5.8 INTRODUCTION TO ADVANCED WATER TREATMENT

Conventional treatment will normally produce safe drinking water. However, increasing drinking water standards (for example **nitrate, chlorinated organics, taste** and **odour problems**, etc.) and the growing **demand for exceptionally high quality water** by many industries has resulted in many **physico-chemical post treatment processes** being employed at water treatment plants. These include chemical removal by **softening**, **adsorption**, **ion-exchange**, **membrane filtration**, and **reverse osmosis**.

Chemical Precipitation

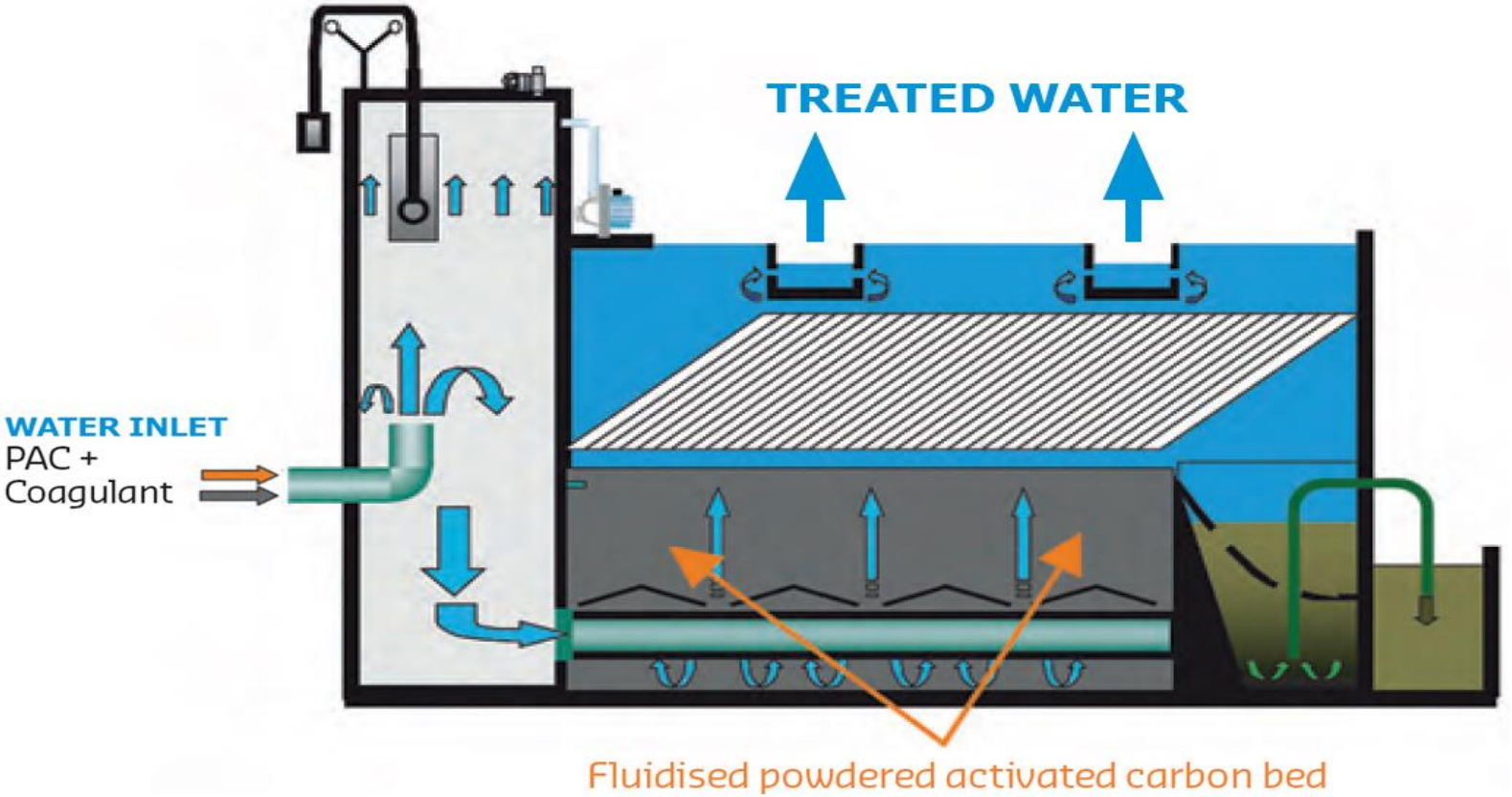
Removal of calcium and magnesium

Chemical precipitation is more widely known as **precipitation softening**. It is used primarily to remove or reduce the hardness in potable waters caused by excessive salts of calcium and magnesium. Precipitation softening converts the soluble into insoluble ones, so that they can be removed by subsequent flocculation and sedimentation. Lime or soda ash are normally used to remove the hardness.

Adsorption

Adsorption is a physical process where soluble molecules (adsorbate) are removed by attachment to the surface of a solid substrate (adsorbent).
Adsorbents must have a very high specific surface area and the most widely used is activated carbon.
Activated carbon is used either as a powder (Powered Activated Carbon – PAC) or as granules (Granular Activated Carbon – GAC). In water treatment it is used to **remove taste, odour, colour** and **organic residual**.

Adsorption



Operating principle of Pulsazur

Ion-Exchange

Ion-exchange is an adsorption process that employs the reversible interchange ions of the same charge between a solid ion-exchange medium and a solution. Used primarily for water softening Ca^{2+} and Mg^{2+} cations are exchanged by Na^{+} where the Na_2R is the ion-exchange medium with R the negatively charged polymer.

$$Ca^{2+} + 2NaR \leftrightarrow CaR_2 + 2Na^{+}$$

$$Mg^{2+} + 2NaR \leftrightarrow MgR_2 + 2Na^{+}$$

Most exchange media are synthetic polymer resins.

Reverse Osmosis (RO)

Reverse osmosis uses a semi-permeable membrane. Osmosis is the movement of water (or any solvent) from weak solution to a strong solution through a semi-permeable membrane. So if the membrane was placed between freshwater and saltwater, the solvent (i.e. pure water) will move through the membrane until the salt concentration on either side is equal. Only water can pass the membrane so the salts are retained. The movement of water across the membrane is caused by a difference in pressure and continues until the pressure in both solutions is equal limiting further passage. The pressure difference which causes osmosis to occur is known as the osmotic pressure.

Reverse Osmosis (RO)

Reverse osmosis uses this principle to make the solvent move from the concentrated solution to the weak by exerting a pressure higher than the osmotic pressure on the concentrated solution, thus reversing the direction of flow across the membrane.