TREATMENT OF FOOD PROCESSING WASTES

Module- 35
Lec- 35

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The types of waste water produced by food processing operations reflect the wide variety of ingredients and processes carried out. Such as:

- Washing of root vegetables, including sugar beet, can give rise to high TSS levels in the effluent.
- Further processing of vegetables, involving peeling and/or dicing, increases the dissolved solids (e.g. sugar in fruit processing)
- Cereals processing and brewing create a carbohydrate-rich effluent.
- Effluent from processing legumes contains a higher level of protein.
- Effluent from processing oilseeds contains some fats usually as suspended matter.
- Milk processing creates an effluent with varying proportions of dissolved lactose and protein plus suspended fat.
- Meat and poultry processing gives rise to effluents rich in both protein and fat.

In most of these examples, there is particulate waste, i.e. particles greater than 1 mm in size, in addition to the fine suspended matter.

These should be removed by screening prior to disposal of the plant effluent into the drain and strainers should be fitted into each drain to collect those particles that bypass the screens. Both screens and strainers must be cleaned daily.

Material recovered from screens within the process plant may be suitable for further processing.

**Treatment of wastes**

- Physical Treatment:-
  - Sedimentation and/or flotation usually form the first stage of effluent treatment, depending on the particular effluent.
  - Flotation must be carried out where the fat may be recovered and recycled within the process.
Production processes starting with dirty raw materials such as root vegetables produce an effluent with high TSS.

- A sedimentation or grit tank is needed in this instance.
- For disposal, the grit may be removed from the tank by a jog conveyor and dumped into a skip, either back onto the farmland, if relatively uncontaminated, or by landfill.

Following either of these pretreatments, the effluent should be collected into balance tanks. These serve to even out the fluctuations in the some properties of the wastes in following way:

- Mixing is done both to aid standardization and to maintain an aerobic environment, thus reducing off odor generation.
- Lime (calcium hydroxide) or sodium hydroxide has been used to raise pH.

- Hydrochloric acid is used to lower the pH.
- Sodium hydroxide is used as the principal cleaning agent and normally results in an alkaline effluent.

**Chemical treatment:**

- Chemical addition is usually by dosing a solution into the waste stream followed by rapid mixing to ensure even distribution.
- Addition of polyvalent cations, for instance aluminium sulphate at pH 5.5–7.5, or ferric chloride (or sulphate) at pH 5.0–8.5, promotes the formation of denser agglomerates that can be sedimented and recovered as sludge.
- The effluent from the settlement tank may either be discharged to the sewer as partially treated effluent, incurring a much lower disposal charge, or else taken on to biological treatment.

**Biological Treatments:**
Biological treatments may be divided into two parts:
- Aerobic processes and
- Anaerobic processes.

In aerobic processes, oxygen acts as the electron acceptor so the primary products are water and carbon dioxide. In anaerobic treatment, the primary products are methane and carbon dioxide, with sulphur being reduced to hydrogen sulphide.

- aerobic treatments produce the less polluting effluents, anaerobic treatment has great potential for large-scale treatment of sludge and highly polluted waste waters.

In general, smaller plants opt for aerobic treatment while the larger plants may use a combination of aerobic and anaerobic methods.

**Comparison of aerobic and anaerobic processes.**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Aerobic</th>
<th>Anaerobic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital cost</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>Energy cost</td>
<td>Medium-high</td>
<td>Net output</td>
</tr>
<tr>
<td>Influent quality</td>
<td>Flexible</td>
<td>Demanding</td>
</tr>
<tr>
<td>Sludge retention</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Effluent quality</td>
<td>Potentially good</td>
<td>Poor</td>
</tr>
</tbody>
</table>

**Biogas and its Utilization**
Gas collected from anaerobic treatments contains primarily methane and carbon dioxide in ratios varying from 1 : 1 to 3 : 1, with traces of hydrogen, hydrogen sulphide and other volatiles.

- It is normally collected in a floating-dome gas holder at relatively low pressure, 1.0±0.5 kPa.
- The capacity of the gas holder depends on the output from the digester and whether the gas is used constantly or only during part of the day.

- Gas may be used in boilers to raise steam or in a CHP engine, the heat being used to maintain the fermentation temperature in the reactor.

**Sludge Disposal**

Sludge production is a major problem with both aerobic and anaerobic processes, in terms of both their immediate offensive nature and the potential for pollution.

- If agricultural land is nearby, it may be economic to dispose of the unconcentrated sludge direct to the land, preferably by injection below the surface to minimise nuisance and avoid runoff.
- In many cases, it is necessary first to concentrate or thicken the sludge. This may be carried out by gravity settlement for 2–5 days, sometimes aided by the addition of polyelectrolytes.
- Disposal of sludge from food processing by landfill is uncommon in the UK but has been used widely in other parts of the EU.

**Where to dispose the sludge?**

- Sludge has been used to aid bioremediation of contaminated land, where its nutrients and humus help raise the activity of the soil bacteria.
- It has also been useful in raising the productivity of the poor soils often used for forestry.
- With further dehydration, such as by belt drying, there is potential for mixing the sludge with straw and composting.
Final Disposal of Waste Water

- Final disposal of treated waste water is into a water course where it will be diluted by the existing flow.
- General requirements are covered by regulations, in the EU based on the Urban wastewater directive (91/271/EC).
- Discharge licenses may include maxima for flow, temperature, suspended solids, dissolved solids, BOD₅ (The biochemical oxygen demand of wastewater during decomposition occurring over a 5-day period.), nitrogen, phosphorous and turbidity.

References: