Overview

Sampling Protocols and Methods

Presented By: Matt Lee P.E.
President Aqua Test Inc.
Aqua Test Inc.

- Formed in 1986
- Primary function was operation of commercial wastewater treatment Systems
- Operate approximately 1.5 Million GPD
- Certified Environmental Testing Laboratory
Sampling Overview

- Minimum level of credentials/certifications
- Understand the purpose of wastewater sampling
- Typical Sample Parameters
- Equipment
- Identify proper sample collection and handling procedures.
- Documentation related to sampling event
Credentials/ Certifications

- Locally recognized training facility
- Manufacturer rep
- Credibility
- Defensibility
Sampling purpose

- System operation
- Troubleshooting
- Manufacturers requirement
- Compliance for regulatory purposes
Sample Purpose Dictates

- Analysis methods
- Timing of sampling
- Sampling location
- Sample collection
- Sample containers
- Sample volume
- Sample transport
- Laboratory
- Interference
The Goal of Any Sampling Event?

- Representative
- Reproducible
- Defensible
- Useful
System Operation- Nutrient Removal

- Field kits are a viable option
  - Non compliance
  - Information is available immediately
  - System “tweaks” occur immediately
Compliance Monitoring: Biological

- System usage - peak flow
  - Day after Thanksgiving
- Is the site operating properly?
  - Disinfection equipment working
  - Blowers are on
- Laboratory sample acceptance times
- Distance from site to lab
Manufacturers Requirements:

- System guarantees
- Surrogate testing
  - Field testing of a constituent
  - Lower cost
Minimum Equipment and Tools

- Gloves
- Safety Glasses
- Disinfection solution
- Sampling Equipment
- Field instruments / Chemistry Kits
- Sample Bottles with labels and documentation
- Distilled water
- Cooler with blue ice
- Imhoff cone
• Thermometer

• Tool used to measure sludge levels

• Sample collection tool

• Imhoff cone
• Distilled water wash bottle

• DO and Temp meter

• pH measuring device
• **DO test kit**—
  1 to 12

• **Pocket pH meters & buffer**
  for calibration in the field

• **DO test kit**—
  0 to 1
Typical Sample Constituents

- BOD$_5$
- CBOD$_5$
- TSS
- F.O.G.
- Cl$^-$
- Nitrogen Species, TKN, NO$_3$, NH$_3$
- Phosphorous
- Biological
  - Fecal and/or Total Coliforms
Sample containers

- Types of containers
  - Glass
  - Polyethylene
- Test specific
- Check with laboratory
- Clearly label the sample container with water proof markings
- Water tight
Sampling requirement examples

- **Biochemical oxygen demand (BOD)**
  - Container - polyethylene or glass
  - Preservation - 4°C (ice)
  - Maximum holding time - 48 hours

- **Oil and grease (FOG)**
  - Container - glass
  - Preservation - 4°C and add HCL or H$_2$SO$_4$ to pH<2
  - Maximum holding time - 28 days

- **Fecal coliforms**
  - Container - polyethylene or glass
  - Preservation - 4°C and 0.008% Na$_2$S$_2$O$_3$
  - Maximum holding time - 6hrs
Sample volume

- Test dependent
- Rule of thumb
  - Quart/Liter
- Check with laboratory
- More tests = more sample
- Cleaner water = more sample
- Fill the container
  - No air gap
Composite, integrated, and grab sample

- **Grab sample**- one sample taken from one point and time
  - Gives an idea of what is happening right then
- **Integrated sample**-
  - Combination of grab samples collected at the same time but at different locations.
- **Composite sample**-
  - Multiple samples taken from one point at multiple times and integrated together for analysis
  - Pulled from a location that provides a composite.
  - Multiple grab samples at different flow periods.
  - Averaging over the course of a day
Grab vs.
Composite Sampling
A septic tank is a composite sample

- Typical septic tank is 1000 gallons
- Typical daily flow is 200 gpd
- This provides a 5 day composite sample
A system operating at design flows of 450 gpd will have an approximate 2 day composite sample
Grab sampling is considered controversial by some

- No standardized protocol
- Varying Detention Times affect results
- Peak vs. low flow affect results
Composite Sampling

- Typically used in wastewater treatment process
- Requires expensive equipment
- Labor intensive
- Method chosen is time or flow paced
Comparison of Grab and Composite samples

- A grab sample is a single sampling event
- A composite sample may be developed from multiple grab samples or through a composite sampler
# Analytical Constituent Requirements

*Standard Methods for the Examination of Water and Wastewater, 20th ed*

<table>
<thead>
<tr>
<th>Grab Required</th>
<th>Grab or Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkalinity</td>
<td>BOD$_5$</td>
</tr>
<tr>
<td>Oil &amp; Grease</td>
<td>Nitrogen species</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>Solids</td>
</tr>
<tr>
<td>pH</td>
<td>Phosphorous</td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td>Biological</td>
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</tr>
</tbody>
</table>
### Example 1

<table>
<thead>
<tr>
<th>Sample I.D</th>
<th>pH</th>
<th>Dissolved Oxygen mg/L</th>
<th>BOD$_5$ mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Grab</td>
<td>6.25</td>
<td>.65</td>
<td>243</td>
</tr>
<tr>
<td>Mid Point Grab</td>
<td>6.60</td>
<td>.47</td>
<td>245</td>
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<tr>
<td>Final Grab</td>
<td>6.72</td>
<td>.46</td>
<td>238</td>
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<tr>
<td>Composite Sample Based on Grabs</td>
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<td></td>
<td>242</td>
</tr>
<tr>
<td>Composite automated</td>
<td>7.12</td>
<td>5.19</td>
<td>215</td>
</tr>
<tr>
<td>Sample I.D</td>
<td>pH</td>
<td>Dissolved Oxygen mg/L</td>
<td>BOD$_5$ mg/L</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------</td>
<td>-----------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Initial Grab</td>
<td>6.25</td>
<td>.65</td>
<td>243</td>
</tr>
<tr>
<td>Mid Point Grab</td>
<td>6.61</td>
<td>.55</td>
<td>230</td>
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<tr>
<td>Final Grab</td>
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<td>222</td>
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<td>Composite Sample Based on Grabs</td>
<td>6.81</td>
<td>5.45</td>
<td>232</td>
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<tr>
<td>Composite automated</td>
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<tr>
<td>Sample Number</td>
<td>Flow</td>
<td>BOD$_5$ mg/L</td>
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<tr>
<td>---------------</td>
<td>-------</td>
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</tr>
<tr>
<td>1</td>
<td>275</td>
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<tr>
<td>2</td>
<td>11.2</td>
<td>267</td>
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<td>3</td>
<td>39.64</td>
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<td>20.2</td>
<td>252</td>
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<td>6</td>
<td>71.8</td>
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<tr>
<td>7</td>
<td>6.0</td>
<td>220</td>
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<tr>
<td>8</td>
<td>129.4</td>
<td>190</td>
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<tr>
<td>Summary Results</td>
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</tr>
<tr>
<td>------------------------------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Composite</strong></td>
<td>242 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flow Weighted Composite</strong></td>
<td>227 mg/L</td>
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<td></td>
</tr>
<tr>
<td><strong>Daily Flow</strong></td>
<td>280 gpd</td>
<td></td>
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</tbody>
</table>
Sampling safety

- Use proper Personal Protection Equipment
  - Gloves
- Never enter confined spaces
- Be cautious of toxic gases
- Disinfect hands and equipment
Usually samples are collected from the following points:

- Pressure distribution - pump tank
- Gravity system - outlet of the septic tank
- Propriety system - use manufacturers’ recommendations
Influent vs. effluent

- Influent samples are collected from the beginning of a component.
- Effluent sample is collected from the outlet of a component.
Sampling location

- Depends on test
- Process performance
- Best – external sampling port
- Outlet baffles
- Discharge from system
- Consistency
Sampling port for gravity line
Sample collection

- Selecting right tool for the job.
  - Sludge judge
  - Dip stick
  - Sample bottle
  - Dipper
  - Vacuum pump

- Use clean collection equipment

- Collect from “cleanest” end first
Outlet Baffles and Test Ports:

- Care must be taken not to entrain Bio-growth
- Use an Imhoff Cone
Onsite analysis methods

- Dissolved oxygen
  - Measured at sample source
- pH
- Temperature
- Turbidity
- Chlorine residual
- Odor
Laboratory analysis methods

- $\text{BOD}_5$
- CBOD
- COD
- Solids
- TSS
- TN
- TP
- Chloride
- Alkalinity
- FOG
- Fecal / Total Coliforms
Sampling documentation

- Chain of custody
  - Name of person collecting sample
  - Each person having custody (w/ date and time)
  - Sample number
  - Sample description
  - Qc/Qa
  - Required for lab validation of results
A sample is in your “custody” when:

- It is in your actual physical possession.
- It is in your view, after being in your physical possession.
- It was secure beyond a reasonable doubt if not in your view.
**CHAIN OF CUSTODY RECORD**

This information will be used for reporting/billing

<table>
<thead>
<tr>
<th>Name:</th>
<th>Attention:</th>
<th>Address:</th>
<th>Phone:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Lab Use</th>
<th>Sample ID / Collection Point</th>
<th>Date</th>
<th>Time</th>
<th>Comp.</th>
<th>Grab</th>
<th>No. of</th>
<th>BOD &lt;sub&gt;5&lt;/sub&gt;</th>
<th>TSS</th>
<th>O &amp; G</th>
<th>pH</th>
<th>FC</th>
<th>TC</th>
<th>TKN</th>
<th>NH&lt;sub&gt;3&lt;/sub&gt;-N</th>
<th>NO&lt;sub&gt;2&lt;/sub&gt;</th>
<th>NO&lt;sub&gt;3&lt;/sub&gt;</th>
<th>Notes</th>
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</tbody>
</table>

**INSTRUCTIONS:** use one line per sample & indicate tests to be performed by checking appropriate boxes

<table>
<thead>
<tr>
<th>Special Instructions - Client:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Shipped Via:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>UPS</td>
</tr>
<tr>
<td>Hand</td>
</tr>
<tr>
<td>Other</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Temperature Acceptable:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

**Sampler's Signature:**

<table>
<thead>
<tr>
<th>Print Name:</th>
</tr>
</thead>
</table>

**Relinquished To Lab By:**
Sample transport

- Ice chest w/ ice
  - Label cooler “not for food”
- Check with lab for constraints on analysis
- Maximum holding time
  - Test must be started w/in the time requirement
- Document COC
Laboratory

- Standard methods
- Testing methods
- Data range
  - Non-detection
  - Greater than X
  - Too numerous to count
- Purpose of the data
- Lab accreditation
  - Check for specific test
Summary

- Sample purpose
- Analysis methods
- Timing of sampling
- Sampling location
- Sample collection
- Sample containers
- Sample volume
- Sample transport
- Laboratory
- Interference
Thank You!