HIGH STRENGTH WASTE WATER

What are your greatest struggles?

Presented by Doug Rarog
6 main concerns

- Biological Oxygen Demand – B.O.D.
- Dissolved Oxygen – D.O.
- Total Suspended Solids – T.S.S.
- Phosphorous
- Nitrogen
- Pathogens
  - *E. coli*
  - *Total Coliform*
Biological Processes

- Aerobic
- Anoxic
- Anaerobic
- Combined aerobic-anoxic-anaerobic
- Pond processes

*The biological processes are considered the most effective and economic process in the field of wastewater treatment (Metcalf and Eddy, 1991)*
Bacteria and Enzymes

• Natures Way to Clean

• Specific Functions – Key-Lock Mechanism
  • enzymes specifically react with only one or a very few similar compounds

• Only Organic Material

• Well Accepted Process
More than half of the energy in wastewater treatment is consumed by aeration. - "Elucidating the Impact of Low Dissolved Oxygen Wastewater Treatment on Pharmaceutical Fate" – Lauren B. Stadler
Dissolved Oxygen

- High B.O.D. or C.B.O.D.
- Increased Water Temperature negatively effects D.O.
- High D.O. concentrations can negatively effect the denitrification process making it less efficient
- Sudden drastic changes in influent
Total Suspended Solids

- Reducing T.S.S. will almost always reduce B.O.D.
- High T.S.S. levels can damage or clog systems
- Short-circuiting due to excess capacity
  - increase ammonia release / reduced denitrification
  - decrease D.O.
- increased H₂S production – odour & acidification
Food Source for microbial activity

Unused ‘P’ – land applied biosolids have a low plant uptake (20%-60%) – Univ of Oregon Pacific Northwest Test

Major contributor to undesired aquatic plant growth – algae bloom & anoxic water

Bacterial decomposition converts organic phosphorous into inorganic phosphorous
Nitrogen

- Denitrification is the biological process by which nitrate is converted to nitrogen and other gaseous end products.

- The requirements for the denitrification process are:
  - a) nitrogen present in the form of nitrates
  - b) an organic carbon source
  - c) an anaerobic environment

- In multiple stage carbon & nitrogen removal, a disadvantage for denitrification occurs either in the addition of external carbon or the recycle part of the effluent of nitrifying bacteria. Carbon and nitrogen removal occurring in a single unit is a possibility to overcome these disadvantages

Nitrification and Denitrification in the Wastewater Treatment System
P. Y. Yang and Zhi-Qin Zhang
Dept. of Biosystems Engineering, University of Hawaii at Manoa
Pathogens

<table>
<thead>
<tr>
<th>Regulated Tests</th>
<th>Units</th>
<th># of Sites</th>
<th>Avg. Before</th>
<th>Avg. After</th>
<th>Avg. Diff.</th>
<th>% Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Coliforms</td>
<td>MPN/100 ml</td>
<td>65</td>
<td>74107</td>
<td>3155</td>
<td>70952</td>
<td>91.07%</td>
</tr>
<tr>
<td>Total E. Coli</td>
<td>MPN/100 ml</td>
<td>50</td>
<td>17395</td>
<td>107</td>
<td>17288</td>
<td>98.17%</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>mg/L</td>
<td>35</td>
<td>3.48</td>
<td>1.02</td>
<td>2.46</td>
<td>71.02%</td>
</tr>
<tr>
<td>Nitrogen Total Kjeldahl (TKN)</td>
<td>mg/L</td>
<td>32</td>
<td>15.32</td>
<td>3.87</td>
<td>11.45</td>
<td>71.92%</td>
</tr>
<tr>
<td>Biochemical Oxygen Demand (BOD)</td>
<td>mg/L</td>
<td>31</td>
<td>32.57</td>
<td>4.38</td>
<td>28.19</td>
<td>84.12%</td>
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<tr>
<td>Biochemical Oxygen Demand (BOD5)</td>
<td>mg/L</td>
<td>21</td>
<td>108.60</td>
<td>2.00</td>
<td>106.60</td>
<td>98.16%</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>mg/L</td>
<td>19</td>
<td>17.47</td>
<td>4.59</td>
<td>12.88</td>
<td>73.73%</td>
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<tr>
<td>Ammonia</td>
<td>mg/L</td>
<td>15</td>
<td>11.51</td>
<td>1.04</td>
<td>10.47</td>
<td>92.65%</td>
</tr>
</tbody>
</table>

Source: http://www.saskh20.ca/wastewaterinfo.asp
Bio-augmentation Process

- Lowering the Food/Microorganism ratio
- Utilizing native & foreign microbes
- The enzyme spectrum
- Microbial Enhancement Technology (MET)

All organic material can be broken down with the right microbes, time, temp, and F/M ratio.
Biosolids – Sludge Removal
Delburne, Alberta


Removed 71% sludge in 1 year
At 25% of the cost to manually remove.

Estimated removal costs of $100,000, saved $75,000!
Biosolids - Lagoon Reclamation
Zimbabwe, Africa

Reduction of 11,250 m³ of sludge in facultative lagoon

4 month period.
City in Northern Canada

Before  After 6 weeks

Restoration & Reduction of FOG Sludge in Lift Station, 6 weeks.
Calgary, AB CAN

Before After 4 weeks

Full Pipeline Rehabilitation over 24 km, 1 month.
Third Party Verification
Case Study
Sludge Removal

- May 2013 to Oct 2013
- Over 6 ft of Sludge
- Manual Removal est. $60,000+
## Before and After Effluent Results

### Village of Vibank, SK Wastewater Analysis 2013

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Units</th>
<th>Location 1: Lagoon Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>May-13</td>
<td>Oct-13</td>
</tr>
<tr>
<td>Nitrogen Total Kjeldahl</td>
<td>mg/L</td>
<td>31.7</td>
</tr>
<tr>
<td>Biochemical Oxygen Demand (BOD)</td>
<td>mg/L</td>
<td>108.6</td>
</tr>
<tr>
<td>Total Coliforms</td>
<td>MPN/100 ml</td>
<td>325500</td>
</tr>
<tr>
<td>Total E. Coli</td>
<td>MPN/100 ml</td>
<td>113700</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>mg/L</td>
<td>4.95</td>
</tr>
</tbody>
</table>

Biosolids Reduction

Reduced Dry Metric Tons of Biosolids by Avg. 31%
Applications
New or Existing

- Lagoons
- Digesters
- Lift Stations
- Bio-Reactors
- Collection Lines
1 kg Water Soluble Bag

55 lb Tub
Summary

**Economic**
- Proactive
- Lowsers maintenance
- Decrease capital costs
- Increase worker safety

**Environmental**
- Decrease disposal
- Solves problem in system
- Improve WW quality

**System**
- Increase Capacity
- Reduces Odour
Thank You!

Doug Rarog
British Columbia Representative
(250) 878–9620
dougrarog@gmail.com
doug@actizyme.com