

## Hard water

Many compounds dissolve in water, and some of these make the water hard.

Using hard water can increase costs because more soap is needed and hard water often leads to deposits (scale) forming in heating systems and kettles.

*Hard water:*

- is formed when natural waters flow over ground or rocks containing calcium or magnesium compounds
- contains dissolved calcium or magnesium compounds
- contains dissolved compounds that react with soap to form scum
- does not easily form lather with soap (soft water readily forms a lather with soap)
- contains dissolved compounds that are good for health
- often provides calcium compounds that help the development of strong bones and teeth and help to reduce heart illnesses

*Hard water can be made soft by removing the dissolved calcium and magnesium ions:*

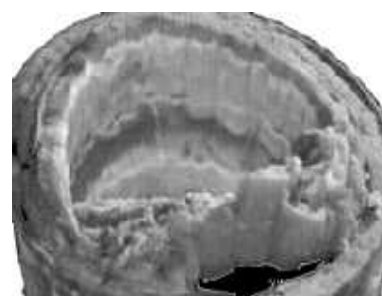
- adding sodium carbonate solution precipitates out calcium carbonate or magnesium carbonate
- ion exchange columns contain hydrogen ions or sodium ions which replace calcium and magnesium ions when hard water passes down the column

1. What is hard water and how is it formed?
2. Describe **three** problems presented by hard water.
3. Describe **two** benefits of hard water.
4. Describe **two** ways in which hard water can be made soft.



**Limescale.**  
Choking the life out of your Central Heating.

Limescale thickness (mm)	% increase in energy needed to heat water in a boiler
2.0	15
4.0	25
5.5	39
8.0	55
11.0	70



5. Use the data in the table to plot a graph to show how the amount of energy needed to heat water in a boiler changes as the inside gets coated with limescale.
6. Great job – you are a water softener salesperson! Write a short, but utterly convincing, sales pitch to sell your water softener to a householder. You should include information taken from your graph such as:
  - the increased energy needed if the limescale is only 1mm thick.
  - the thickness of limescale needed increase energy costs by 50%.