WATER TREATMENT PROCESSES

Effluent → Primary treatment → Secondary Treatment

runoff → Tertiary treatment
# PRIMARY TREATMENT

- to prepare the wastewater for biological treatment

<table>
<thead>
<tr>
<th>Purpose</th>
<th>treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove large solids, grit</td>
<td>screening</td>
</tr>
<tr>
<td>Remove oils, grease</td>
<td>Flotation, Sedimentation</td>
</tr>
<tr>
<td>And suspended solids</td>
<td>Coagulation filtration</td>
</tr>
<tr>
<td>Adjust the pH</td>
<td>Neutralization</td>
</tr>
</tbody>
</table>
For process wastewaters

• to remove toxic pollutants

- Heavy metal removal, precipitation

- oxidation / reduction for toxic organic pollutants removal

- adsorption i.e. Activated carbon

- stripping, ion exchange

etc.
SECONDARY TREATMENT

- Biological degradation of organic compounds (aerobic / anaerobic)

- Microorganisms and solids will be allowed to settle

- Recycle of a fraction of sludge

** toxic residues have to be removed prior to biological treatment **
TERTIARY TREATMENT

- to remove specific types of residuals
- filtration: to remove suspended or colloidal solids
- adsorption, chemical oxidation: remove organics
- ozonation, chlorination: disinfection

**all these processes have their place in overall Wastewater treatment scheme**
SELECTION OF A TREATMENT PROCESS

Depends upon:

1. Characteristics of the wastewater
   - Form of pollutants → suspension
     → colloidal
     → dissolved
   - Biodegradability
   - Toxicity of the components
2. The required effluent quality

3. The costs

4. The availability of land
Preliminary analysis

Organic stream

Stream + heavy metals

Mineral stream

Volatile Toxic/ nonbiodegradable

Equalization, neutralization Oil, grease, solids removal

Biodegradable

Toxic substance treatment

Biological treatment

Final disposal

Water Treatment Processes
Technologies for toxic wastewaters treatment

- Reverse osmosis → Discharge recycle, treatment
  - Ion exchange
    - filtration
      - Precipitation
        - Oxidation/reduction
          - Heavy metals
            - water
          - Organics
            - Air or Stream stripping
              - Volatile Organics
                - NH₃
<table>
<thead>
<tr>
<th>Method</th>
<th>mode of operation</th>
<th>degree of treatment</th>
<th>land requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagoon</td>
<td>- intermittent</td>
<td>intermediate</td>
<td>earth dug</td>
</tr>
<tr>
<td></td>
<td>- continuous</td>
<td></td>
<td>10-60 days’ retention</td>
</tr>
<tr>
<td></td>
<td>- facultative</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- anaerobic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerated Lagoon</td>
<td>complete mix</td>
<td>high in summer</td>
<td>earth basins</td>
</tr>
<tr>
<td></td>
<td></td>
<td>low in winter</td>
<td>8.55-17.1 m²/(m³/d)</td>
</tr>
<tr>
<td>Method</td>
<td>mode of operation</td>
<td>degree of treatment</td>
<td>land requirement</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------------------</td>
<td>-------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Activated Sludge</td>
<td>complete mixed plug flow</td>
<td>&gt;90 % removal of organics</td>
<td>earth or concrete</td>
</tr>
<tr>
<td></td>
<td>sludge recycle</td>
<td></td>
<td>0.56 – 2.62 m²/(m³/d)</td>
</tr>
<tr>
<td>Trickling Filter</td>
<td>continuous application</td>
<td>intermediate or high</td>
<td>5.52-34.4 m²/(1000m³/d)</td>
</tr>
<tr>
<td>RBC</td>
<td>multistage continuous</td>
<td>intermediate or high</td>
<td></td>
</tr>
<tr>
<td>Anaerobic Mix</td>
<td>complete mix</td>
<td>intermediate</td>
<td></td>
</tr>
</tbody>
</table>
## Physical and chemical waste treatment

<table>
<thead>
<tr>
<th>Method</th>
<th>waste</th>
<th>mode</th>
<th>degree of treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ion Exchange</td>
<td>plating</td>
<td>continuous</td>
<td>demineralized water product recovery</td>
</tr>
<tr>
<td></td>
<td>nuclear</td>
<td>filtration</td>
<td></td>
</tr>
<tr>
<td>Reduction Precipitation</td>
<td>plating heavy metal</td>
<td>batch</td>
<td>complete removal of Cr &amp; heavy metals</td>
</tr>
<tr>
<td>Coagulation</td>
<td>paper board refinery rubber, paint textile</td>
<td>batch</td>
<td>complete removal of suspended and colloidal matters</td>
</tr>
<tr>
<td>Method</td>
<td>waste</td>
<td>mode</td>
<td>degree of treatment</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------</td>
<td>-----------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Adsorption</td>
<td>toxic or organic refractory</td>
<td>column of activated carbon</td>
<td>complete removal of most organics</td>
</tr>
<tr>
<td>Chemical Oxidation</td>
<td>toxic &amp; refractory organics</td>
<td>batch or continuous $O_3$ or catalyzed $H_2O_2$</td>
<td>partial or complete oxidation</td>
</tr>
</tbody>
</table>
Ex. Municipal wastewater

Water → screening → Sedimentation tank

disinfection ← clarifier ← Aeration tank

Sludge thickening

Aneorobic digesters

Land uses ← Belt presses
Ex. Drinking water

Raw water (source water) → Coagulation/ flocculation → sedimentation

↓

Disinfection ← filtration (Layer of charcoal, sand, gravel)
Pure water treatment

1. Carbon dioxide
2. Lime
3. Lime water
4. Ferric sulphate
5. Ozone
6. Sodium hypochlorite
7. Ammonia

Water Treatment Processes
Ex. Oil removal and separation

- **Corrugated Plate Interceptors (CPI's)**
  - Efficient gravity separators
  - Removal of gross solids and free oil
  - >75% free oil removal

- **Dissolved Air Flotation (DAF)**
  - Ex. Oil removal and separation

- **Membrane Plant**
  - Treated Effluent
  - Recovered Oil
Ex. Wastewater from sulfite Pulp and paper

Conventional treatment comprises

1. Preliminary treatment

2. Primary or physical treatment (sedimentation)

3. Secondary or biological treatment (activated sludge, aerated lagoons or biofiltration)

4. Sludge treatments (sludge dewatering)