Water Treatment- Ion Exchange Process and Phosphate Conditioning

Ion Exchange Process

These are giant organic molecules having acidic or basic groups are known as Ion-exchange resins. There are two types of resins that is cation exchange resin and anion exchange resin. They are also known Acid resins and base resins.

Cation exchange resins (Acid resins) contain the acid group (- COOH). They exchange their H^+ ions with other cations such as Ca^{2+}, Mg^{2+}, etc., present in hard water. Acid resins are, therefore exchanges cations and known as cation exchange resins.

$2RCOO^-H^+ + Ca^{2+} \rightarrow (RCOO)_2Ca + 2H^+$

$RCOO^-H^+ + Na^+ \rightarrow RCOONa + H^+$

Anion exchange resins (Base resins) exchange contain basic group like OH^- ions. They exchange their OH^- ions with the other anions present in hard water like HCO_3^-, Cl^-, SO_4^{2-}. Basic resins, therefore exchanges anions and are also known as anion exchange resins.

$RNH_3^+OH^- + Cl^- \rightarrow RNH_3Cl + H^+$

$2RNH_3^+OH^- + SO_4^{2-} \rightarrow (RNH_3)_2SO_4 + OH^-$

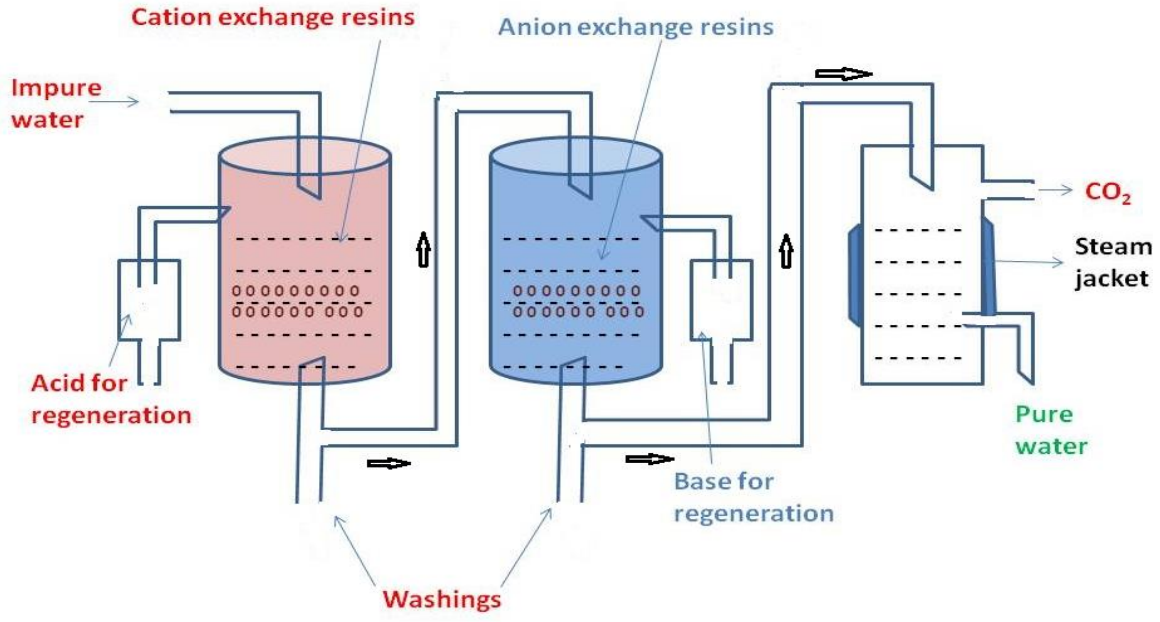

Diagram- Ion Exchange Process

Ion Exchange Process-

1. In the ion exchange process, hard water is passed through two tanks 'A' and 'B'.
2. Tank- A contains acid resin (Cation exchange resins) and tank- B is filled with basic resin (anion exchange resins).
3. All the cations present in hard water (except H^+) are removed by the acid resin present in Tank- A.
4. The basic resin present in Tank- B removes all the anions (except OH^-) present in hard water.
5. Water obtained after passage through both the tanks is free from all the cations and anions that make it hard. The water obtained after passing through the ion-exchangers is called deionized water or demineralized water.
6. This is as good as distilled water. The water becomes soft after this process.

Phosphate conditioning

In high pressure boilers, scale formation can be avoided by adding sodium phosphate, which reacts with hardness causing substance of water and removes the salts which causes hardness.

Forming non adherent and easily removable soft sludge of calcium and magnesium phosphates hardness can be removed. This can be removed by blow down operation.

Phosphates bind with the hardness causing salt/metal to form the precipitate.

Mainly used phosphates are:

1. If Water is alkaline Sodium dehydrogenate phosphate Na_2HPO_4
2. If Water is neutral Disodium hydrogen phosphate Na_2HPO_4
3. If Water is acidic Trisodiumhydrogen phosphate Na_3PO_4

$$\mathbf{3MCl_2 + 2Na_3PO_4 \rightarrow M_3(PO_4)_2 + 6NaCl}$$