Wastewater Engineering
Lecture - 3

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Physical Characteristics of Sewage

Sewage Characteristics

Sewage is used water that has been negatively affected by humans. Sewage / Wastewater Characteristics are broadly classified into the following three groups.

Physical Characteristics - Solids

Settleable solids:

- Placing 1-L sample in Imhoff cone and noting volume of solids in mm that settle after 1 h.

- Typically 60% of suspended solids (SS) in municipal wastewater are settleable.

Imhoff Cone

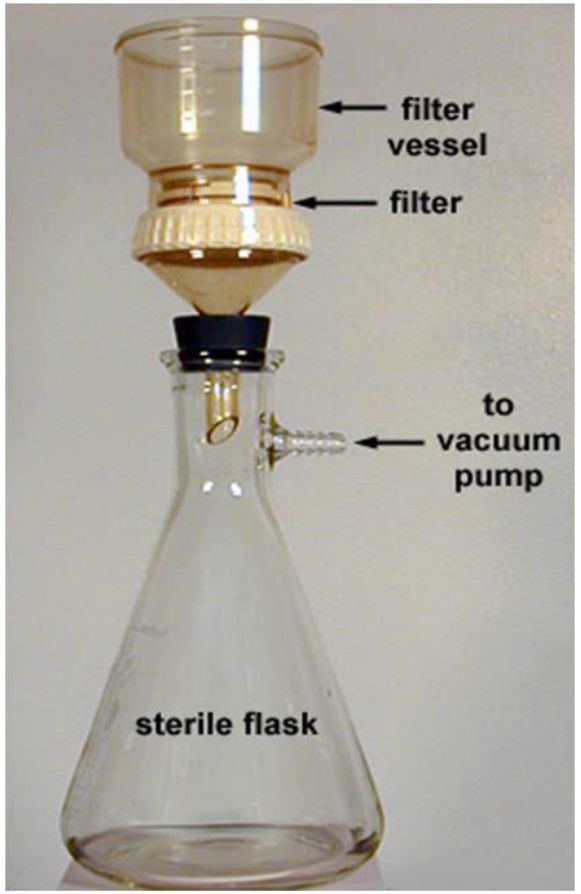
Total solids (TS):

- Obtained by evaporating wastewater sample to dryness (at 103- 105C^0) and measuring mass of residue

Physical Characteristics - Solids

Total suspended solids (TSS):

- Filtration step is used to separate TSS from total dissolved solids (TDS); Portion of TS retained on filter (e.g., Whatman fiber glass filter-GF/C) measured after being dried at 105 C^0
- More TSS measured as pore size of filter used is reduced
- Important to note filter paper pore size, when comparing TSS values;



Filtration Apparatus

Physical Characteristics - Solids

Total Dissolved Solids (TDS):

- Solids contained in filtrate that passes through a filter with nominal pore size of 2 μm or less are classified as dissolved;

- Size of colloidal particles in wastewater typically in range from 0.01-1 μm

Physical Characteristics - Solids

Volatile and Fixed Solids (VS and FS):

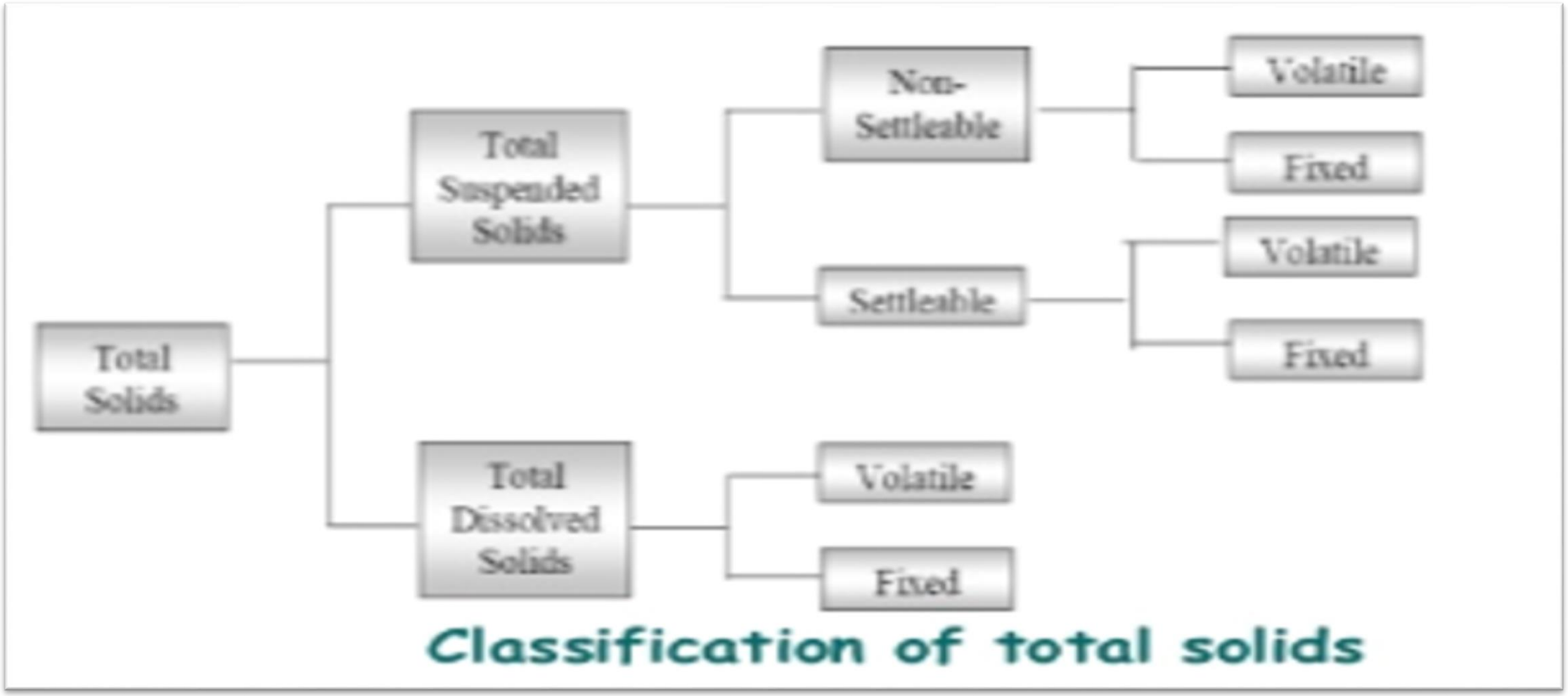
- Material burned off when ignited/heated at 500 ± 50oC classified as volatile solids (VS); In general, VS are organic matter

- Residue that remains after sample is ignited at 500 ± 50oC classified as fixed solids (FS)

- TS, TSS, and TDS comprised of both VS and FS

- Ratio of VS to FS used to characterize wastewater with respect to amount of organic matter present

Physical Characteristics - Solids



Physical Characteristics - Odor

- **Odor** is produced by gas production due to the decomposition of organic matter or by substances added to the wastewater.

Detection of odor:

- Odor is measured by special instruments such as the Portable H2S meter which is used for measuring the concentration of hydrogen sulfide.

Physical Characteristics - Temperature

- Temperature of wastewater is commonly higher than that of water supply.

- Depending on the geographic location the mean annual temperature varies in the range of 10 to 21C^0 with an average of 16 C^0.

Physical Characteristics - Temperature

Importance of temperature:-

a. Affects chemical reactions during the wastewater treatment process.
b. Affects aquatic life (Fish, ……).
c. Oxygen solubility is less in worm water than cold water.
d. Optimum temperature for bacterial activity is in the range of 25 to 35 C^0
e. Aerobic digestion and nitrification stop when the temperature rises to 50 C^0.
f. When the temperature drops to about 15C^0, methane producing bacteria become in active.
g. Nitrifying bacteria stop activity at about 5C^0.

Physical Characteristics – Density, Specific Gravity

Density and Specific Gravity

Density:

- Mass per unit volume expressed as g/L or kg/m3; density of domestic wastewater is the same as that of water at same temperature.

Specific Gravity: Ratio of density of wastewater to density of water.

S_p = density of Wastewater / Density of Water

- Both density and specific gravity are temperature dependent and will vary with concentration of TSS

Physical Characteristics – Turbidity

- **Turbidity** is the measure of light-transmitting properties of water, used to indicate quality of waste discharges and natural waters with respect to colloidal and residential suspended matter.

- Measurement based on comparison of intensity of light scattered by a sample to the light scattered by reference suspension under same conditions.

- Formazin suspensions are used as primary reference standard.

- Results of turbidity reported as nephelometric turbidity units (NTU)

Physical Characteristics – Color

- Color is an indication of the age of wastewater
- Fresh wastewater is light brownish-gray color.
- As travel time in collection system increases, and more anaerobic conditions develop, wastewater color changes sequentially from gray to dark gray, and ultimately to black.
- Black color of wastewater refers to septic condition.