

UNIT 5: WATER SYSTEM

Necessity of Water

- In the hospitality industry water is used in a number of ways starting from supplying bacteria free clean drinking water.
- Hot and cold water in bathrooms and toilets.
- In kitchens for cooking food.
- Water is also needed in the laundry.
- For cleaning floors and articles.
- For water sprinkler system.
- For Swimming pools.

Availability of Water in Hotels

- Water in the hospitality industry is generally supplied by the Govt. Dept.
- But since hospitality units require quite large amounts of water they are required to have buffer stock of water and for which large tanks and reservoirs are required.
- Hospitality units generally have their own stand by arrangement for water supply in the form of bore wells.
- Bore wells are to be dug with the permission of local civic authorities and they charge yearly rent for bore well.
- Since the bore well provides hard water the hotel has to invest in a water treatment plant.
- The water is supplied to the various locations in the hotel by means of a large network of pipes, pipe fittings, valves etc.

Hardness of Water

- Water is termed as hard when it contains more minerals than ordinary water, especially the minerals – calcium and magnesium.
- Types of Hardness in water
- Temporary or Carbonate hardness: it is due to the presence of bicarbonates of calcium and magnesium dissolved in water. Simple boiling removes this hardness.
- Permanent or non-carbonic hardness: it is due to the presence of chlorides and sulphates of both calcium and magnesium. Simple boiling cannot remove this hardness. Use of chemicals and ion exchange methods are used to remove the permanent hardness.

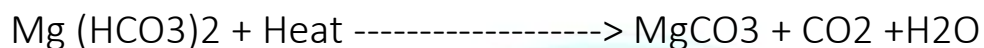
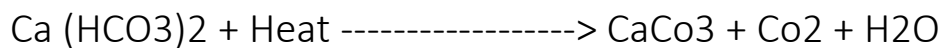
III – Effects of Hard Water

- It produces less lather with soap, resulting in more soap consumption.
- It produces soap scum, which produces a dirty feeling during and after bath and wash.
- It causes scale formation inside the water boilers and boiling utensils and thus results in corrosion and reduces the heat transfer efficiency.
- It causes turbidity during boiling of water.
- It affects the taste and structure of cooked food.
- Too much intake of hard water affects the digestive process in human beings. It also leads to other health issues.
- It discolours fabric.

Method of removing temporary hardness of water

Temporary hardness of water can be removed by Boiling or by adding lime to water (CaO). Water containing Calcium bi carbonate on heating results in the following products.

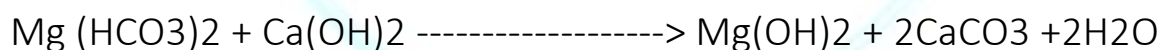
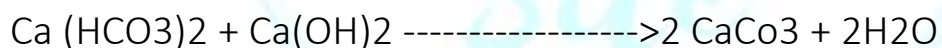
BY BOILING:



Calcium and Magnesium carbonates are insoluble in water, and hence accumulate as thick white precipitate at the bottom and can be removed in the sedimentation tank. The CO₂ formed is liberated as gas.

Addition of Lime (also called Clarke's process):

Lime also known as Calcium Oxide (CaO) when added to hard water results in the following reaction.



Calcium and Magnesium carbonates are insoluble in water, and hence accumulate as thick white precipitate at the bottom and can be removed in the sedimentation tank.

Method of removing permanent hardness of water

Permanent hardness can be removed by certain special methods, generally called water softening methods. The basic principle of softening is the same i.e. converting soluble Ca and Mg salts in hard water into corresponding insoluble salts and finally removing the precipitate. The six methods, which are commonly used for softening permanent hardness, are as follows:

1. Zeolite/ Permutit /Base Exchange Process.
2. Washing Soda Process
3. Lime Soda Process
4. Caustic Soda Process
5. Ion - exchange process or demineralization (DM) process.
6. Calgon Process

Zeolite / Permutit/ Base Exchange Process

- A zeolite softener resembles a sand filter in which the filtering medium is zeolite (a naturally occurring green salt generally termed as green sand) rather than sand.
- Chemically represented as $\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 4\text{SiO}_2 \cdot 2\text{H}_2\text{O}$
- It is manufactured synthetically under the name 'Permutit' which is chemically known HYDRATED SODIUM ALUMINIUM ORTHOSILICATE
- The hard water enters through the top and is evenly distributed on the entire zeolite bed. As the hard water passes through the zeolite the hardness causing ions (Ca^{+2} , Mg^{+2} etc.) are retained by the zeolite as CaZ and MgZ respectively, while the outgoing water contains equivalent amount of sodium salts.

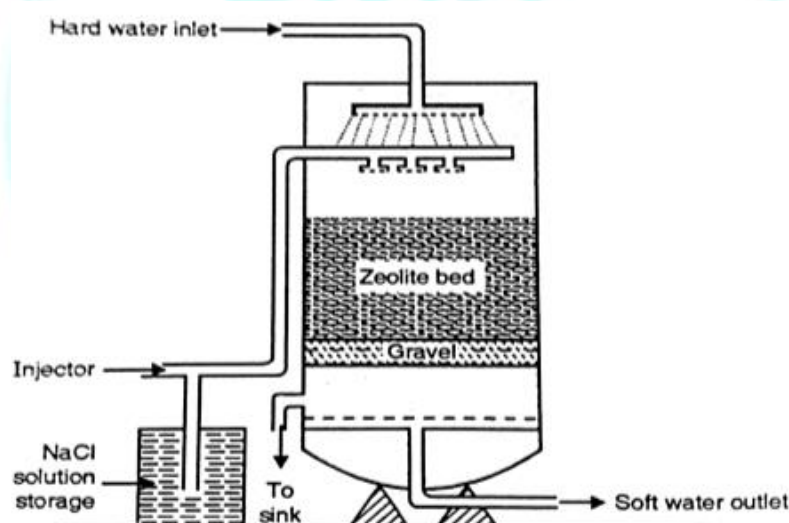
- The sodium ions of the zeolite get replaced by calcium and magnesium ions of the hard water forming insoluble calcium zeolite and magnesium zeolite.

$\text{Na}_2\text{Z} + \text{Ca or Mg salt} \longrightarrow \text{Na}_2 \text{ salt} + \text{Ca or Mg zeolite}.$

After a few days of operation, all the active sodium zeolite changes to Ca and mg zeolite. To replenish the Zeolite bed with Na ions. The zeolite bed is treated with 10 % solution of NaCl (brine solution).

This process is known as regeneration. The regenerated zeolite is now ready to be used for water softening again.

The rate of filtration through zeolite is about 300 litres per square metre per minute.



Advantages of the Zeolite / Permutit/ Base Exchange Process

- Zero hardness can be obtained.
- The plants are compact, automatic and easy to operate.
- The running, maintenance and operation (RMO) cost is quite less.
- It also removes iron and manganese from water.

Washing Soda Process

In this process Washing Soda (Na_2CO_3) is added to hard water which results in formation of insoluble Ca and Mg salts which form a precipitate.

Caustic Soda Process:

In this process Caustic Soda (NaOH) is added to hard water which results in formation of insoluble Ca and Mg salts which form a precipitate. This process can be used to remove temporary as well as permanent hardness of water

Lime Soda Process:

In this process along with Washing Soda (Na_2CO_3), Lime (CaO) is also added to hard water which results in formation of insoluble Ca and Mg salts which form a precipitate.

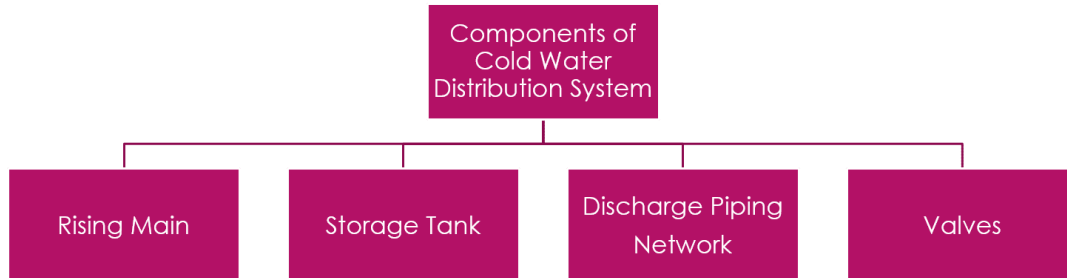
Calgon Softener:

This method makes use of Sodium Hexametaphosphate (NaPO_3)₆.

Ion Exchange Process

Method of functioning is very similar to the Zeolite process, main difference being that in this process, Hydrogen is exchanged instead of Sodium. It makes use of the resins, Phenol-formaldehyde ($\text{C}_8\text{H}_6\text{O}_2$)

Cold Water Distribution System in a Hotel



1. Raising Main – It is a supply pipe line that rises from ground level to the storage tank on the roof top. Since the supply pressure is not enough, there are intermediate booster pumps to enable the water to reach the top storage tanks. Sometimes intermediate storage and multiple tanks are used for serving a group of intermediate floors. The water is stored in the storage tank through the raising main, the storage tank is located at the highest point in the building to ensure a reasonable pressure in the distribution pipes.

2. Discharge or Service Piping – Water for drinking, kitchen and wash basins etc. is directly taken from the rising main by branch pipe at different floors and flows into the service taps. The stop valves should be fitted immediately after the exit from the tanks for disconnecting the pipeline distribution system in case of leakage in tank or pipe system.

3. Valves – are generally gate valves used to completely open or close the water lines.

4. Storage Tanks

Storage Tank

1. Float Valve / Ball Valve – is a spherical rubber ball at the inlet pipe (at the top of the tank), drops down and opens the inlet when the water level falls and rises as the water level rises and finally closes the inlet when the tank is full. An alarm generally gives the signal that the tank is full.
2. Silencer pipe – This is fitted at the end of the inlet pipe to lower the point of discharge a little above the bottom of the tank. It reduces the water filling noise in the tank.
3. Overflow Pipe – It works when the float valve is out of water.
4. Lid – Covers the tank.

Hot Water Generation and Distribution System:

Cold water raised to a temperature of 38°C is usually considered as hot. The operating temperature range is 49 to 60 degree celcius . In hotels the most prevalent system for hot water are:

- Centralised hot water generation and distribution system.
- Localised hot water generation and distribution system.

Centralised Hot Water System:

This system is usually employed in large hotels. Three different principles used to generate hot water are:

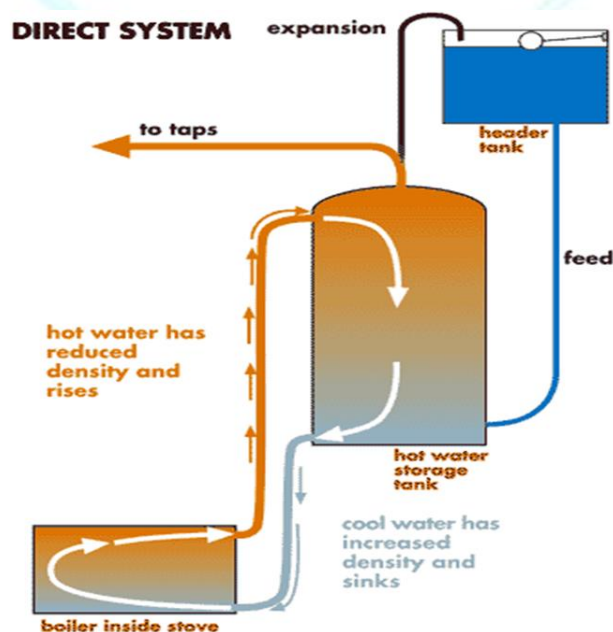
1. Direct Heating System
2. Indirect Heating System
3. Solar Water Heating System

Direct Heating System

- This system involves natural circulation.
- Hot water from the boiler circulates through a hot water tank called cylinder.
- Circulation continues because hot water being lighter rises up to the cylinder from the boiler and cold water descends down to the boiler.
- The service pipes are taken from the cylinder to service taps.
- A cold-water system is connected to the boiler from where cold water runs into the boiler via stop valves.
- Whenever there is increase in volume of water and cylinder is unable to accommodate this, the resulting pressure would lead o the possible busting of pipes.
- To avoid this possible bursting, the water is supplied to an overhead cistern.

Disadvantages:

- Oxygen released while heating cold water causes rusting of boiler.
- Boiling can lead to sever scale formation



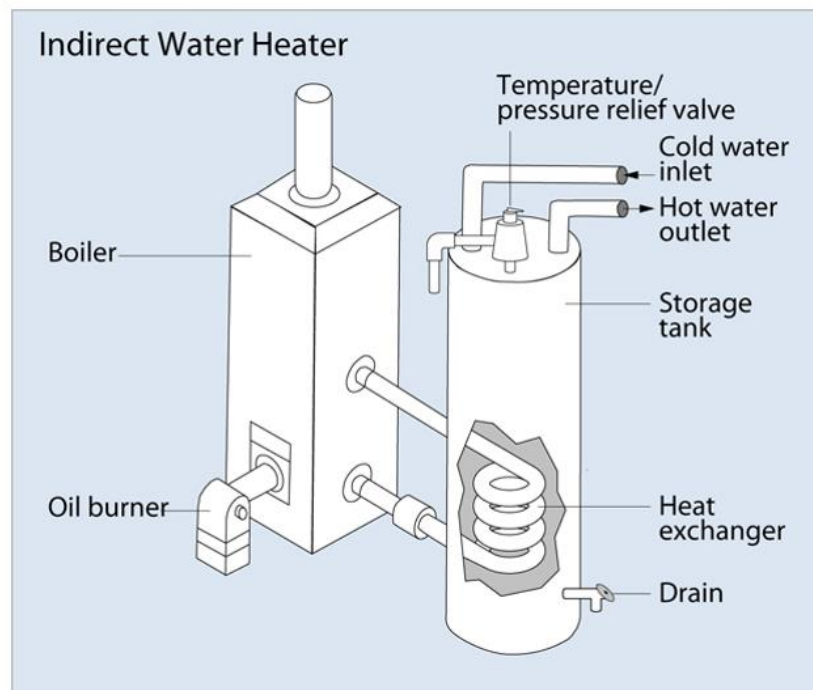
Indirect Water Heating

- In this system the water cylinder is replaced by a direct heat exchanger called the calorifier where hot water or steam from the boiler enters the calorifier through a coil of tubes and heats the cold water passing through the calorifier.

- Two circulations are followed.

Primary Circulation – takes place between the boiler and the calorifier

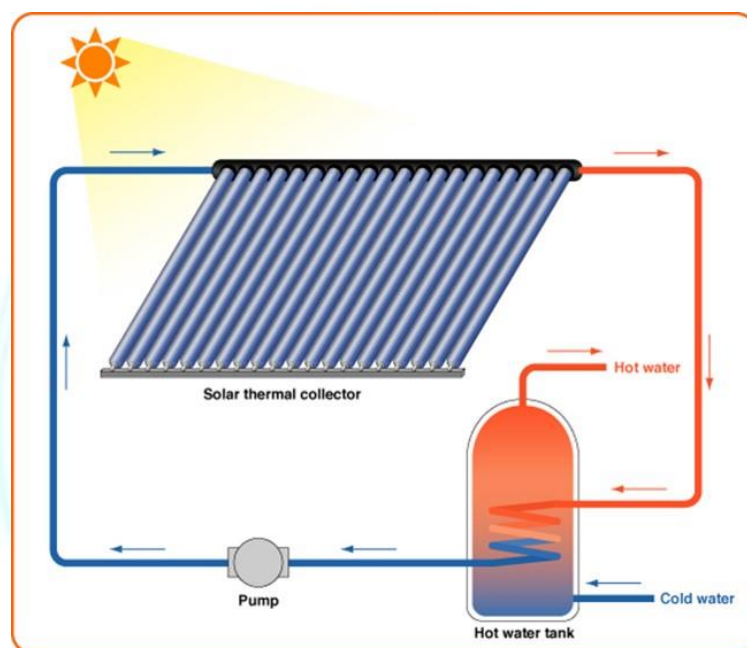
Secondary Circulation – takes place between the calorifier and service taps.



Solar Water Heating System

- Is the most efficient and eco-friendly water heating system. Each evacuated tube is similar to a thermos in principle. A glass or metal tube containing the water or heat transfer fluid is surrounded by a larger glass tube. The space between them is a vacuum, so very little heat is lost from the fluid.

- These collectors can even work well in overcast conditions and operate in temperatures as low as -40°F. Individual tubes are replaced as needed.
- A solar thermal collector collects heat by absorbing sunlight. A collector is a device for capturing solar radiation.
- The quantity of solar energy striking the Earth's surface (solar constant) averages about 1,000 watts per square meter under clear skies, depending upon weather conditions, location and orientation.



Localized Hot Water System:

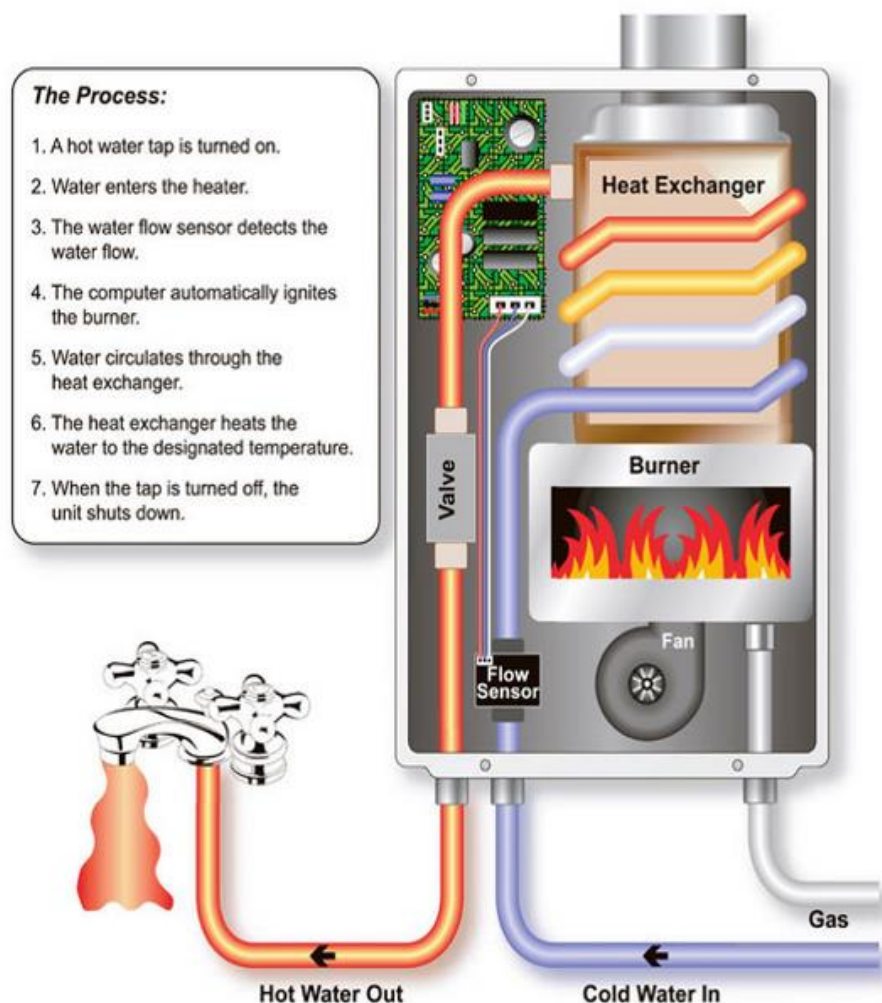
Storage Tank Water Heater (Geyser):

- A thermostat controls the temperature of water and it can be heated at any desired temperature.
- There are two light bulbs provided in the geyser. The red bulb indicates the water is being heated and the green bulb indicates that water is heated up to the desired temperature.
- Automatic heating begins if the temperature of the heated water falls below the set level.

- Geysers are used when the duration of hot water supply is limited.
- May require maintenance if hard water is being used.

Tankless Water Heaters:

- When the hot water tap is turned on, water enters the heater.
- The flow sensor detects the water flow.
- The burner is automatically ignited.
- Water circulates through the heat exchanger.
- The heat exchanger heats the water up to the designated temperature.
- When the tap is turned off, the unit shuts down.



SWIMMING POOL MAINTENANCE

- To keep the pool water transparent, sparkling and free from dirt, filtered water must be used.
- After a specified period of time, usually as recommended by local public health authority, entire water content should be cycled through the filter.
- To ensure proper functioning, the filtration equipment must be cleaned periodically according to a maintenance schedule.
- The process of cleaning the filters is known as backwashing.
- Different types of nets are used to remove floating objects and also large objects that are settled at the bottom of the pool.
- In some pools, the pool water is continuously kept in motion where it passes through the filter and all unwanted floating objects are trapped in the filter.
- The swimming pool has an opening at the water surface level, leading to the drain at the outside. This opening is called WEIR and a strainer is placed at this opening which arrests the objects floating in water, which is subsequently removed.
- Chemicals are added to the pool water to maintain the proper hygienic conditions.
- Disinfectants are added to make the water bacteria free.
- The dosing can be done manually or may be automated.
- To maintain the correct pH level appropriate chemicals are added.
- The pH is normally maintained between 7.2 to 7.6.
- Algae which are water plants that grow in water, are also very difficult to eliminate. If their growth is not hampered by disinfectants, they are to be manually removed.
- The initial as well as the make-up water is supplied to the pool by the water treatment plant in the hotel.

Basic fittings in the water distribution line

These are fittings in water lines to regulate flow through the lines and are an integral part of any water distribution system.

Taps – a tap is what we see at the draw off end of water service line. Depending upon the directions of water entering the tap and coming out of the tap, they may be categorized as:

1. **BIB TAP** - It has a horizontal inlet and free outlet in the form of a bent tube called bib. The bib prevents dust from entering into the free end and contaminating water when it comes out.
2. **PILLAR TAP** – It has a vertical inlet and horizontal outlet through a bib. They are designed for use in lavatory basins and baths. Basic fittings in the water distribution line
3. **GLOBE TAP** – It has a horizontal inlet and vertical outlet. Previously, these were used in baths and are now largely replaced by pillar taps.
4. **SELF CLOSING TAP** – This type of tap open when either pulled up or pushed down. Left to itself, it will always close by spring action. It greatly helps in reducing wastage.
5. **SENSOR OPERATED TAP** – Has a sensor which operates when it detects movement in front of it.

*** For the convenience of guests, the hot and cold taps can be distinguished by a red spot and blue or green spot respectively

VALVES

It is a plumbing device that is used for stopping or fully opening supply to a line or fitting. They are put in line with the pipe line. Valves are fitted throughout the water distribution line to facilitate

closure of a particular line for maintenance work. Different types of valves used in a water distribution system are: Gate Valves.

Globe Valves. ...

Needle Valves. ...

Butterfly Valves. ...

Check Valves. ...

Relief Valves

*** The function of a valve is same as a tap i.e. to open or close or control flow of water. Tap has a smaller valve and is fitted just before any service utility like basin, shower etc. Valves control flow of water in larger pipe line.

TRAPS

In plumbing, a trap is a device which has a shape that uses a bending path to capture water to prevent sewer gases from entering buildings. In domestic and commercial applications, traps are typically U, S, or J-shaped pipe located below or within a plumbing fixture.

