

# Hardness of water : Total Hardness, Mg- Hardness & Ca-Hardness

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- Water that has high mineral content is known as Hard water.
- Hardness of water is a measure of the total concentration of the calcium and magnesium ions expressed as calcium carbonate.
- Hard water contains bicarbonate, chlorides and sulphates of calcium and magnesium.



- When treated hard water with soap, it gets precipitated in the form of insoluble salts of calcium and magnesium.
- Groundwater is usually harder than surface water because it is in contact with these geologic formations.

There are two types of hardness

1. Temporary hardness
2. Permanent hardness



# HOW HARDNESS CLASSIFIED?

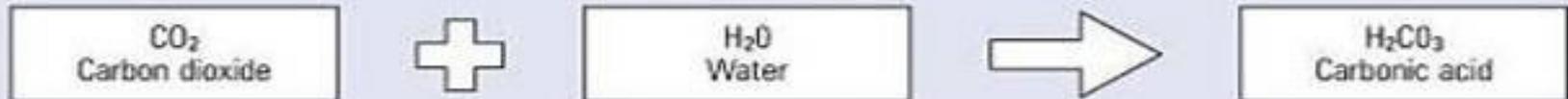
Hardness of water

**Carbonate Hardness**  
(Temporary Hardness)  
Calcium & Magnesium  
Bicarbonates

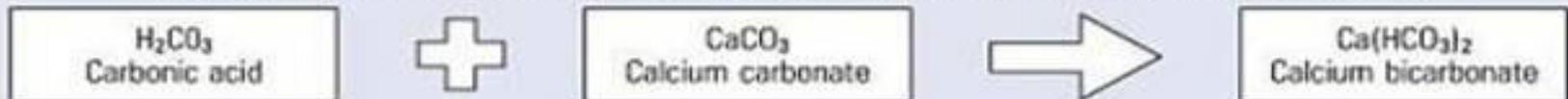
**Non-Carbonate  
hardness**  
(Permanent Hardness)  
Calcium Sulphate  
Magnesium Sulphate  
Calcium Nitrates  
Magnesium Nitrates  
Calcium and Magnesium  
Chlorides

# Temporary Hardness

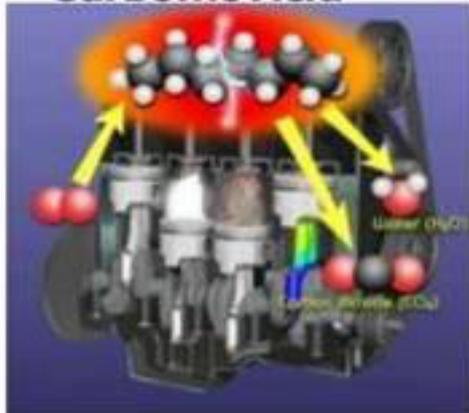
Carbon dioxide combines with water to form carbonic acid:



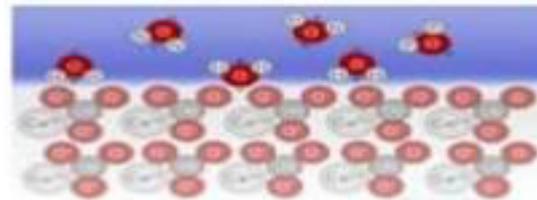
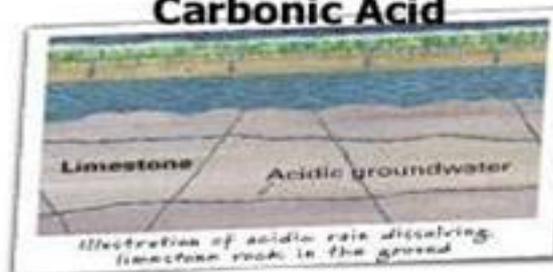
Limestone (calcium carbonate) is dissolved by carbonic acid to form calcium bicarbonate:



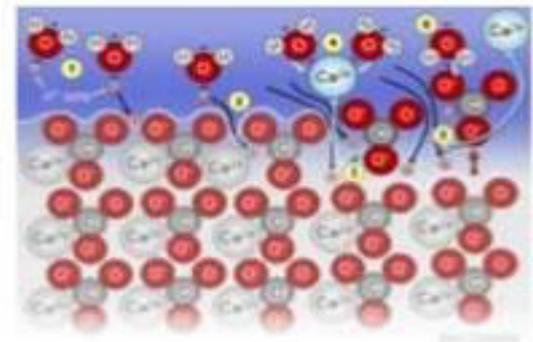
Carbonic Acid



Limestone +  
Carbonic Acid



Calcium Hydrogen Carbonate (aq)



# Permanent hardness :-

- The permanent hardness is stable.
- Cannot be removed by boiling.
- If water has passed through gypsum in the ground it will contain calcium and sulfate.
- After boiling very little hardness is lost, because calcium is not precipitated by sulfate. 

## Hardness Calculations:-

Since calcium carbonate is one of the more common causes of hardness, total hardness is usually reported in terms of calcium carbonate concentration (mg/L as CaCO<sub>3</sub>).

**Total hardness = Carbonate hardness + Non-carbonate hardness**



**Calcium Hardness:-** Occurs when water passes over limestone deposits.

- Calcium- Important role in biological processes of fish.
- Necessary for bone formation, blood clotting and other metabolic reactions.
- Fish can absorb calcium directly from the water or food.
- In low calcium conc. Fish loses sodium & potassium salts.
- That reduces the energy available for growth.
- The growth time of fish to the market size reduces.



**Magnesium Hardness** :-Dolomite and other magnesium bearing formations.

- Magnesium is an essential nutrient for plants, and is a component of chlorophyll.

**Total Hardness = Calcium Hardness + Magnesium Hardness**



## Effect of hardness:-

- Scales are formed as inner coating of the pipelines prevents corrosion.
- Useful for growth of children due to calcium.
- Sodium soaps react with multivalent metallic cations to form a precipitate losing their surfactant properties.
- Lathering doesn't take place until all hardness ions precipitate out.
- This precipitate adheres to surfaces of tubes, sinks, dish washer and may stain clothing.



Due to Softness of water:-

- Absolutely soft waters are corrosive and dissolve the metals.
- Cases of cardio vascular diseases are reported in soft water areas.





**Thank  
you!**