METHODS OF WATER TREATMENT

1.7 INTERNAL CONDITIONING OR INTERNAL TREARMENT

i. **PHOSPHATE CONDITIONING**

ii. **CALGON CONDITIONING**

iii. **COLLOIDAL CONDITIONING**

iv. **SODIUM ALUMINATE CONDITIONING**

1.7 INTERNAL CONDITIONING OR INTERNAL TREARMENT

This method involves the removal of scale forming substances and corrosive chemicals in water, which were not completely removed in the external treatment, by adding suitable chemicals directlyinside the boiler. These chemicals are called **boiler compounds**.

i. PHOSPHATE CONDITIONING

Scale formation in high pressure boilers can be avoided by adding sodium phosphate. The added phosphate reacts with calcium and magnesium salts to produce soft sludges of calcium and magnesium phosphates.

$$3\ CaSO_4 + 2\ Na_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 3\ Na_2SO_4$$

$$3\ CaCl_2 + 2\ Na_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 6\ NaCl$$

$$3\ MgCl_2 + 2\ Na_3PO_4 \longrightarrow Mg_3(PO_4)_2 + 6\ NaCl$$

$$3\ MgSO_4 + 2\ Na_3PO_4 \longrightarrow Mg_3(PO_4)_2 + 3\ Na_2SO_4$$

Three types of phosphates are employed in phosphate conditioning. They are:

- ✓ Trisodium phosphate (Na_3PO_4)
- ✓ Disodium hydrogen phosphate (Na_2HPO_4)
- ✓ Sodium dihydrogen phosphate (NaH_2PO_4)

The optimum pH for the precipitation of $Ca_3(PO_4)_2$ is 9.5 to 10.5. The exact choice of the phosphatesalt depends upon the alkalinity of boiler feed water.

- ✓ **Trisodium phosphate (Na_3PO_4)**

When the alkalinity of boiler feed water is low, it has to be raised to 9.5-10.5 for this highly alkaline phosphate is preferred. Na_3PO_4 is highly alkaline, used for strong acidic water.

- ✓ **Disodium hydrogen phosphate (Na_2HPO_4)**

When the alkalinity of boiler feed water is already sufficient for precipitation, Na_2HPO_4 is preferred. Na_2HPO_4 is weakly alkaline, used for weakly acidic water.

- ✓ **Sodium dihydrogen phosphate (NaH_2PO_4)**

When the alkalinity of boiler feed water is too high, acidic phosphate is preferred. It reduces the pHto the optimum range. NaH_2PO_4 is acidic, used for alkaline water.

ii. CALGON CONDITIONING

When calgon (Sodium hexa meta phosphate $Na_2[Na_4(PO_3)_6]$) is added to boiler water, it interacts with calcium ions forming a highly soluble complex and thus prevents the precipitation of sludge and scale forming salts.

$$\mathbf{2\ CaSO_4 + Na_2[Na_4(PO_3)_6] \longrightarrow Na_2[Ca_2(PO_3)_6] + 2\ Na_2SO_4}$$

The complex$Na_2\,[Ca_2(PO_3)_6]$ is soluble in water and there is no problem of sludge disposal.

iii. COLLOIDAL CONDITIONING

Scale formation can be avoided by adding colloidal containing agents like kerosene, agar – agar, gelatin, etc., It is used in low pressure boilers. These colloidal substances get coated over the sale forming particles and converted them into non-adherent, loose precipitate called sludge, which can be removed by blow down operation.

iv. SODIUM ALUMINATE CONDITIONING

Sodium Aluminate ($NaAl_2O_3$) undergoes hydrolysis in boiler water to give gelatinous white precipitate of aluminium hydroxide and sodium hydroxide.

$$\mathbf{NaAl_2O_3 + 2H_2O \longrightarrow Al(OH)_3\downarrow + NaOH}$$