Dairy Industry : Effluent Standards

Parameter	Concentration not to exceed in mg/l, except pH	Quantum per processed
pH	**6.5 – 8.5**	
*BOD at 27^0C, 3 days	**100**	
**Suspended solids	**150**	
Oil and grease	**10**	
Wastewater generation	**-**	$3m^3$/kl of milk

* - BOD may be made stringent up to 30 mg/L if the recipient fresh water body is a source for drinking water supply.

** - Suspended solids is relaxable up to 450 mg/l, and BOD is relaxable up to 350 mg/L, provided the wastewater is discharged into town sewer leading to secondary treatment of the sewage.

Dairy Industry : Effluent Standards

- BOD shall be up to 350 mg/l for the chilling plant effluent for applying on land provided:
  - The land is designed and operated as secondary treatment system with suitable monitoring facilities.
  - The drainage water from the land after secondary treatment has to satisfy a limit of **30 mg/L BOD and 10 mg/L of nitrate** expressed as ‘N’.
  - The net addition of the groundwater quality should not be more than **3 mg/L of BOD and 3 mg/L of nitrate** expressed as ‘N’.
  - The limit for applying on land is allowed subject to the availability of adequate land for discharge under the control of the industry.

Dairy Wastewater

- The dairies collect milk from the producers / farmers and then either simply bottle it for marketing or produce different milk products.

- Large quantity of wastewater originates depending on the products.

- As such the wastewater is biodegradable but strong in nature.

Sources of waste

- Wastewater originates from: receiving station, bottling plants, cheese factories, butter plant, casein plant, condensed milk plant, dried milk plant, and ice cream plant.

- Wastewater also comes from water softening plant.

- **Receiving station**
  - Milk is received and after inspection emptied into a weighing vat, it is sampled and loaded into tank cars for transport to bottling plants.
  - The empty cans are rinsed, washed, sterilized and are returned to the farmers.

Sources of waste

- **Bottling plant**
  - The milk received from receiving station is processed. The processing includes **cooling, clarification, filtration, pasteurization and bottling**. (Bottle or polythene container)
  - The wastewater originates from the above two operation from washing of bottles, cases, cans, processing equipment and floors.
  - Waste contains milk drippings and chemicals used for cleaning containers and equipments.

Sources of waste

- **Cheese factory**
  - The milk is **pasteurized** and cooled and placed in a vat, where a starter (lactic acid producing bacterial culture) and rennet (enzymes rennin used to curdle milk) are added.
  - This separates the **casein** of the milk in the form the curd. The whey is withdrawn and curd is compressed to remove excess whey.
  - Other ingredients (e. g. cream) are then added and cheese blocks are cut and packed for sale.
  - **Wastewater** from this section includes discarded whey and the wash water used for cleaning vats, equipments, floors, etc.

Sources of waste

- **Creamery process**
  - The whole milk is preheated to above 30 ^{o}C to separate the cream from the milk. (Centrifuged to separate cream).
  - In **butter plant** cream is pasteurized and may be ripened with a selected acid and bacterial culture.
  - This is then churned at temperature about 7 to 10 ^{o}C to produce butter granules.
  - The butter milk is drained out and butter is washed and after standardization packed for sale.
  - Butter milk, wash water used to clean the churns, and small quantity of butter forms the **wastewater** from this section.

Sources of waste

- **Skimmed milk:** is then sent for bottling for human consumption.
- **Condensery**
  - Whole milk or other dairy products are evaporated to obtain concentrated product e. g. unsweetened milk, sweetened milk, nonfat milk, whey, butter milk.
  - Dry milk powders are produced by evaporation followed by drying by either roller process or spray process.
  - The dry milk plant waste consist chiefly the wash water used to clean containers and equipments.
- In addition to the wastewater from all the above, some amount of uncontaminated cooling water comes as waste. This is often recycled.

Wastewater Composition

- Nature of waste is intermittent in origin.
- Nature and composition depends on types of products produced, and the size of the plants.
- Wastewater volume generation 3 m^3/m^3 of milk processed.

Characteristics of dairy wastewater

Item	Value	Ngp. Milk scheme
pH	6.5 - 8.5	7 - 10
Alkalinity	300 - 600 mg/l	300 - 400
T.D.S.	1000 - 1200 mg/l	Up to 3000
S.S.	500 to 1000 mg/l	400 – 2000 (TS = 1200 – 3000)
BOD	1000 - 1900 mg/l	800 - 2400
COD	1500 - 3000 mg/l	1300 - 4000
Total nitrogen	70 to 80 mg/l	
Phosphorous	10 to 60 mg/l	
Chloride	100 mg/l	
Oil and grease	200-300 mg/l	

Effect of waste on Receiving Streams

- Wastewater is organic in nature and slightly alkaline when fresh.
- When discharge in to river.
  - **Rapid DO depletion** problem
  - **Growth of sewage fungi** covering bottom of stream and hydraulic structures may occur.
  - Wastewater also carries bacteria responsible for **tuberculosis**.
  - In absence of DO lactose gets converted to lactic acid, and **precipitation of casein** occurs, decomposition of casein under anaerobic condition leads to odour and black sludge formation.
  - At certain dilution can be **toxic to fishes**.
  - Combined treatment of dairy and domestic wastewater is possible, if the **quantity of sewage is 10 times than dairy waste**. However, the dairy waste should be discharge in fresh condition otherwise may cause corrosion of sewers.

Reduction in volume and strength of wastewater

- Reduction in volume and strength of wastewater is possible by following:
  - Prevention of spills, leakages and installing dripping pans at receiving station
  - Reducing the amount of water for washes.
  - Segregation of uncontaminated cooling water and recycling the same.
  - Utilizing butter milk and whey for by-product recovery. (chicken food by evaporation, poultry food)

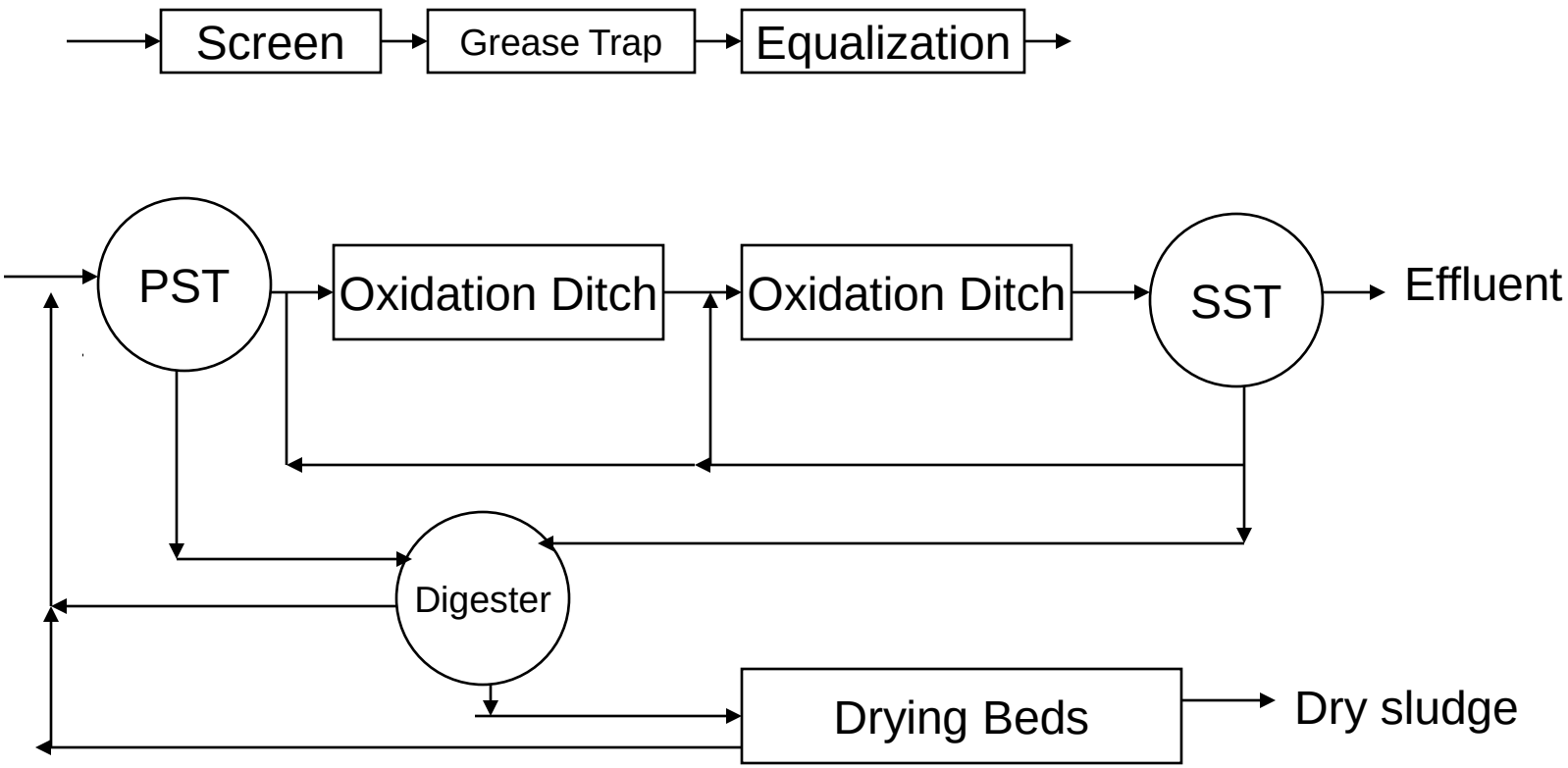
Treatment of Dairy wastewater

- Due to low COD/BOD ratio, can be treated efficiently by **biological treatment processes**.
- Wastewater contains **essential nutrients** for bacterial growth.
- Due to intermittent nature of the waste discharge, it is desirable to provide **equalization tank** with or without aeration.
- **Aeration in equalization** eliminates odour during conversion of lactose to lactic acid and also helps in breaking size of suspended organic matter. It may also reduce BOD by about 50%.
- Provision of **grease trap** is necessary as a pretreatment to remove fat and other greasy substances.

Treatment of Dairy wastewater

- High rate **trickling filter, ASP** can be effectively used
- When sufficient land is available low cost treatment options such as **Oxidation Ditch, Aeration Lagoon, Stabilization ponds** can be economical.
- **Oxidation Ditch**: F/M = 0.2 kg/kg of MLVSS, MLSS conc. 4000 mg/L, aeration period = 1.5 day can gives BOD removal efficiency of 95 to 98%.
- **Stabilization Pond**: 12 days HRT, 550 to 585 kg BOD/hect.day; 60 to 75% efficiency can be obtained.
- **Anaerobic Lagoon**: 7 days HRT, 3m depth, 90% efficiency at OLR = 0.48 kg COD/m^3.d.
- UASB reactor 3 to 5 Kg COD/m^3.d, HRT 12 to 18 h + ASP (extended aeration).

Treatment of Dairy wastewater (in the past)



Treatment of Dairy wastewater (presently used)