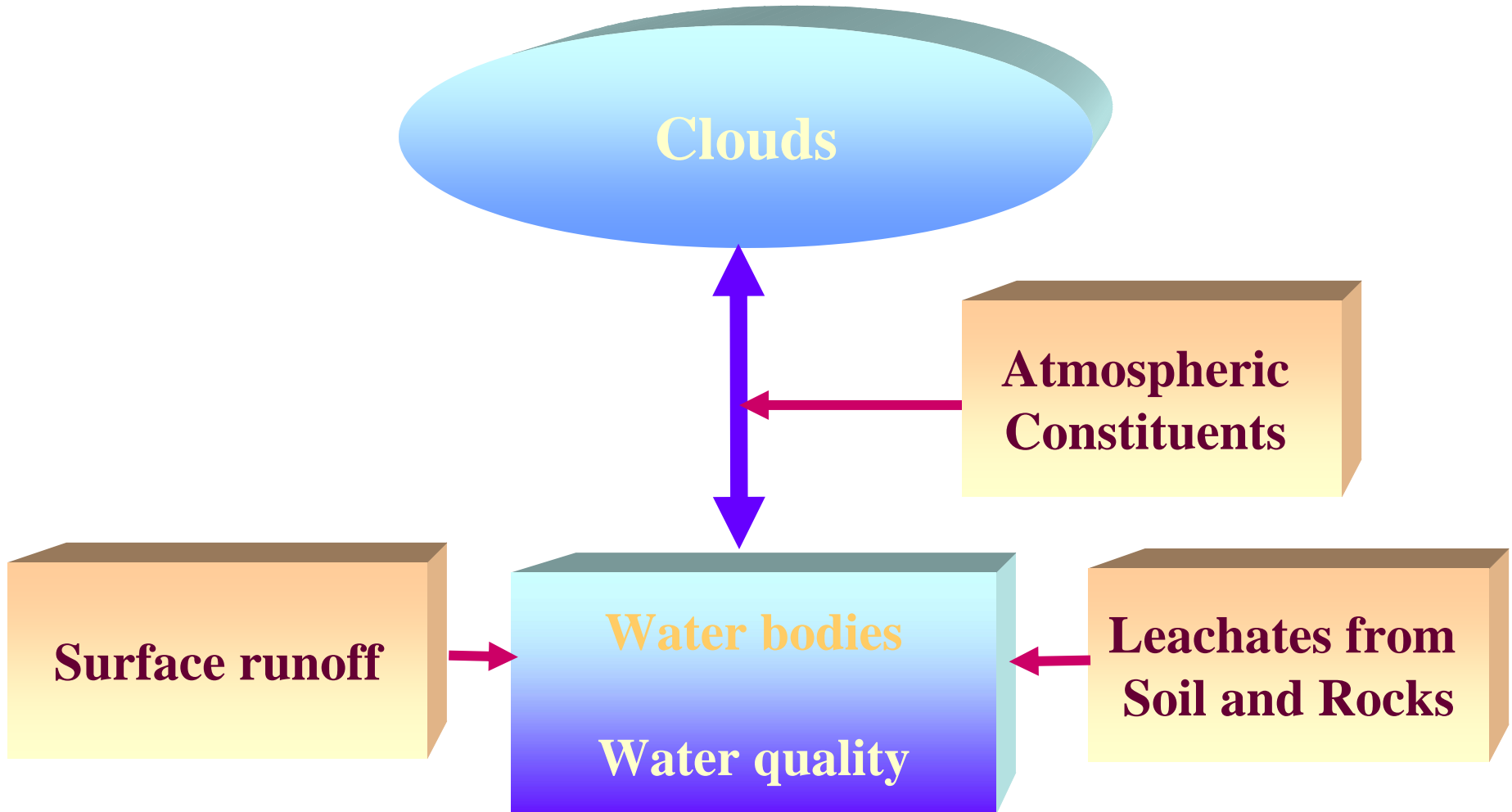
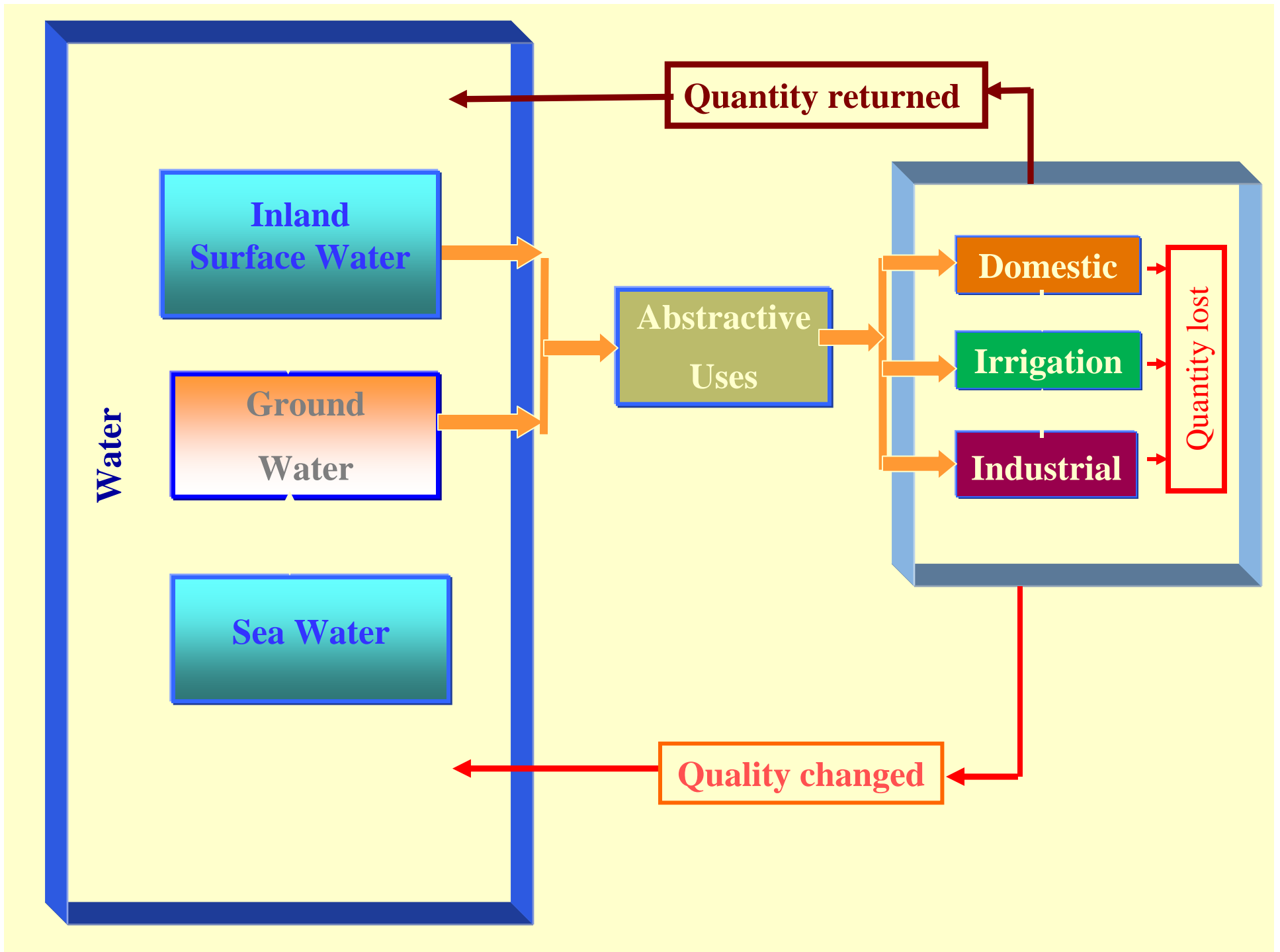
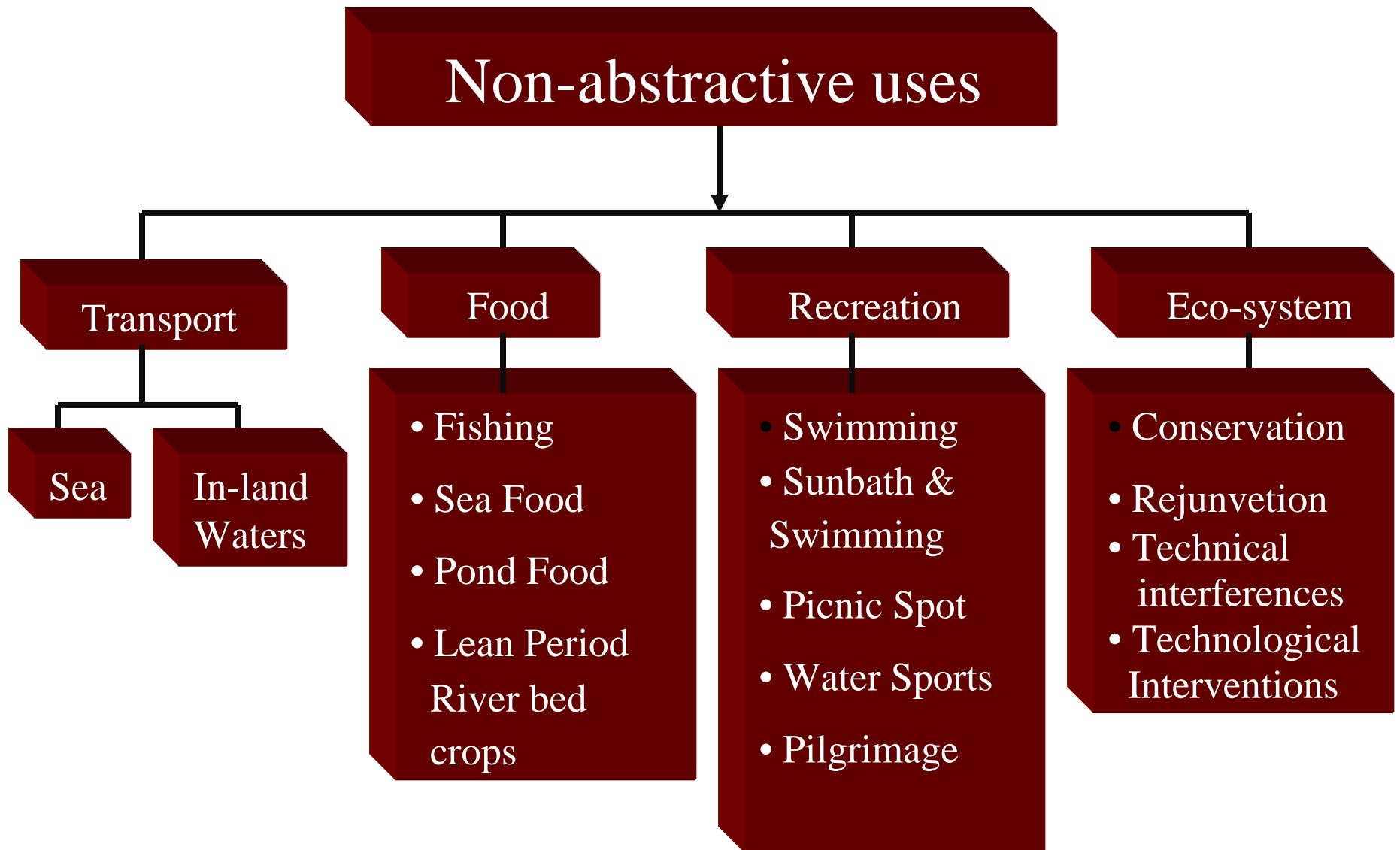


Dispersion & Dissolution in Water





Water



Adverse Effects of Impurities

Problems

- **Aesthetically not acceptable and Palatability decreases**
- **Health related problems**
 - **affect mucous membrane**
 - **gastro-intestinal irritation**
 - **Dental and skeletal fluorosis**
 - **Methaemoglobinemia**
- **Encrustation in water supply structure**
- **Adverse effects on domestic use**

Constituents Responsible

- **Clay, Silt, Humus, Colour**
- **pH**
- **Hardness, TDS, Ca, Mg, SO₄**
- **Fluoride**
- **Nitrate**
- **Hardness, TDS**
- **Ca, Mg, Cl**

Adverse Effects of Impurities

- **Eutrofication of the waterbody**
- **Taste, discolouration and corrosion of pipes fittings and utensils**
- **Promotes iron bacteria**
- **Corrosion in water supply system**
- **Carcinogenic effect**
- **Toxic effect**
- **Formation of chlorophenols with chlorine**
- **Imparts unpleasant taste and odour after chlorination**
- **Water-borne diseases**

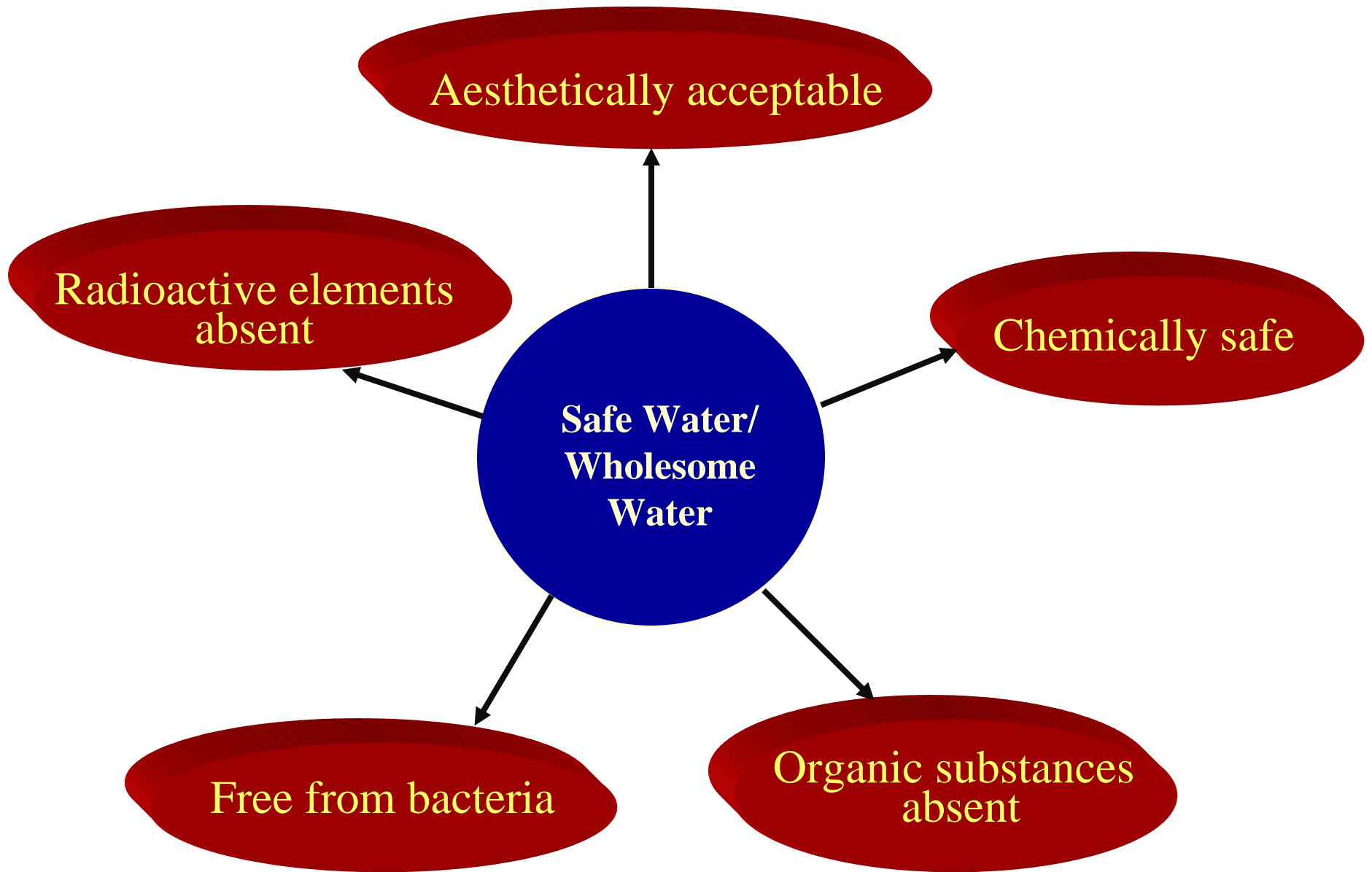
- **Zoo & Phyto, Phosphate, Nitrate**
- **Iron, Mn, Cu, Zn, Alkalinity**
- **Fe & Mn**
- **pH, Cl**
- **Cr, As**
- **Cd, Pb, Hg**
- **Phenols**
- **Oil & grease**
- **Bacteria & viruses**

Contamination / Pollution

- ✓ During its traverse water picks up impurities in varying amounts
- ✓ Gases from atmosphere
- ✓ Inorganic and organic salts from top soil and geological strata
- ✓ During its traverse water get contaminated by inorganic and organic salts sometimes beyond desirable limits

Pollution

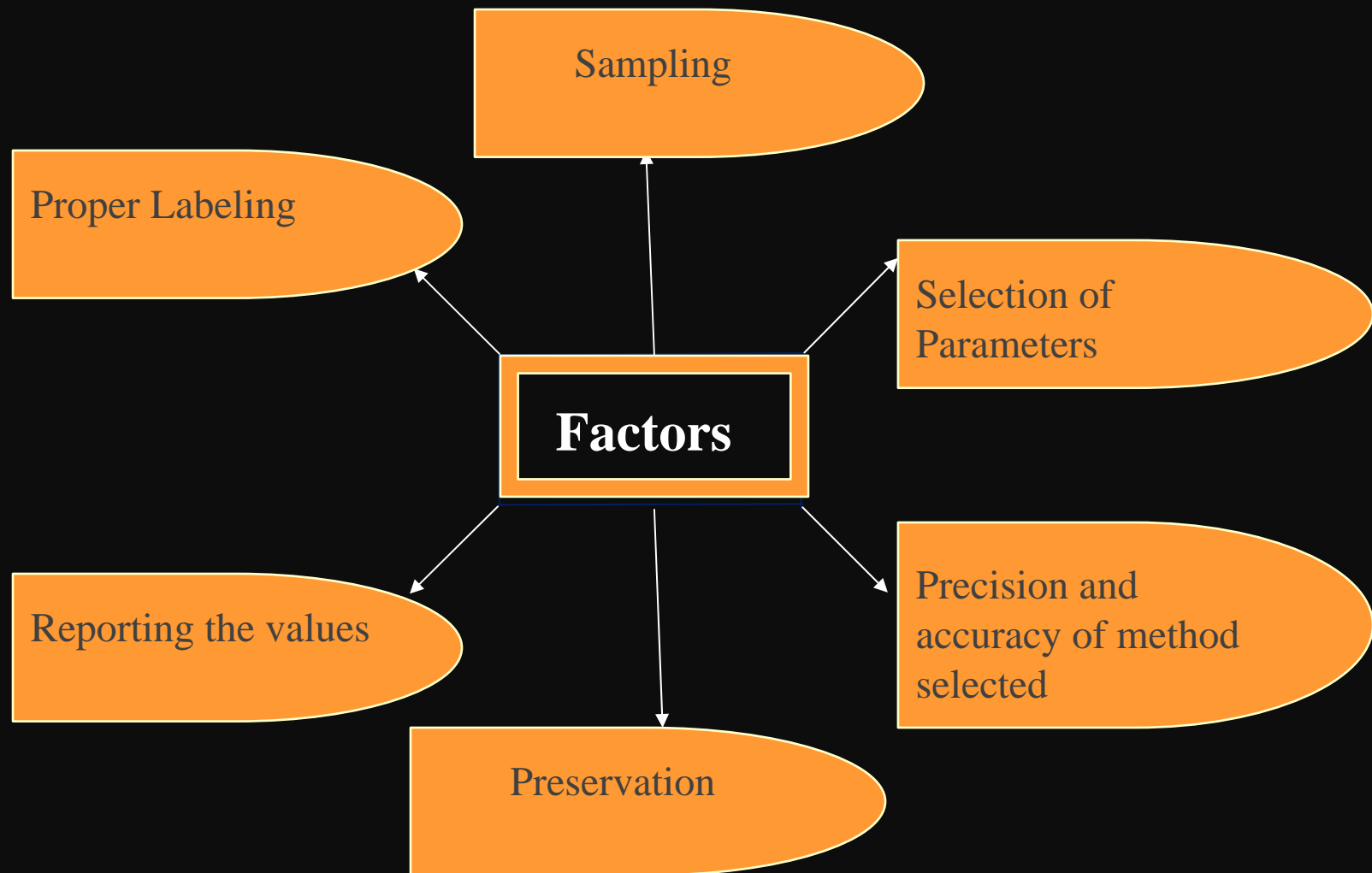
- ✓ Presence of undesirable substances in the quantities which are harmful to man vegetation or property is referred to as pollution
- ✓ Quality of water depends upon quality and quantity of inorganic and organic salts present in water



Water Quality Assessment

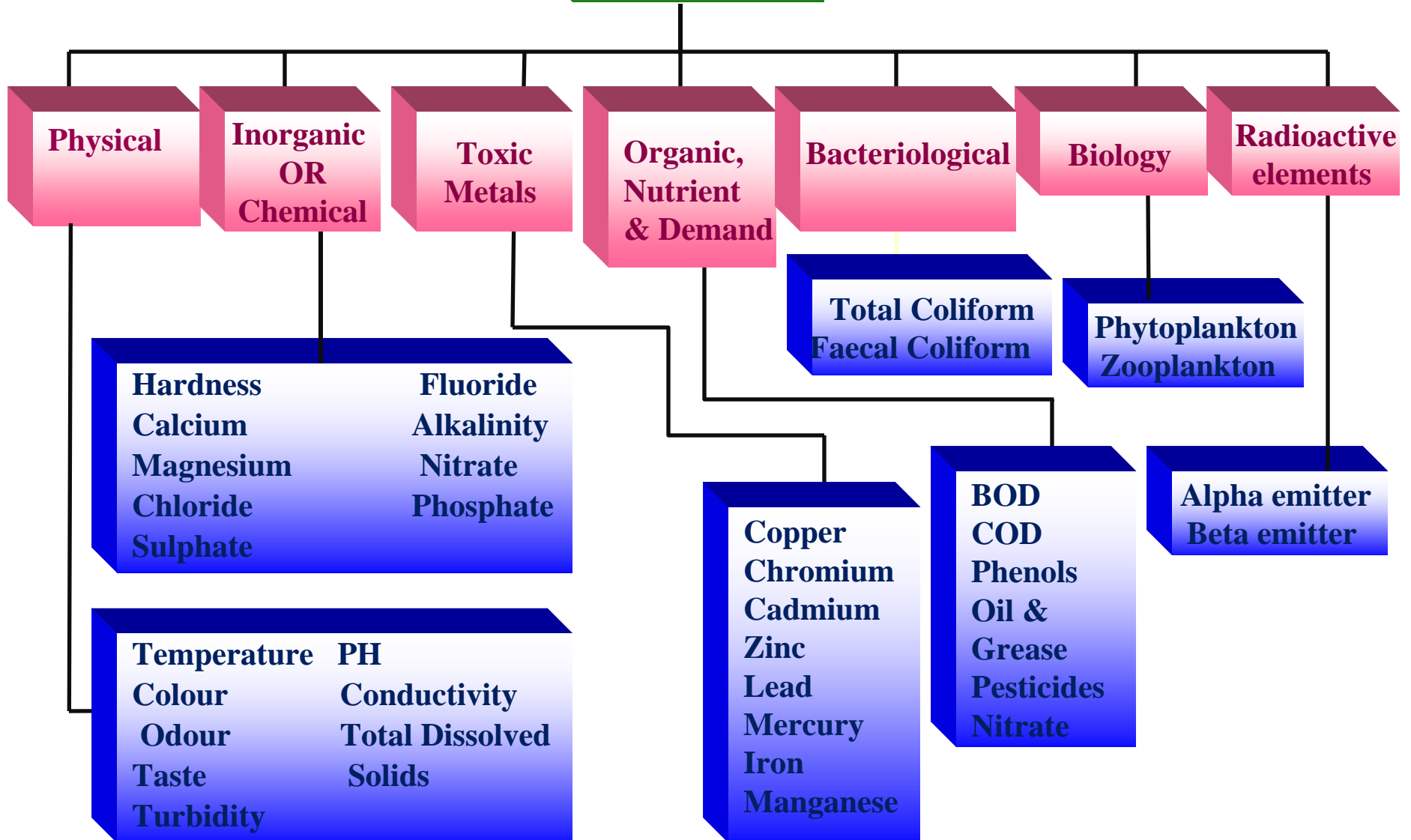
- ↓ To measure concentration of the constituents in quantity for characterisation of water for different uses
- ↓ Of the various parameters in potable water few are objectionable even when present in very small quantity
- ↓ Others if only present in unusual quantities as to relegate the water from the potable to the unusable class
- ↓ The analyst familiar with water quality characterisation will often select parameters to be measured based on experience and intuition

Water Analysis - Key Factors



Water Quality Assessment : Potable & Industrial Uses

Parameters



Water Quality Consideration

- **Irrigation**
 - ✓ pH
 - ✓ Conductivity
 - ✓ Sodium & Potassium
 - ✓ Nutrients
 - ✓ Specific compounds

- **Industries**
 - ✓ As per specific requirement

- **Domestic Consumption**
 - ✓ As per BIS Standards

- **Water Bodies**
 - ✓ As per CPCB guidelines

Classification of Inland Surface Waters (CPCB Standards)

S. No.	Characteristics	A'	B'	C'	D'	E'
1.	Dissolved Oxygen, mg/L, Min	6	5	4	4	-
2.	Biochemical Oxygen Demand, mg/L, Max	2	3	3	-	-
3.	Total Coliform Organisms*, MPN/100 mL, Max	50	500	5000	-	-
4.	Total Dissolved Solids, mg/L, Max	500	-	1500	-	2100
5.	Chlorides (as Cl), mg/L, Max	250	-	600	-	600
6.	Colour, Hazen Units, Max	10	300	300	-	-
7.	Sodium Absorption Ratio, Max	-	-	-	-	26
8.	Boron (as B), mg/L, Max	-	-	-	-	2
9.	Sulphates (as SO ₄), mg/L, Max	400	-	400	-	1000
10.	Nitrates (as NO ₃), mg/L, Max	20	-	50	-	-
11.	Free Ammonia (as N), mg/L, Max	-	-	-	1.2	-
12.	Conductivity at 25°C, micromhos/cm, Max	-	-	-	1000	2250
13.	pH value	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
14.	Arsenic (as As), mg/L, Max	0.05	0.2	0.2	-	-
15.	Iron (as Fe) , mg/L, Max	0.3	-	50	-	-
16.	Fluorides (as F), mg/L, Max	1.5	1.5	1.5	-	-
17.	Lead (as Pb), mg/L, Max	0.1	-	0.1	-	-
18.	Copper (as Cu), mg/L, Max	1.5	-	1.5	-	-
19.	Zinc (as Zn), mg/L, Max	15	-	15	-	-

•If the coliform count is found to be more than the prescribed tolerance limits, the criteria for coliforms shall be satisfied if not more than 20 percent of samples show more than the tolerance limits specified, and not more than 5 percent of samples show values more than 4 times the tolerance limits. Further, the faecal coliform should not be more than 20 percent of the coliform. Source : Indian Standard (IS:2296-1982).

A' Drinking water source without conventional treatment but after disinfection

B' Outdoor bathing (organised)

C' Drinking water source with conventional treatment followed by disinfection

D' Propagation of wild life, fisheries

E' Irrigation, industrial, cooling, controlled waste disposal

Dissolved Oxygen

- All living organisms depend upon oxygen to maintain the metabolic processes that produce energy for growth and reproduction
- Dissolved oxygen is important in precipitation and dissolution of inorganic substances in water

Need

- To assess quality of raw water
- To check on pollution
- Determination of biological changes by aerobic or anaerobic organisms
- D.O. is the basis of BOD test to evaluate pollution potential of wastes
- All aerobic biological wastewater treatment processes
- Important factor in corrosion.

Methodology

The Winkler method with Azide modification

Principle

- Oxygen present in sample oxidizes the divalent manganous to its higher valency which precipitates as a brown hydrates oxide after addition of NaOH and KI
- Upon acidification, manganese revert to divalent state and liberates Iodine from KI equivalent to D.O. content in the sample
- The liberated Iodine is titrated against standard (N/40) solution of Sodium thiosulphate using starch as an indicator.

Procedure

- Collect sample in BOD bottle
- 2 ml MnSO_4 + 2 ml Alkali iodide-azide + close stopper
- Mix well + allow the ppt to settle
- Add 2 ml concentrated H_2SO_4 + mix well till ppt dissolves
- Take 203 ml (Correspond to 200 ml) sample in a conical flask + titrate against Sodium thiosulphate (0.025 N) till pale yellow colour + starch + titrate till blue to colourless

Calculation

- 1 ml of 0.025N $\text{Na}_2\text{S}_2\text{O}_3$ = 0.2 mg of O_2
- D.O. in mg/l = $\frac{(0.2 \times 1000) \times \text{ml of thiosulphate}}{200}$

Results : D.O. mg/l

Interferences

- Ferrous ion
- Ferric ion
- Nitrite
- Microbial mass
- High suspended solids

To reduce interferences, modification in the estimation procedures are suggested

- Alsterberge azide : Nitrite, higher concentration of ferric ions
- Redeal Stewart : Ferrous ion
- Alum / Flocculation : High suspended solids
- Copper Sulphate Sulfamic acid flocculation : Biological flocs
- Alkaline Hypochlorite : Complex of sulphur compound