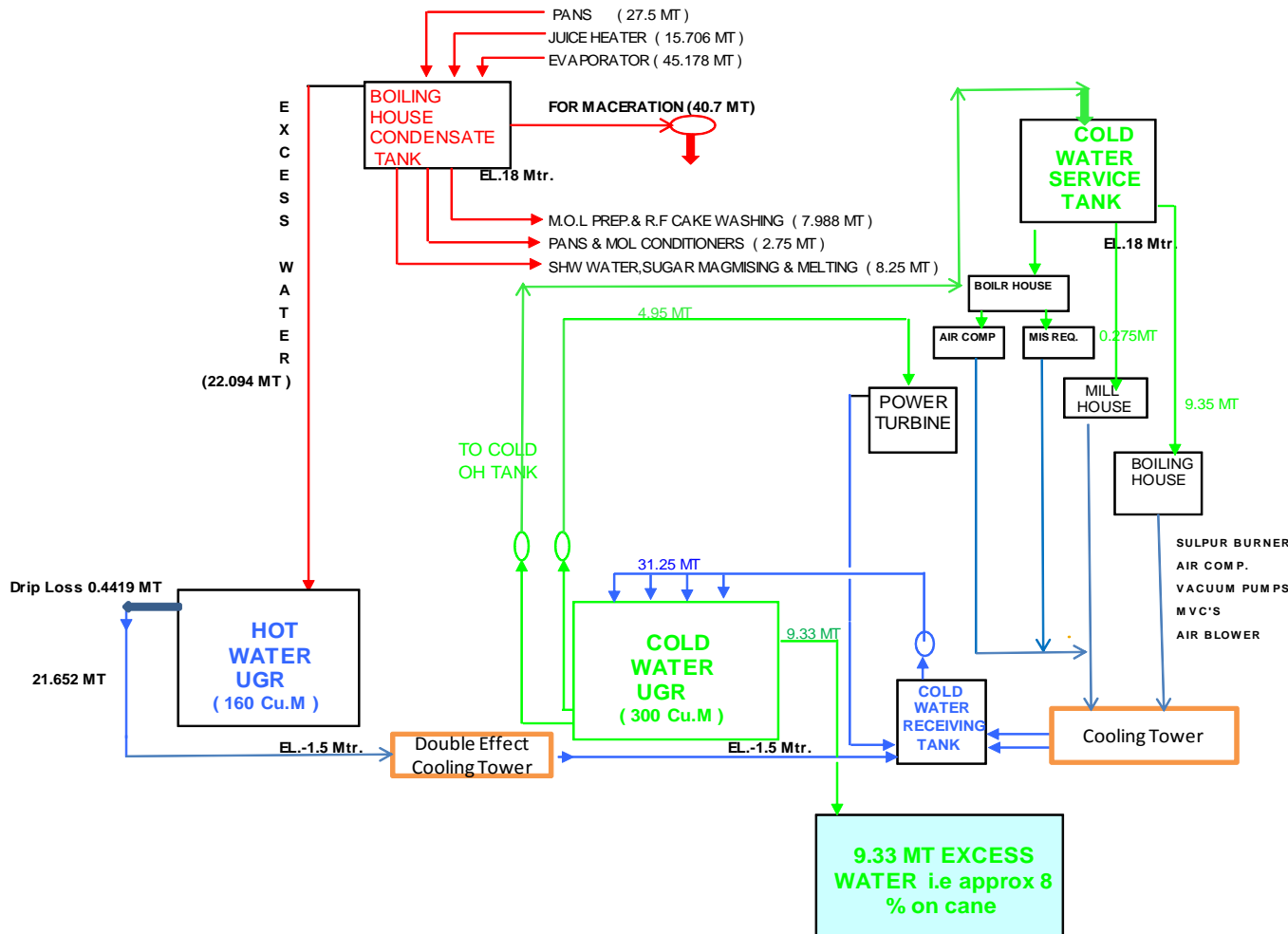
# COLD WATER CIRCULATION

## NATIONAL SUGAR INSTITUTE -KANPUR, COLD WATER RECIRCULATION

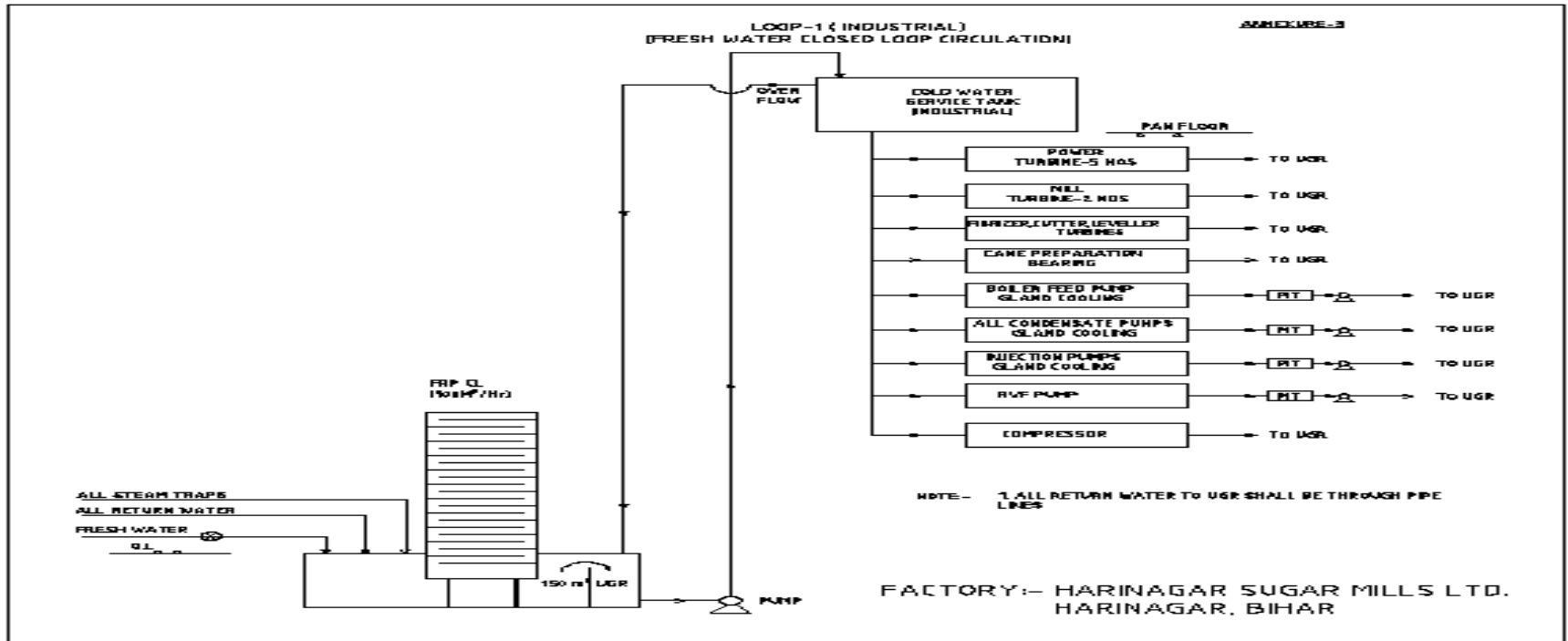


# HOT WATER MANAGEMENT

## PROPOSED WATER MANAGEMENT AT 2500 TCD PLANT

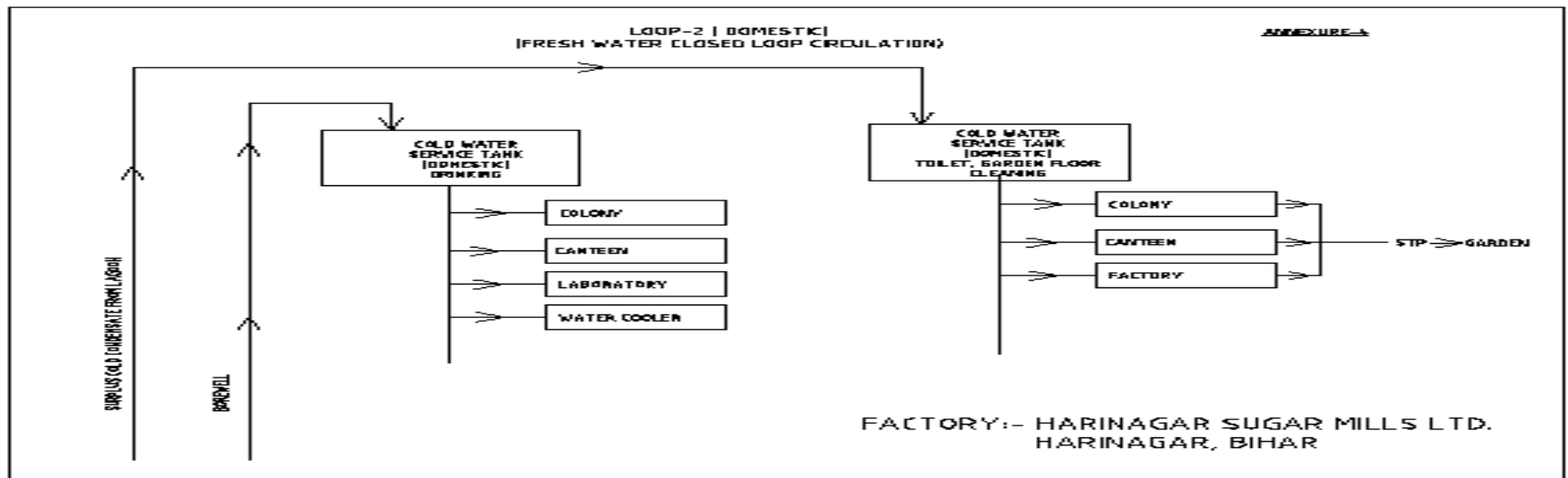


# LOOP-1

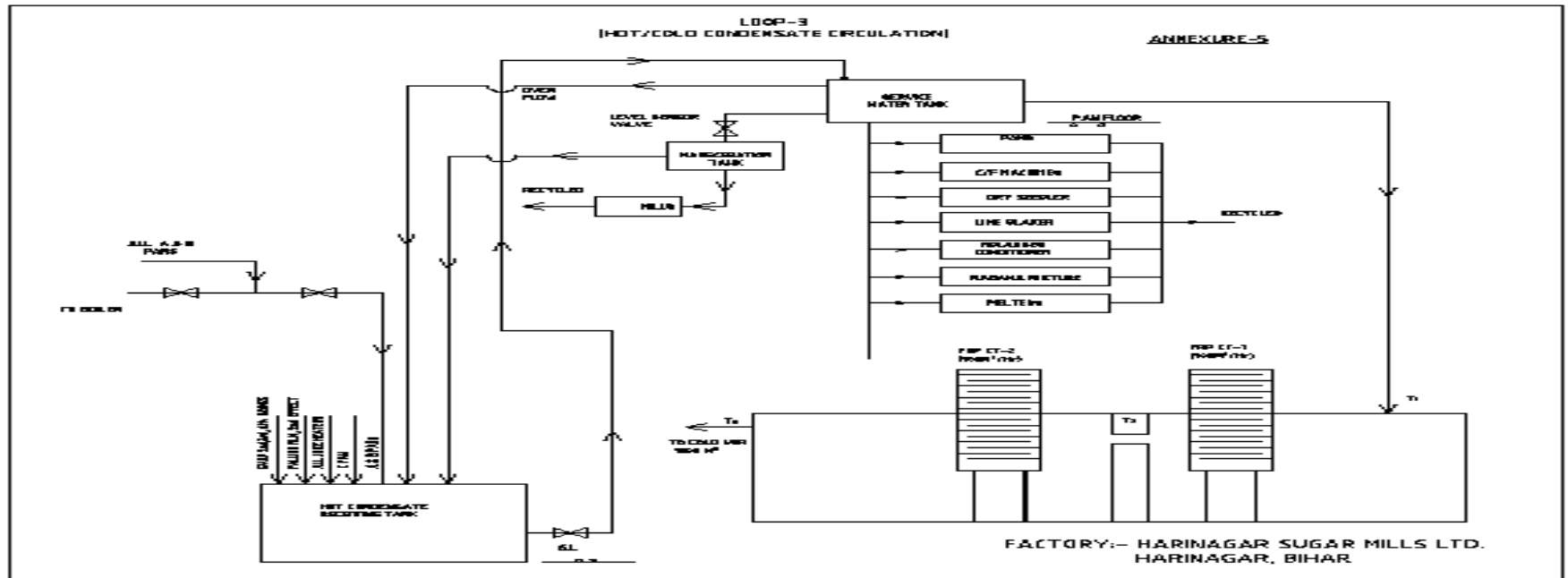




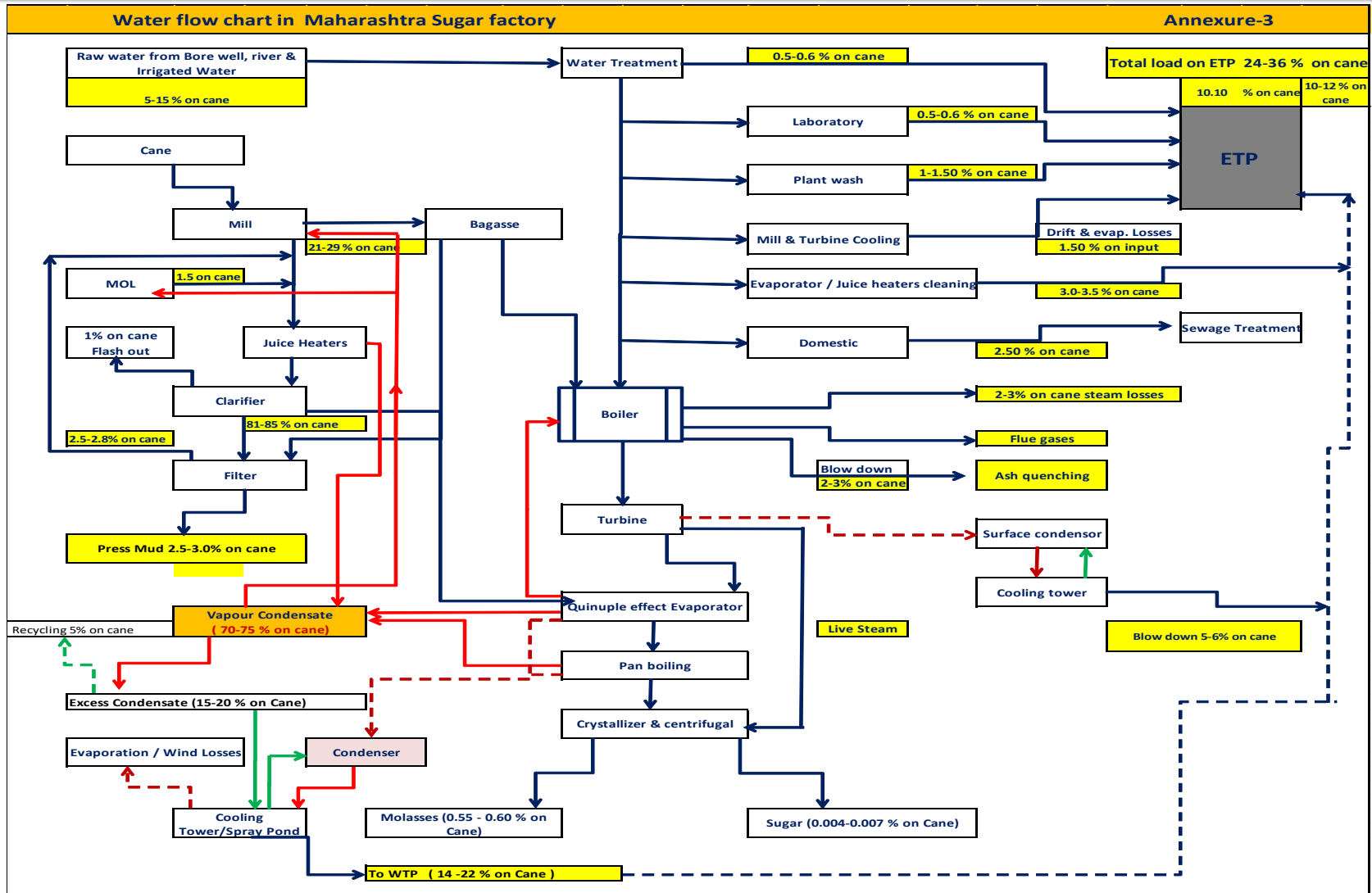
# LOOP-2



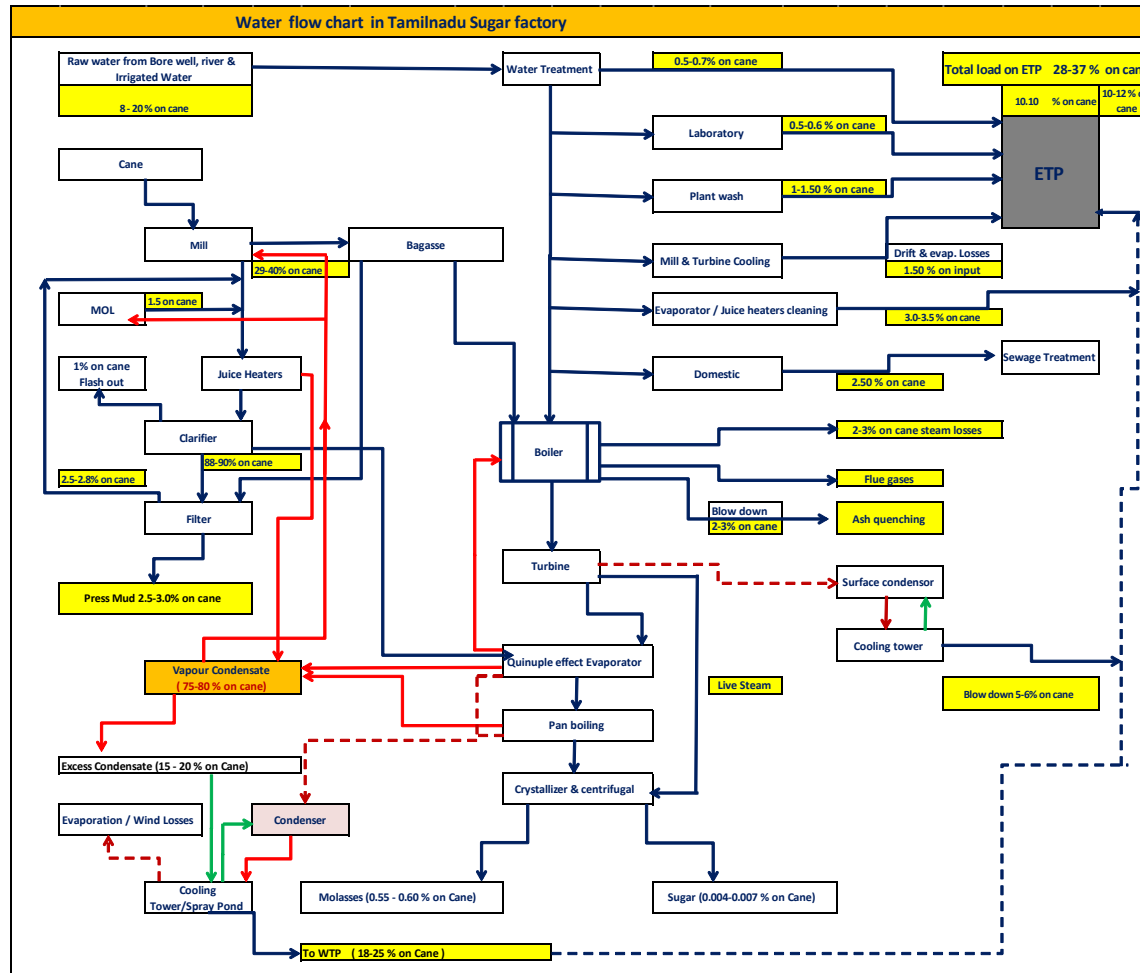
# LOOP-3



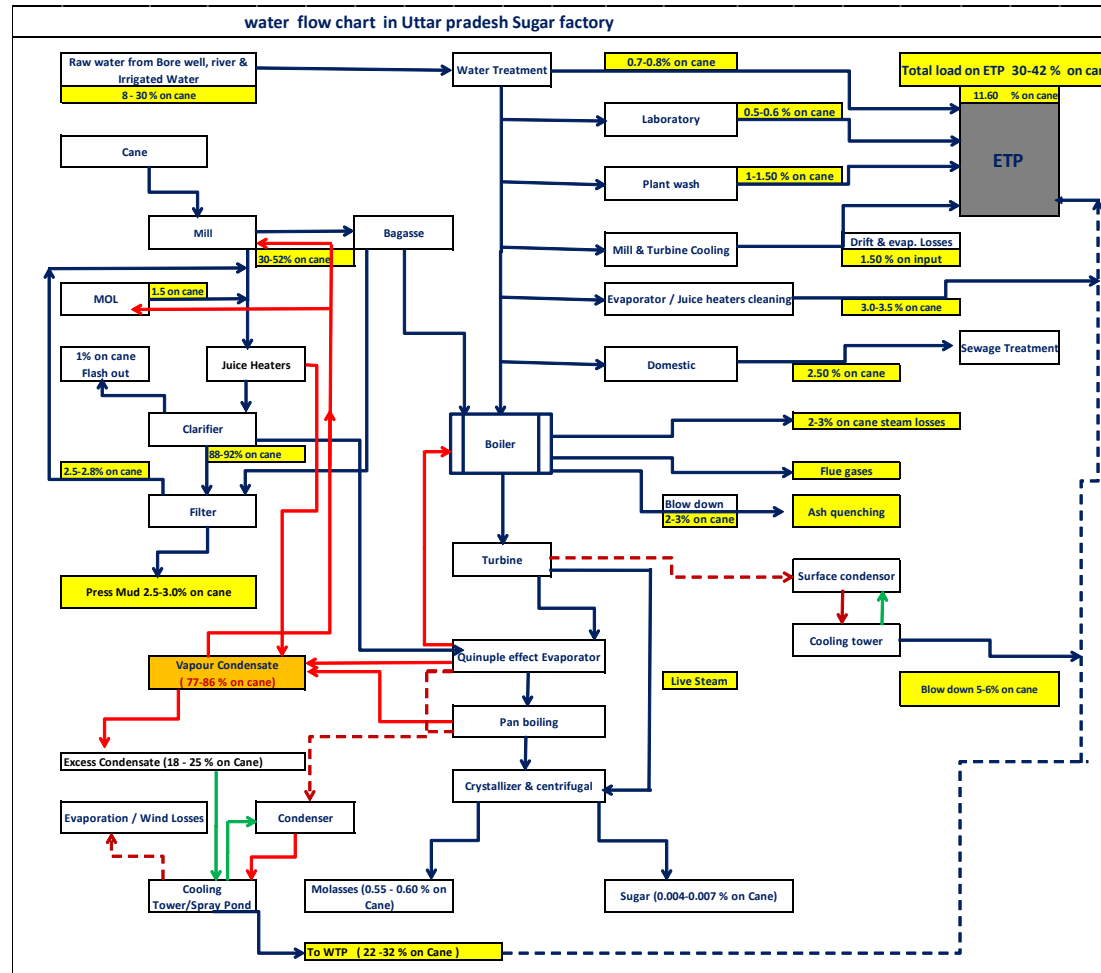
# WATER BALANCE IN MAHARASHTRA



# WATER BALANCE IN TAMIL NADU



# WATER BALANCE IN UTTAR PRADESH



# WATER BALANCE IN tropical & sub-tropical

- Maharashtra
  - raw water- 5 to 10 %
  - waste water – 14-22%
- Tamil Nadu
  - raw water - 8 to 20%
  - waste water – 18 to 25%
- Uttar Pradesh
  - raw water - 8 to 30%
  - waste water – 22 to 32%

# WATER ANALYSIS

WATER SAMPLE	pH	TDS ppm	CONDUCTIVITY $\mu\text{S/cm}$	COD ppm	TSS ppm	BOD ppm
CONDENSATES	7.29 - 8.29	75 - 130	150 - 160	190 - 251	160 - 300	75 - 110
WASTE WATER (ETP inlet)	5.0-6.0	550 - 2700	740 - 2000	700 - 1200	200 - 800	200 - 450
TREATED WATER (ETP outlet)	6.8 - 8.9	270 - 1830	390 - 1000	190 - 450	110 - 500	84 - 200
FRESH WATER	7.0 - 7.94	140 - 570	250 - 500	14 - 85	11 - 350	3 - 35

# ACHIEVEMENTS

- Closed loop re-circulation of cold/ hot water has reduced the water loss thus reduction in fresh make-up water.
- Reuse of cold treated condensate for Industrial and Domestic application has reduced the fresh water requirement
- Use of surplus cold condensate for gardening and agriculture has saved fresh water
- Enable to achieve the norms of CPCB for Sugar Factories



# CPCB Guideline

to 17 highly polluted industry including

Sugar:

Online monitoring of flow, pH, COD, BOD, TSS.

Transmission of online data so generated to SPCB/PCC and CPCB. Regular maintenance and operation with facility of online calibration.

## **Online continuous monitoring system for Effluents**



**CENTRAL POLLUTION CONTROL BOARD  
PARIVESH BHAWAN, EAST ARJUN NAGAR  
DELHI – 110 032**

Courtesy: CPCB

# Parameter vs available methods & approximate cost

Sugar	1. pH	1. Electrode Method	>10	0.75
	2. BOD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	16.00 (BOD+COD+TSS) +Controller & DAS & Data Transmission
		2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	28.00 (BOD+COD) +Controller & DAS & Data Transmission
	3. COD	1. UV-Vis Spectro-photometry (Entire spectrum scanning)	>4	Combined with BOD
		2. Combined Combustion Catalytic Oxidation at 680°C and NDIR Method (TOC)	>4	Combined with BOD
	4. TSS	1. Scattered light IR Method	>4	3.00
		2. UV-Vis Spectro-photometry (Single wavelength)	>4	3.00
	5. Flow	1. Magnetic /Ultrasonic	>4	0.75

Courtesy:: CPCB

# Control Parameters

Four different **flowmeter** technologies --- electromagnetic, ultrasonic, ultrasonic Doppler, and ultrasonic transit time.

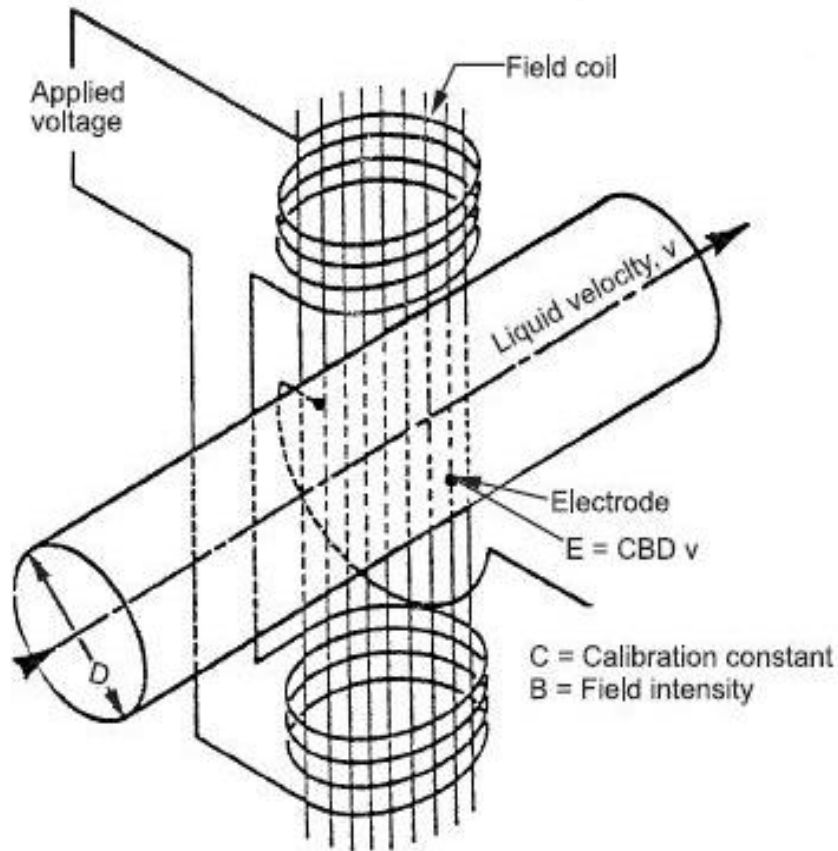
**Suspended solids** and turbidity analyzers use technologies of scatter, absorption, Coriolis and torque effects.

Current practices of using **TOC analysis** as an alternative to **BOD<sub>5</sub>** & correlation data and analysis between BOD<sub>5</sub> and TOC (site-specific)

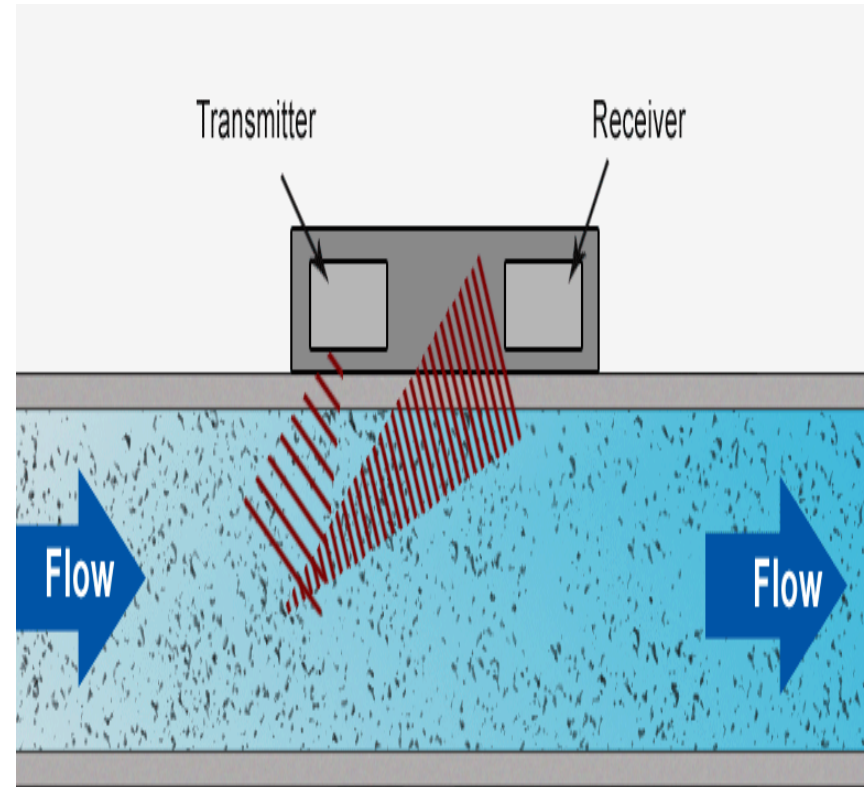
Courtesy: CPCB

# Electromagnetic vs Ultrasonic

Magnetic Flowmeter Operating Principle



Source: Piping engineering .com



Doppler Flow Meter

Source: Alicat.com

# BOD, COD & TOC

- BOD is a biochemical reaction, measures oxygen equivalent of aggregate organic matter and only biodegradable organic matter is oxidized. Take 5 days (20°C)/ 3 days(27°C).
- In COD organic matter is oxidized chemically, measures both biodegradable and non-biodegradable organic matter. Take 2 hrs.
- In TOC organic matter is combusted, measures both biodegradable & non-biodegradable organic matters. Take 5-10 minutes.

# ***WARNING! COD...HAZARDOUS WASTE***

Along with the potassium dichromate in 50% sulfuric acid solution, pre-prepared COD vials also contain silver sulfate as a catalyst and mercuric sulfate to eliminate chloride interference. Thus, COD vials are considered ***hazardous waste*** and must be handled and disposed of in an approved manner.

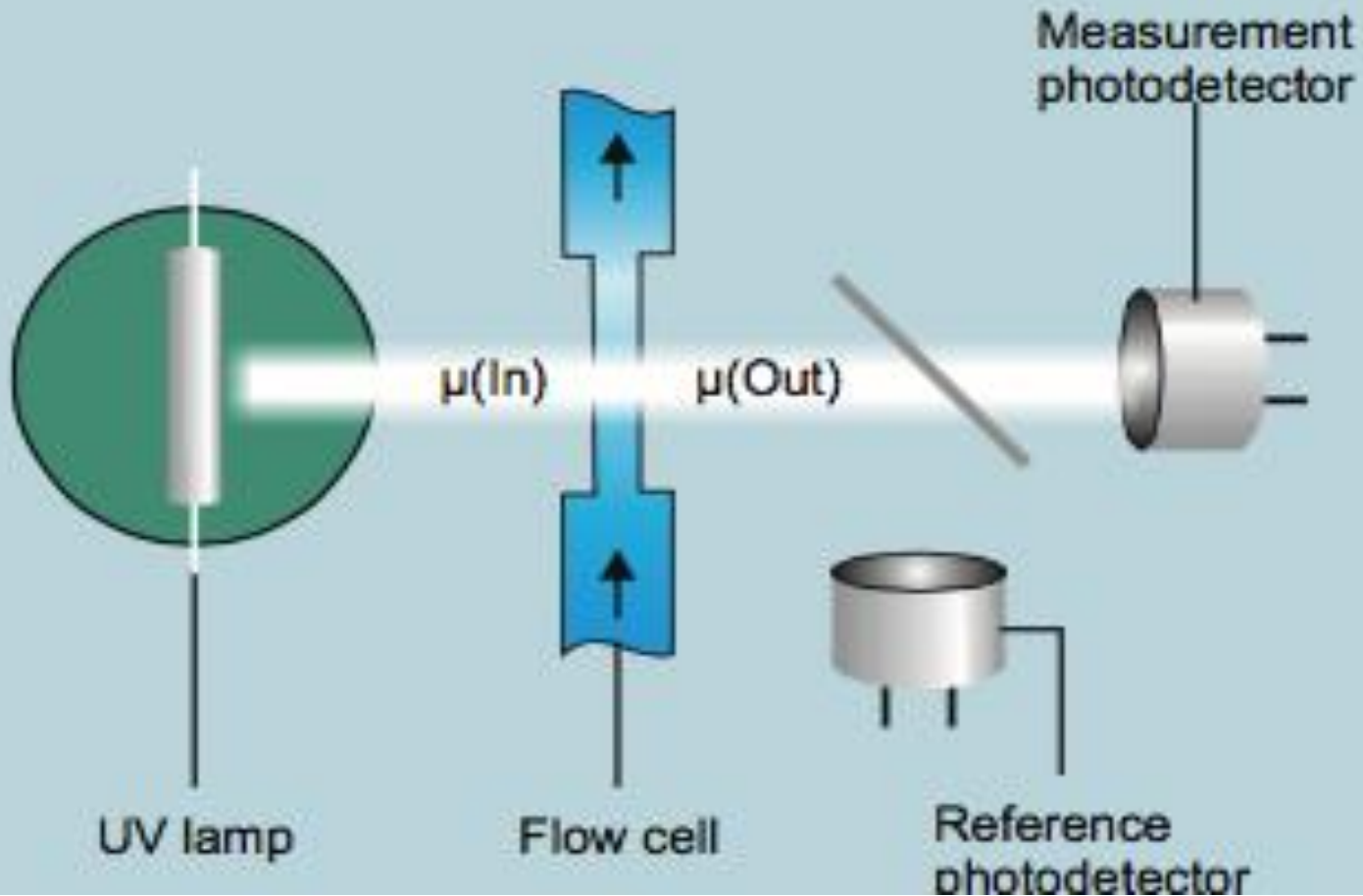
***DO NOT DISPOSE OF COD VIAL CONTENTS DOWN THE DRAIN!***

Most pre-prepared COD vial vendors will have a return policy for used COD vials so that used vials can be returned to the vendor sealed in the original containers for proper disposal.

# COD

## Measuring principle

Based on Lambert-Beer's Law



Courtesy: Forbes Marshal

# Challenges of UV absorption method

- In-spite of the progress of optical spectroscopy system , there are still some limitations:
- Affected by surrounding condition variation, vibration , radiation change & temperature changes
- Its Optical Fiber, which are susceptible to bending , twisting & crushing problem which may alter calibration
- Cuvettes need to be very high standard, otherwise that will absorb photon in the UV region.



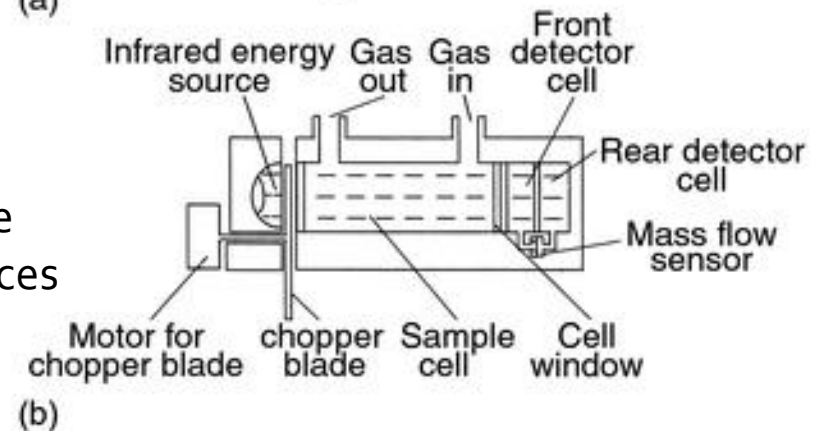
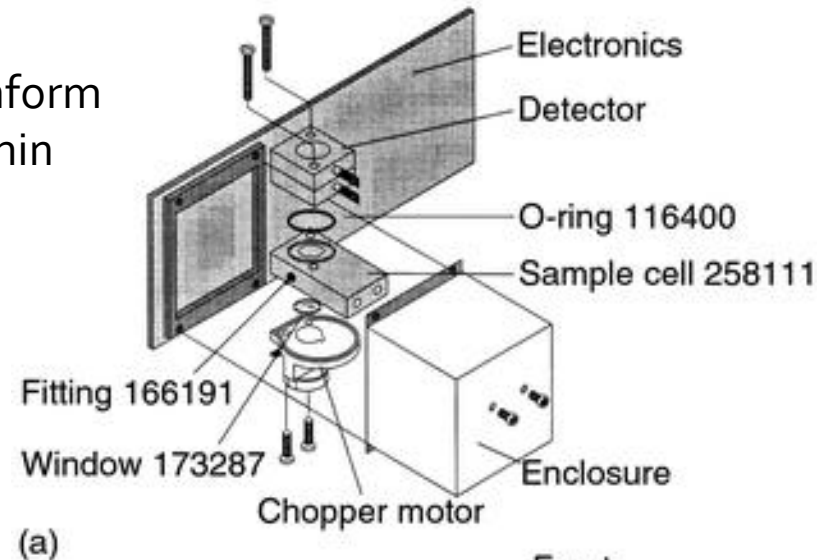
# TOC online analyzer

TOC will not determine which particular Compound are present, instead TOC will inform the user the sum of all organic Carbon within these compound.

TOC is useful for process control & Regulatory compulsion.

TOC analysis offered today are either combustion method or low temperature oxidation method.

For Industrial waste effluent, Combustion Technology(680° C) is preferred because particulates, chlorides and tough to oxidize compound are the type of changing matrices that the combustion oxidation technology was design to handle.



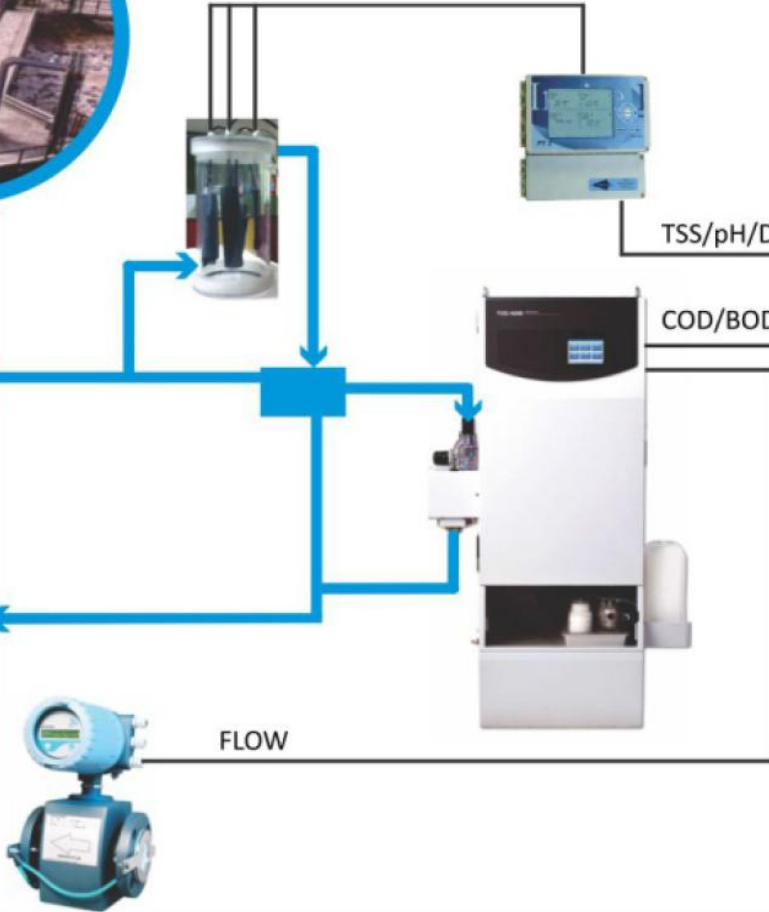
# Loading

- One is Flow (millions gallons/day) and the other is concentrations (mg/L or ppm). Concentrations tells how much of a substance (i.e mg of BOD) is present in a known volume of waste water (e.g 1 liter). However, concentration isn't the whole story since it does not tell how much (i.e mass or weight) of a substance is going down to drain-commonly referred as loading.

**Flow x Concentrations x 8.34 (weight of 1 gallon of water)= Lbs/day  
(Loading).**

**PLANT A: (1.0MGD)(250 ppm)(8.34)= 2085Lbs/day**

**PLANT B: (0.05MGD)(1000ppm)(8.34)= 417Lbs/day**



Source: Swan Environmental pvt ltd

# FUTURE VISION

- Development of appropriate treatment technology for surplus condensates to use treated condensate for other useful purposes.
- Zero discharge from sugar Factories.
- Zero fresh water consumption.
- TOC analysis as a substitute for BOD & COD analysis in regulatory requirement.

SAVE WATER

SAVE WATER

SAVE WATER

SAVE WATER

AND

SAVE WATER

THANKS