Dairy Industry : Effluent Standards

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Concentration not to exceed in mg/l, except pH</th>
<th>Quantum per processed</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.5 – 8.5</td>
<td></td>
</tr>
<tr>
<td>*BOD at 27°C, 3 days</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>**Suspended solids</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Oil and grease</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Wastewater generation</td>
<td>-</td>
<td>3 m³/kl of milk</td>
</tr>
</tbody>
</table>

* - 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 °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 °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 m³/m³ of milk processed.
### Characteristics of dairy wastewater

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
<th>Ngp. Milk scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.5 - 8.5</td>
<td>7 - 10</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>300 - 600 mg/l</td>
<td>300 - 400</td>
</tr>
<tr>
<td>T.D.S.</td>
<td>1000 - 1200 mg/l</td>
<td>Up to 3000</td>
</tr>
<tr>
<td>S.S.</td>
<td>500 to 1000 mg/l</td>
<td>400 – 2000 (TS = 1200 – 3000)</td>
</tr>
<tr>
<td>BOD</td>
<td>1000 - 1900 mg/l</td>
<td>800 – 2400</td>
</tr>
<tr>
<td>COD</td>
<td>1500 - 3000 mg/l</td>
<td>1300 – 4000</td>
</tr>
<tr>
<td>Total nitrogen</td>
<td>70 to 80 mg/l</td>
<td></td>
</tr>
<tr>
<td>Phosphorous</td>
<td>10 to 60 mg/l</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>100 mg/l</td>
<td></td>
</tr>
<tr>
<td>Oil and grease</td>
<td>200-300 mg/l</td>
<td></td>
</tr>
</tbody>
</table>
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/m³.d.

• UASB reactor  3 to 5 Kg COD/m³.d, HRT 12 to 18 h + ASP (extended aeration).
Treatment of Dairy wastewater (in the past)

- Screen
- Grease Trap
- Equalization
- PST
- Oxidation Ditch
- Oxidation Ditch
- SST
- Effluent
- PST
- Digester
- Drying Beds
- Dry sludge
Treatment of Dairy wastewater (presently used)

- Screen
- Grease Trap
- Equalization
- Neutralization
- UASB
- Aeration Tank
- SST
- Effluent
- Sludge Recycle
- Sludge to drying beds