SUGAR INDUSTRY

STANDARDS FOR LIQUID EFFLUENT

Parameter	**Concentration not to exceed, mg/l**
Bio-chemical oxygen demand, 3 days at 27 ^{o}C	100 for disposal on land, 30 for disposal in surface waters.
Suspended solids	**30** for disposal in surface waters, 100 for disposal on land

Sugar Industry

- Sugar can be produce from beet or from sugar cane.
- In India sugarcanes are used, Europe –beet is used.
- The mills are typically operated for 4 to 8 months after the harvesting of sugar cane.
- Odour nuisance near the sugar mills is a very common phenomenon.

Manufacturing process

- **Mill house:**
  - Sugar canes are cut into pieces and crushed in a series of rollers to extract the juice in the mill house.

- **Lime Treatment**
  - The **milk of lime is added** to the juice and **heated**.
  - When colloidal and suspended impurities are coagulated, most of colour is also removed during lime treatment.
  - The coagulated juice is clarified to remove sludge.
  - The sludge is further filtered through filter press and then disposed off as solid waste (press mud).

Manufacturing process

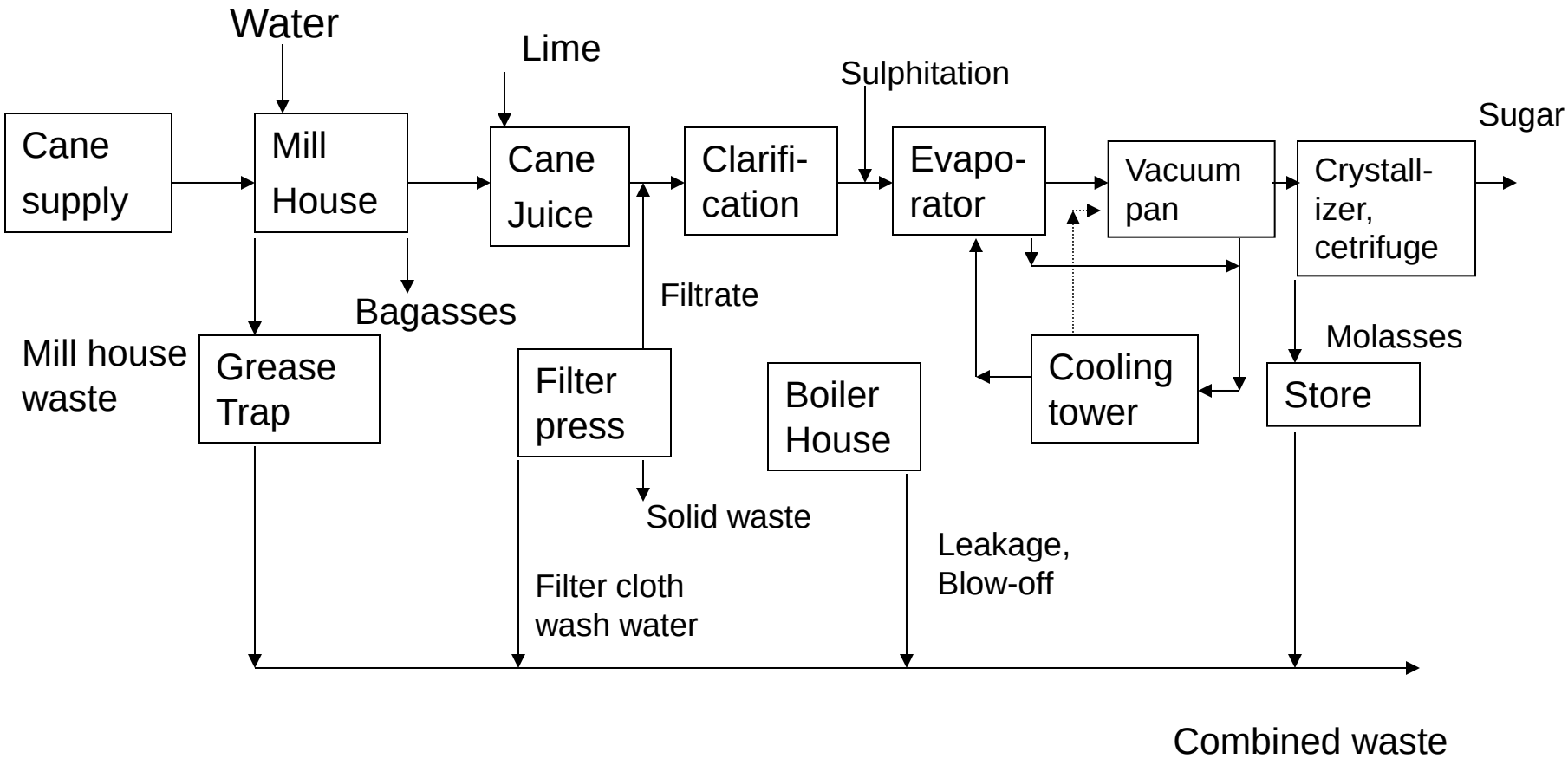
- **Sulphitation process**
  - The filtrate is recycled to process along with entire quantity of clarified juice.
  - This juice is treated by passing sulphur dioxide gas through it. This is known as sulphitation process.
  - Colour of juice is completely bleached out due to this process.

- The clarified juice is then preheated and concentrated in evaporators and vacuum pans. The partially crystallized syrup from vacuum pan known as '**massecuite**' is transferred to the crystallizers.

Manufacturing process

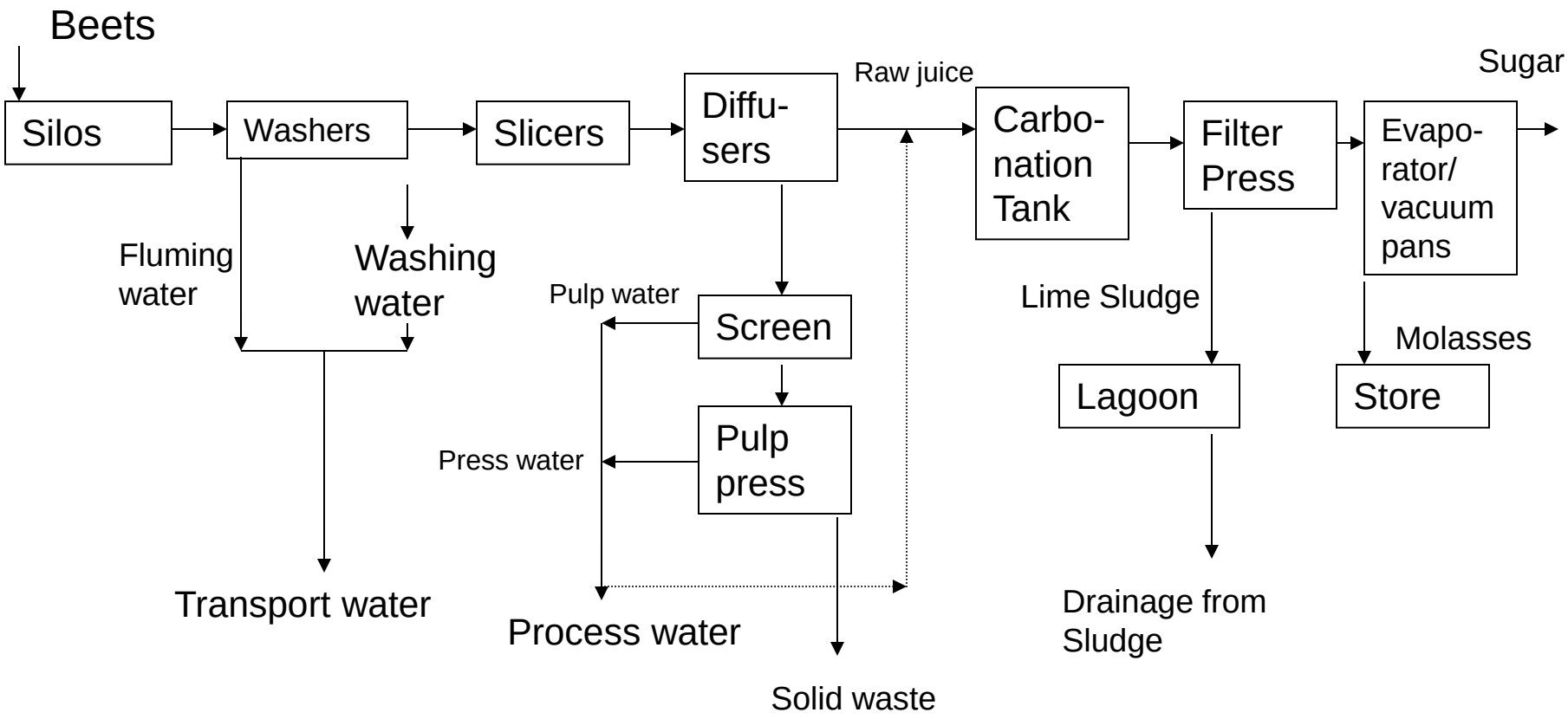
- **Crystallizers**
  - In crystallizers **complete crystallization** of sugar occurs. The massecuite is then centrifuged to separate the sugar crystals from liquor.
  - The spent liquor is discarded as '**black strap molasses**'.
  - Sugar is then dried and bagged for transport.
  - The fibrous residue of the mill house, known as '**bagasses**' is burnt in the boilers or may be used as raw-materials for paper products.
  - Black strap molasses is used as raw material in distilleries.

Manufacturing process



Flow diagram of cane sugar manufacturing process

Manufacturing process of beet sugar



Sources of wastewater and characteristics

- The wastewater from mill house include the water used as splashes to extract maximum amount of juice and those used to cool the roller bearings.
  - This wastewater contains high BOD due to presence of sugar and oil and grease from machineries.
- The wastewater from occasional washing of filter cloths (used for filtering the juice) though small in volume, contains high BOD and SS.

Sources of wastewater and characteristics

- The **water used for cooling** in evaporators also contributes as wastewater. The cooling water gets polluted as it picks up some organic substances from the vapors of boiling syrup in evaporators and vacuum pan.
  - Although this water is recirculated it is required to be discharged. This contributes to considerable volume of waste and moderate BOD.

- Additional waste originates due to the **leakages and spillages** of juice, syrup and molasses in different sections, and also during handling of molasses. Washing of floor (periodic) contributes a lot to pollution load. Though, it is small in volume, strong in BOD concentration.

- Periodic **blow-off of the boilers** produce another intermittent waste discharge. This is high in SS, low in BOD and usually alkaline.

Characteristics of combined waste from sugar mill

pH	4.6 to 7.1
COD	600 to 4400 mg/l
BOD, 20 ^{o}C	300 to 2000 mg/l
Total solids	870 to 3500 mg/l
Total volatile solids	400 to 2200 mg/l
Total suspended solids	220 to 800 mg/l
Total nitrogen, mg/l	10 to 40
COD/BOD ratio	1.3 to 2.0

Effect of the waste on receiving water

- The sugar mill effluent decomposes rapidly after few hours of stagnation.
- Rapid depletion of DO followed by anaerobic stabilization of waste causes a secondary pollution of offensive odour, black colour, and fish mortality.
- Usually situated in rural areas, hence no sewers are available for discharge.

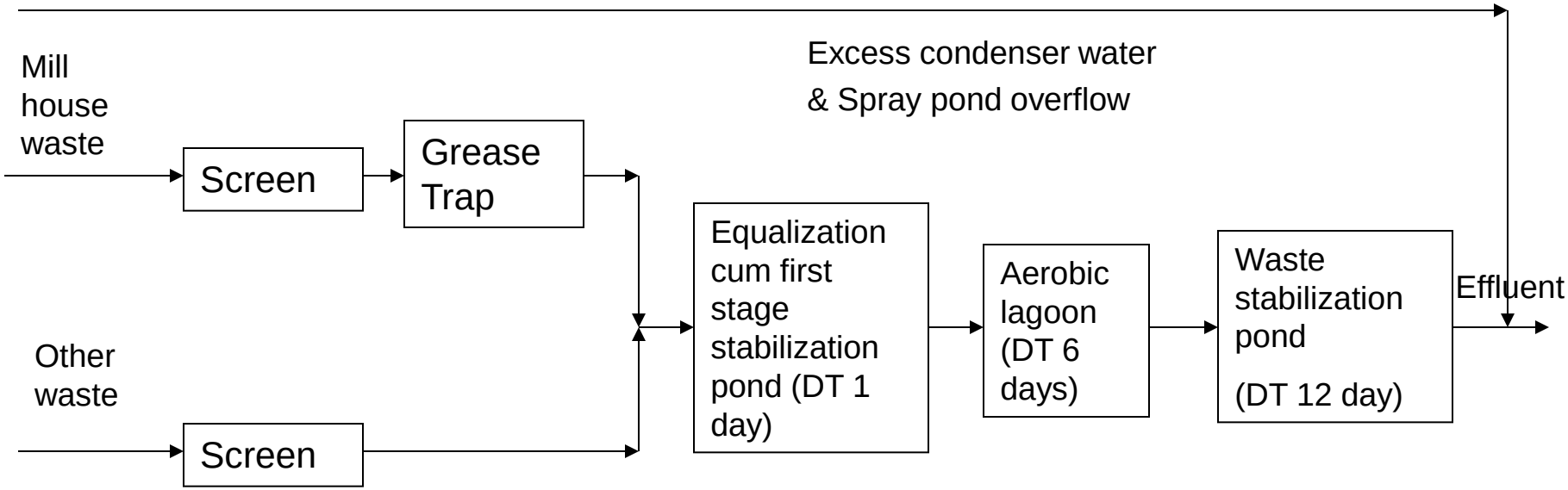
Treatment of the wastes

- Pollution load in sugar mills can be reduced with better water and material economy practiced in plant.
- Recycling will reduce the volume of waste to great extent. e.g. volume of mill house waste can be reduced by recycling the water used for splashing.
- Dry floor cleaning and reducing quantity of floor wash water can reduce the volume of waste.
- Proper control of operation can reduce the pollution load e. g. overloading of evaporators and vacuum pans, extensive boiling of the syrup leads to loss of sugar through condenser water thus increase in volume and strength of effluent.

Treatment of the wastes

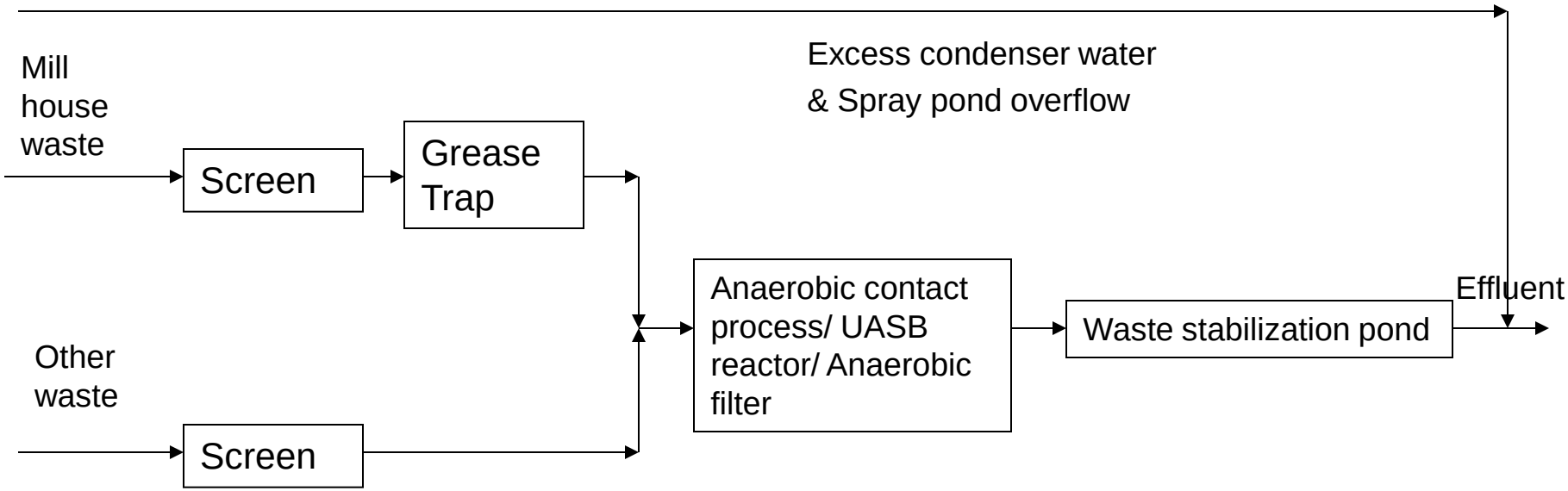
- COD/BOD ratio (approx. 1.6 - 2) makes it biodegradable wastewater.
- Conventional aerobic treatment (ASP and TF) are not too efficient even at low organic loading rate.
- Due to seasonal nature of waste conventional treatment may not be economical.
- Anaerobic treatment (digestion and lagoon) can give > 70% to 90% efficiency. Effluent from anaerobic treatment can be treated by stabilization pond.
- Two stage biological treatments (anaerobic lagoon + stabilization pond) is common. Overall BOD > 90% can be removed.
- UASB reactor followed by waste stabilization pond is also effective.

Treatment of the wastes



Flow diagram of complete treatment of sugar industry wastewater

Treatment of the wastes



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