Introduction to water treatment

Fourth stage students of Soil and Water Department

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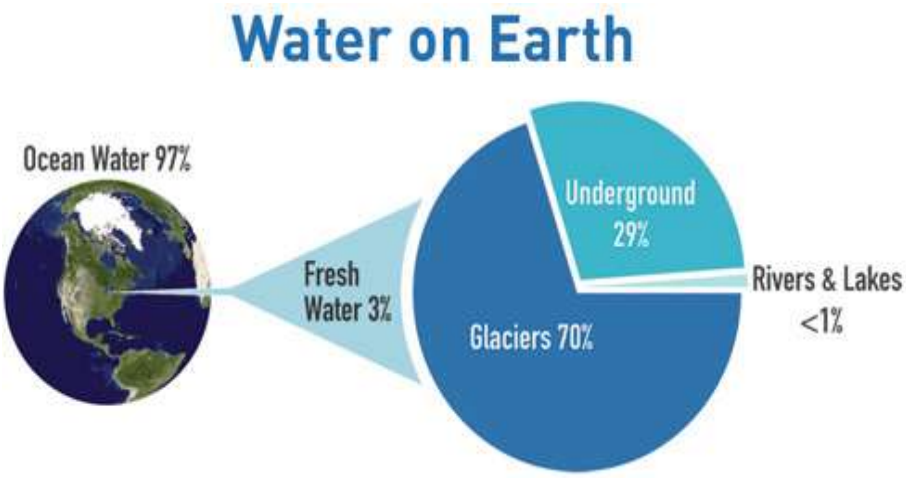
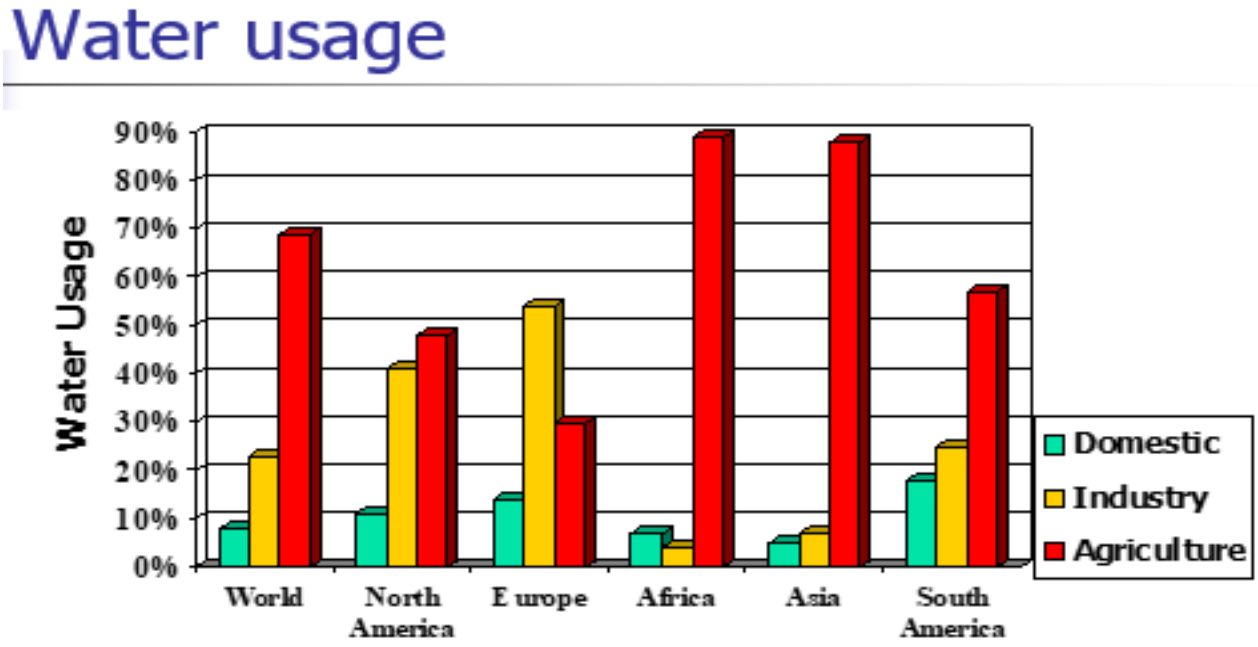
Academic Year: 2023 – 2024



Annual renewable water resources = 41,022 km^3

Function of water

- Domestic.
- Industry.
- Agriculture.
- Recreation.
- Safety and security.



Water Requirements

- The uses of water include domestic, commercial and industrial, public services such as firefighting and public buildings, and unaccounted pipeline system losses and leakage. The average usage for the above four categories are 220, 260, 30, and 90 liters per capita per day (L/ (c. d)), respectively. These correspond to 58, 69, 8, and 24 gal/ (c. d), respectively. Total municipal water use averages 600 L/ (c. d) or 160 gal/ (c. d).

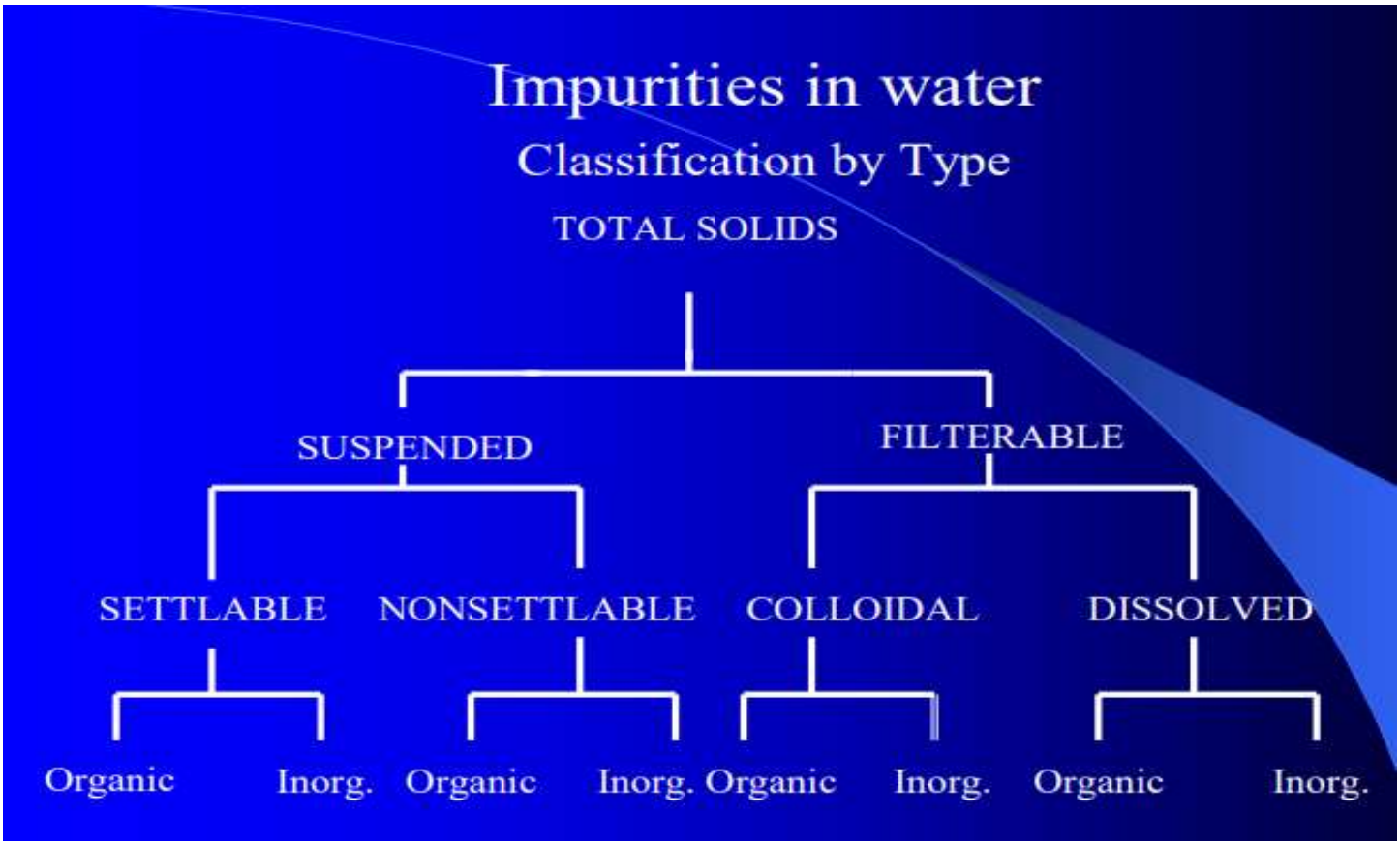
Water treatment aims to remove impurities from water to make it safe for use without harming health or the environment.

The **type and extent of treatment** will depend on the **type of impurities present** in the water and the ultimate use of the water.

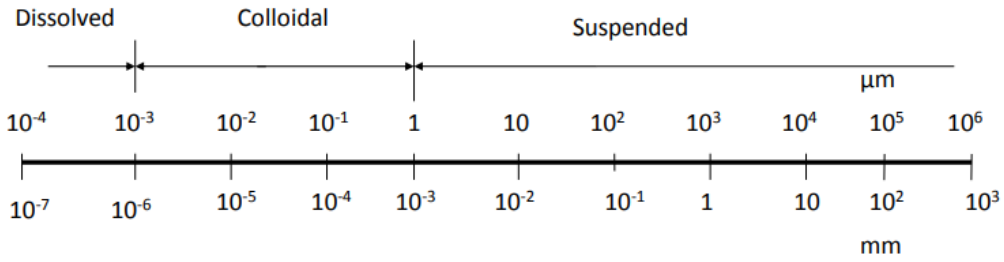
Impurities in water are found in different **forms** which are divided into **suspended solids or dissolved, organic and inorganic materials as well as living microorganisms** some of which are harmful while others are beneficial.

Impurities are classified as:

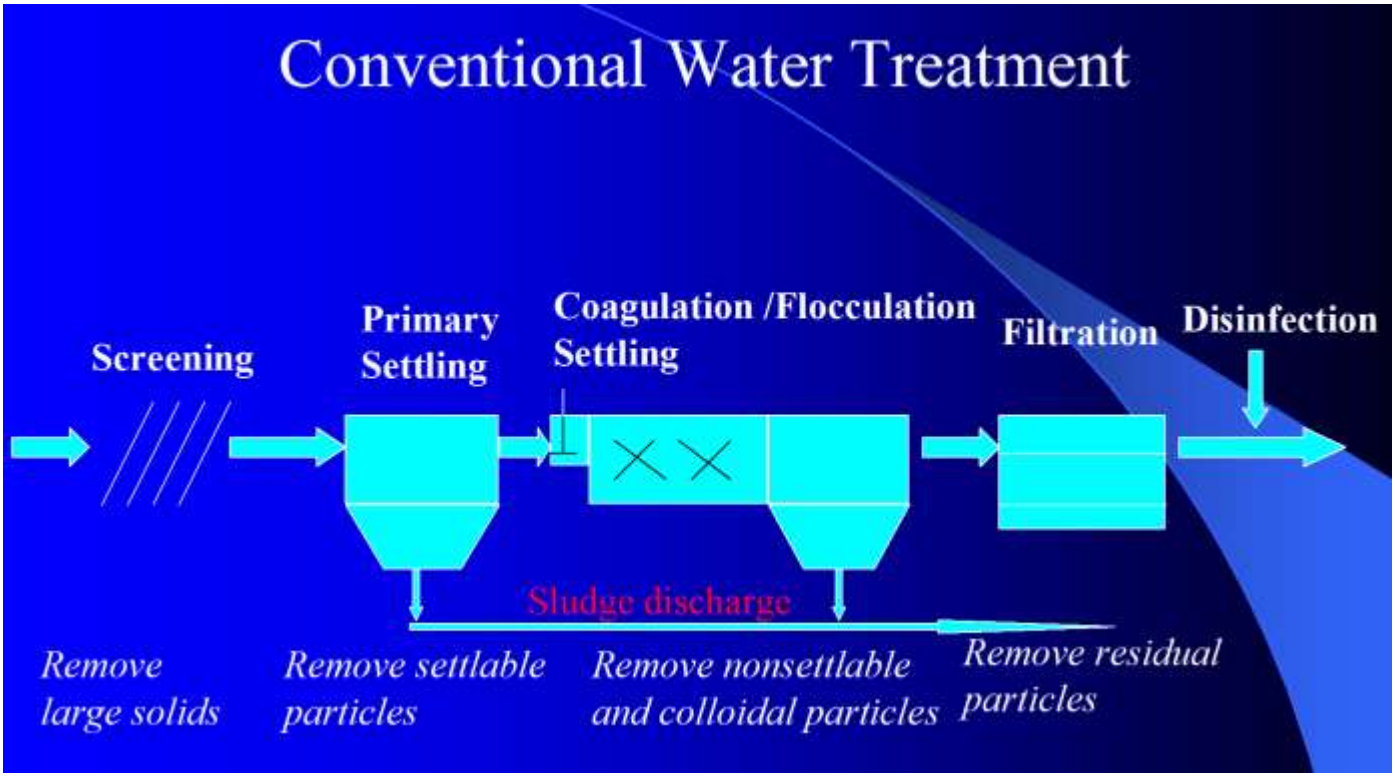
Physical – Chemical – Biological - Radiological and are mostly expressed in terms of units of mass per unit volume.



Classification of impurities by size



Water is considered contaminated, or polluted, when it contains substances that make it unsuitable for its intended use.



Reasons for treating the water:

- ❖ Protect surface-water quality.
- ❖ Protect public health.
- ❖ Meet legal requirements.

Water pollution: Water is considered polluted if some substance or condition is present to such degree that water cannot be used for a specific purpose.

Ideal water supply

Water Quantity is the timing and total yield of water from a watershed, and is measured by total yield and peak flow over a specified period of time.

Water Quality describes the condition of the water, including chemical, physical, and biological characteristics, usually with respect to its suitability for a particular purpose such as drinking or swimming**.**

Good water quality is where it free from disease organism, dangerous chemical substances, radioactive, accepted taste and smell.

Water quality is determined by assessing three classes of attributes: physical, chemical, and biological • There are standards of water quality set for each of these three classes of attributes

1- **Physical.** It includes suspended solid (SS), color, taste, smell, temp.

2- **Chemical.** It includes dissolved substances, alkalinity, hardness, fluoride, heavy metal, organic compound, nutrient (nitrogen & phosphorus), pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD).

3- **Biology. Such as** bacteria, virus, protozoa, helminths.

Iraqi standards for drinking water quality parameters

No.	Parameter	Normal Range
1	pH	6.5-8.4
2	EC	2000 (µs/cm)
3	T.D.S	500-1500 mg/L
4	CL^-	200-250 mg/l
5	Ca^{++}	75-250 mg/L
6	Hardness	100-500 mg/L
7	Alkalinity	125-250 mg/L
8	Turbidity	5 NTU (**nephelometric turbidity units**)
9	$NO3^-$	50 mg/L
10	$SO4^{--}$	200-400 mg/L
11	Mg^{++}	30-150 mg/L
12	K^+	2-3 mg/L
13	Na	200 mg/L
14	PO4	2 mg/L
15	M.P.N of coliform	none detectable per 100 mL
16	M.P.N of E.coli	235 cfu/100mL –575 cfu/100mL **cfu (colony forming units).**

Most Probable Number (**MPN**) is a method used to estimate the concentration of viable microorganisms in a sample by means of replicate liquid broth growth in ten-fold dilutions.

Types and source of water pollution:

- Domestic swage.
- Disease causing agents (bacteria, virus).
- Inorganic chemicals and minerals.
- Synthetic organic chemical and oil.
- Nutrients (Nitrates, Phosphate).
- Radioactive substance.
- Heat from industrial and power plants.

POPULATION ESTIMATES

- Prior to the design of a water treatment plant, it is necessary to forecast the future population of the communities to be served. The plant should be sufficient generally for 25 to 30 years. It is difficult to estimate the population growth due to economic and social factors involved. However, a few methods have been used for forecasting population. They include the **arithmetic method**, **uniform percentage growth rate method** and **Declining Growth Method.**

The arithmetical Increase Method is mainly adopted for old and developed towns, where the rate of population growth is nearly constant. Therefore, it is assumed that the rate of growth of the population is constant. It is similar to simple interest calculations. The population predicted by this method is the lowest of all.

Arithmetical Increase Method Formula:

$$Pn = Po + n\bar{x}$$

where,

Pn - population (predicted) after 'n' number of decades,

Po - last known population (present population) = P2,

n - number of decades between Po and Pn and,

$\bar{x}$ - average rate of increase of population.

Question/ find the population for the year 2030 using the arithmetic increase method based on these data

Year	Population
1930	25000
1940	28000
1950	34000
1960	42000
1970	47000

Solution:

Step 1: Find the increase in population each decade.

Year	Population	Increase
1930	25000	-
1940	28000	3000
1950	34000	6000
1960	42000	8000
1970	47000	5000

Step 2: Find the average rate of increase of population ($\bar{x}$)

$\bar{x}$ = (3000+6000+8000+5000)/4

$\bar{x}$ = 22000/4

$\bar{x}$ = 5500

Step 3: Find the number of decades (n) between the last known year and the required year
n = 6 (6 decades elapsed between 1970 and 2030).

Step 4: Apply the formula **Pn = Po + n$\bar{x}$,**

P[2030] = P[1970] + (6 * 5500)

P[2030] = 47000 + 33000

P[2030] = 80,000. Therefore, population at 2030 will be **80,000**.

EXAMPLE: A mid-size city recorded populations of 113,000 and 129,000 in the April 1980 and April 1990 census, respectively. Estimate the population in January 1999 by using arithmetic method.