EFFLUENT TESTING

Lecture 8
Parameter For Pollutants

• Parameters and Pollutants

• Testing of Pollution Parameters

• Regulations in Developed Countries

• Eco-friendly Processing
Effluent Testing

Textile effluents constitute the largest proportion of the total industrial effluents. Effluent testing is thus imperative to protect the environment from adverse effect of the effluents.

The samples have to be analyzed for different metals, Biological Oxygen Demand (BOD), Suspended Solids(SS), Fats/Oils/ Grease(FOG), nitrogen, phosphorous, and several Total Toxic Organics (TTO's)
Table shows the typical quantities of common pollutants of the textile effluents.

<table>
<thead>
<tr>
<th>Pollutants Found in Textile Effluents and Their Typical Quantities</th>
<th>mg/l (milligram per liter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Biochemical Oxygen Demand (5-day)</td>
<td>264.00</td>
</tr>
<tr>
<td>Average Suspended Solids</td>
<td>36.00</td>
</tr>
<tr>
<td>Fats, Oil and grease</td>
<td>15.00</td>
</tr>
<tr>
<td>Ammonia Nitrogen</td>
<td>0.31</td>
</tr>
<tr>
<td>Total Kjeldahl Nitrogen</td>
<td>20.68</td>
</tr>
<tr>
<td>Total Phosphorous</td>
<td>0.53</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.0002</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.00</td>
</tr>
<tr>
<td>Copper</td>
<td>0.10</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.02</td>
</tr>
<tr>
<td>Iron</td>
<td>0.60</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.01</td>
</tr>
<tr>
<td>Lead</td>
<td>0.00</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.24</td>
</tr>
<tr>
<td>Silver</td>
<td>0.00</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.00</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.02</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>0.00</td>
</tr>
<tr>
<td>Total Metal</td>
<td>0.37</td>
</tr>
</tbody>
</table>
PARAMETERS AND POLLUTANTS

Biological Oxygen Demand

- Biological Oxygen Demand (BOD) is the rate at which organisms use the oxygen in water while stabilizing decomposable organic matter under aerobic conditions.

- It is used as a measure of the organic strength of wastes in water and the environmental impact of chemical pollution. When organic matter (pollutants in wastewater) is plentiful, micro-organisms may grow so rapidly that they deplete the dissolved oxygen to the extent that levels can be harmfully low for fish and aquatic life.

- Generally, municipal wastewater treatment plants are capable of reducing or removing moderate to high levels of BOD but in some cases, pretreatment is necessary.

- BOD, to a certain extent, can be beneficial in a septic system. BOD varies widely from industry to industry. Metal finishing wastewater has BOD less than 200 mg/L, food processing in the tens of thousands, and wool production contributing 400. Municipal waste (MWRD) has a BOD of 120 mg/L.
**Suspended Solids (SS) and Fats, Oils and Grease (FOG)**

These pollutants are generally oxygen consuming wastes in a water body. Acceptable limits are 168mg/l for suspended solids and 250mg/l for FOG.

**Nitrogen, Ammonia Nitrogen and Phosphorous**

- Phosphorous and nitrogen are nutrients that promote the growth of algae and larger vegetation. Too much algae and vegetation can become an interference. And as the algae breaks down, dissolved oxygen is consumed.

- Several years ago, phosphates were considered a serious problem for water bodies and this led to regional bans on phosphate containing detergents, which were significant source of such pollution.
Continued…

- Depending on the receiving stream, phosphorous and nitrogen can be a "wanted" addition or an "unwanted" pollutant.

- Ammonia nitrogen is a toxic chemical and can be harmful to fish. It also could cause oxygen depletion and is difficult to treat biologically. All three of these pollutants from Textile waste are important.
**Metals**: Metals in wastewater, if not removed prior to entering a municipal treatment system, are either transferred to the sludge and accumulate or pass through the treatment system as effluent. These metals can be toxic to aquatic life, especially if they are bio-accumulative, and if metal concentrations are too high in the sludge, the sludge could be considered a hazardous waste. Metals are tested by AAS/ICP.

**Total Toxic Organics**: Volatile organics, semi-volatile organics, pesticides and listed as water pollutants by Pollution Control Boards (PCBs) are to be tested.
**Fatty Acids:**

Fatty acids dodecanoic acid, hexadecanoic and octadecanoic acids, more commonly known by the names lauric acid, palmitic acid and stearic acid respectively, are detected in the 1 to 4 parts per million range in most textile effluents. Water quality data for these acids are as follows:

- **Lauric acid:** Lauric acid is used for alkyd resins, cosmetics, insecticides, food additives, wetting agents, soaps, and detergents. In testing it had no effect on rats fed a diet of 35% lauric acid for two years.

- **Palmitic acid:** Palmitic acid is found in sewage effluents at 0.1 mg/L; 11 mg/L is considered a lethal dose to goldfish.

**2-(2-Butoxyethoxy) ethanol:**

This is also known as diethylene glycol monobutyl ether or Dowanol DB and is a common industrial solvent as cleaners, detergents and soaps. It is in the glycol ether family which is a Clean Air Act Hazardous Air Pollutant and a SARA 313 form R reportable class of chemicals.
**Phthalates:**

The phthalates in the waste stream are mainly due to the detergent and/or sizing used at the textile plant. The prominent phthalates in textile effluent are:

- Diphenyl phthalate
- Di-n-butyl phthalate

**Trichloroethylene:**

Trichloroethylene is used as a solvent for degreasing cotton, wool, etc., solvent for dyeing. Trichloroethylene would be a concern for discharges to a septic system. The US Environmental Protection Agency (USEPA) drinking water standard is trichloro-ethylene upto 5 parts per billion. Since trichloroethylene is very mobile in groundwater, there is a possibility of groundwater contamination and thereby contamination of nearby drinking water wells.
TESTING OF POLLUTION PARAMETERS

1. Colour and physical appearance: Dye -house wastes are the most important effluent as they are intensely coloured and impart turbidity. Observation of the colour is the primary test to determine the line of treatment.

2. Odour: Some of the effluents possess toxic substances which give offensive odour, this type of effluent needs special treatment.

3. Temperature: Temperature measurement is necessary and is done at the time of sampling.

4. pH value: pH of the waste water indicates the acidic or alkaline nature of the effluent. It helps in two ways:

(a) It is useful in determining the type of the treatment to be applied to the effluent,
(b) It determines the efficiency of the applied treatment method.
5. **Total suspended solids (TSS):** The undissolved matter present in the effluent is referred as suspended solids. Determination of the suspended solids helps in estimating the pollution potential of an effluent. It also helps in determining the load on secondary biological treatments, after the removal of settleable solids in primary settling tanks.

6. **Total dissolved solids (TDS):** The determination of dissolved solids helps in estimation of dissolved mineral matter content of the effluent.

7. **Biological oxygen demand (BOD):** The measurement of dissolved oxygen indicates the purity of water / effluent and is important for maintaining aerobic conditions in the water. It is a test of reflection of the pollution strength of the effluent and the rate at which biochemical oxidations would take place.

8. **Chemical oxygen demand (COD):** This test determines the pollution strength of textile effluents by measuring the oxygen requirement of organic and inorganic matters in the effluent.
REGULATIONS IN DEVELOPED COUNTRIES

- Currently the Federal Clean Water Act (CWA) in United States have set up the basic requirements for regulating toxic substances discharged to water supplying systems. Even EPA recommended an integrated approach for controlling toxic pollutants that uses whole effluent toxicity (WET) testing to complement chemical specific analyses as a means to protect both aquatic life and human health.

- In WET tests, aquatic organisms are exposed to various dilutions of effluent for a specific time period, in order to predict at what level the effluent may cause harm to the organisms.

- Another approach developed is to have structural and functional indices that can be used to evaluate the effect of chemicals on communities maintained under controlled laboratory conditions.

- The first one deals with the chemicals already in the environment while the other is developing ecosystem level indices used to evaluate chemicals before they reach the environment.

- Addressing water toxicity creates an even greater cost for the textile mill in terms of production inefficiencies and increased production costs by using dyes and chemicals to comply with water quality regulations. For this purpose the mill must conduct a Toxicity Identification Evaluation (TIE) to determine the specific agents causing the toxicity and must either replace or reduce their use.
ECO-FRIENDLY PROCESSING

Eco-friendly textile processing aims at minimizing the negative effects on the environment.

The textile wet processing units discharge a large quantity of effluent comprising of a wide range of chemicals, i.e., dyes, auxiliary chemicals, which contain metal ions. In the application of reactive dyestuffs where, due to fixation, yields on the order of 50-90%, high concentration of unfixed hydroxylates may be present in the waste liquor. Depending on the type of chromophore used, metals such as copper, nickel, and chromium could also be present. According to Horstmann, a systematic approach to shift average production towards clean technology should be followed as per the sequence. 

Avoid > Reduce > Reuse > Recycle > Biodegrade

Environmentally speaking, wet cleaning has many advantages over dry cleaning including minimal emissions, less toxic raw materials and no hazardous waste. With dry cleaning, the concerns are primarily with air emissions, Worker safety and hazardous waste management. With wet cleaning, those problems, including worker safety, are greatly decreased but wastewater concerns are somewhat increased.