Wastewater Treatment

CE 326 Principles of Environmental Engineering
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# Four Main Processes

<table>
<thead>
<tr>
<th>Reaction Environment</th>
<th>TEA</th>
<th>Main Reaction</th>
<th>End Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aerobic</td>
<td>$O_2$</td>
<td>$BOD + O_2 \rightarrow CO_2 + H_2O$</td>
<td>carbonaceous BOD removal</td>
</tr>
<tr>
<td>2. Aerobic</td>
<td>$O_2$</td>
<td>$NH_4^+ + O_2 \rightarrow NO_3^- + H_2O$</td>
<td>nitrification</td>
</tr>
<tr>
<td>3. Anoxic</td>
<td>$NO_3^-$</td>
<td>$BOD + NO_3^- \rightarrow CO_2 + H_2O + N_2$</td>
<td>denitrification</td>
</tr>
<tr>
<td>4. Anaerobic</td>
<td>$CO_2$</td>
<td>$BOD \rightarrow CH_4 + CO_2$</td>
<td>anaerobic digestion</td>
</tr>
</tbody>
</table>
The diagram illustrates a wastewater treatment process. The flow starts with screens followed by a grit section. The treated water then goes through an aeration basin where mixed liquor is recycled back to the system. The sludge is discarded.

The mathematical equation shown is:

\[ M = \frac{\mu_{\text{max}} S}{K_s + S} \]

- \( M \) = specific growth rate, \( h^{-1} \)
- \( \mu_{\text{max}} \) = maximum growth rate
- \( K_s \) = half saturation coefficient
- \( S \) = substrate concentration (mg/L as BOD)
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The Monod equation describes the growth rate of microorganisms as a function of substrate concentration.
Boone wastewater treatment plant
Boone wastewater treatment plant
Wastewater treatment plants
Wastewater treatment plants
Back River WWTP
Back River WWTP
Back River WWTP
Back River WWTP
Abu Dhabi WWTP
Abu Dhabi WWTP
Abu Dhabi WWTP
Budapest WWTP
Lake Balaton WWTP
Lake Balaton WWTP
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Lake Balaton WWTP
Wastewater Treatment in Developing Countries

Community Biogas Plant in China
Settling Problem in Activated Sludge
Summary of sludge processing

1. **Thickening**
   - Water removal
   - Volume reduction

2. **Digestion**
   - Pathogen destruction
   - Odor control
   - Gas production
   - Stabilization of organic matter

3. **Conditioning**
   - Improved dewatering/thickening rate
   - Improved compactability
   - Stabilization

4. **Dewatering**
   - Pathogen destruction
   - Odor control
   - Gas production
   - Stabilization of organic matter

5. **Incineration and Wet Oxidation**
   - Volume and weight reduction
   - Reduction of fuel requirements for incineration/drying

6. **Final Disposal**
   - Ocean dumping*
   - Landfill
   - Land application
   - Incineration
View of machine used to aerate compost placed in windrows.
Overview of windrow composting operation
Schematic of static aerated compost pile

- Screened or unscreened compost cover
- Processed solid waste
- Bulking agent base
- Perforated pipe
- Nonperforated pipe
- Low point for condensate drainage
- Exhaust fan
- Filter pile screened compost
Biosolids land application

a) Injecting Sludge

b) Sludge-Treated Soil
Placement of geomembrane liner in area-type landfill