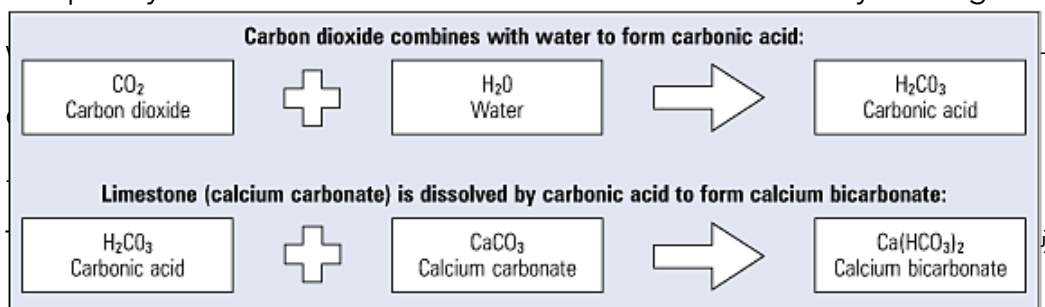


# Water

Hard water ; water with which it is difficult to form a lather with soap. The soap forms scum, which is a grey coloured precipitate. The reason soap is not being used as much today is because of this. Modern detergents work with hard water and can form lather easily. Hardness in water is caused by dissolved  $\text{Ca}^{2+}$  or  $\text{Mg}^{2+}$  ions.

Hardness in water is distinguished by two types; temporary hardness and permanent hardness.

1. Temporary hardness is hardness that can be removed by boiling the



(Image in the file)

- Heating is the reverse, it forms  $\text{H}_2\text{O} + \text{CO}_2 + \text{CaCO}_3$

2. Permanent hardness is hardness in water that cannot be removed by boiling. It is caused by the presence of either sulfates. Calcium or Magnesium sulfate.  $\text{CaSO}_4$  or  $\text{MgSO}_4$ .

# Methods of removing hardness from water.

## 1. Distillation

This is basically just boiling it and condensing the vapour, all the dissolved materials will be removed but it is very costly so it is not advised to be done at a large scale.

## 2. Using washing soda

They were used before the modern detergents came into place and they contained  $\text{Na}_2\text{CO}_3$  basically. The 'Na' does nothing while the  $\text{CO}_3$  combines with the Ca ions in the water to form  $\text{CaCO}_3$  which is not soluble in water and thus we have softer water. TADAAAAA.

## 3. Ion-exchange resin

This is the best method. They exchange the ions that cause hardness with ions that do not. They are commonly used in labs and in homes. The council however supplies deionised water to the labs at my school. Basically speaking, they exchange the  $\text{Ca}^{2+}$  molecules with  $\text{Na}^+$  molecules.

- The balanced equation is as follows:



Advantages for hard water: good taste and provides calcium for teeth and bones.

Don't forget this. They are yummy yummy and good for teathy teathy.

# Water treatment

Before the councils send water to our houses, they do a few checks on it to ensure that the northies do not get mad by looking at it. They ensure that it tastes well, looks well and is odourless. It must also be safe to drink. The steps in doing this is as follows, the steps to treat water that is.

1. Screening ( lidl filter paper )

The water is passed through a big wire mesh to remove random items like plastic bags or dead bodies and such things that you wouldn't want to come through your shower.

2. Flocculation ( coming together and becoming a one big family )

Basically, chemicals are added such as aluminium sulfate to the water which causes small suspended solids to join hands together and sing Kumbaya. Flocculating agents are chemicals that are added to the water that causes this coagulation to occur. ( coming together to sing Kumbaya )

3. Settlement ( settle down, particles. we're not going to leave you behind, or are we? )

The water is passed into settlement tanks in which water slowly rises from the bottom to the top during which particles dissolved in the water slowly drown and die at the bottom of the tank. It's sad but blame gravity if you want, not me. The water at the very top is thus very clean of dissolved particles and it is allowed to overflow into another container.

4. Filtration ( better filter paper )

Unlike settlement, its high grade stuff that's going on over here, the water is passed through large beds of sand which causes any, any dis-

solved particles to be removed. The water is pretty much sober after this point from particles. The water however is not free from microorganisms and they must be removed.

5. Chlorination ( mass murder )

They use fancy terms like 'sterilising the water' in order to justify the mass murder of countless microorganisms. :( They do however see that not a lot is added as it might not taste like premium quality water for some poshies.

6. Fluoridation ( fancy making )

Small amounts of fluoride ions are added to the water as it apparently helps to reduce tooth decay and strengthens the enamel of the teeth.. hmm. They say that but if you add too much then it causes fluorosis which causes staining of the teeth. So, which is it? illuminati!

7. pH Adjustment

Nothing fancy in here, use of calcium hydroxide, caoh and sulfuric acid to control the pH of the water.

## Water Pollution

So, organisms that live in water need oxygen to survive and they get this from the dissolved oxygen in water. Normally, this rate is fine but when you add organic waste into the water, microorganisms use up the dissolved oxygen to produce carbon dioxide and more water. What happens now is that the oxygen content of the water is going down and thus many organisms find it very hard to breathe. The lower it gets, more and more organisms begin to die. If it reaches zero then anaerobic bacteria jumps in and you do not want to know how that smells. Yuck!

B.O.D Test. Basically, Biochemical oxygen demand is the amount of oxygen consumed by biochemical action when kept at 20 degrees in a dark room for five days.

- Biochemical - Oxygen Consumption - 20 degrees - dark room - 5 days.

The test is done by filling two bottles with the water to be tested. The first one is tested for dissolved oxygen using the winkler method, or just say a dissolved oxygen sensor. The second one is kept in dark ( for photosynthesis to not occur ) at 20 degrees ( to keep the experiment valid when comparing with other experiments ). After which, the second one is also tested for dissolved oxygen and the difference between them is the result. You need to calculate this as parts per million of oxygen. Parts per million is also known as milligrams per litre.

## **Eutrophication of water**

Eutrophication is known as the enrichment of water with nutrients, especially plant nutrients. This leads to reduction of dissolved oxygen. ( Nitrate and Phosphate ions ). This can occur naturally by just build up of these nutrients or artificially when fertilisers are washed into rivers. This causes huge growths of algae as they have a lot of nutrients to support the growth. But, sadly, disaster strikes as these algae are short lived and die out very soon. When this does happen, the algae uses up a lot of the oxygen and this reduces the dissolved oxygen in the water. This kills a lot of nemos and thus the ending to 'finding nemo' from this point on won't be happy any more.

## **Pollution by Heavy Metal Ions. ( Metallica and Iron Maiden hate good water )**

Another cause of water pollution is the addition of lead and mercury ions. Don't forget lead as it is an issue everywhere and no one would eat mercury so that is also not hard to forget. Lead is poisonous as it can cause brain damage to young children, like t.v is not doing that already along with the smartphones nowadays with all those apps. Mercury is also very bad and the release of mercury into water is controlled. You don't want to be ingesting mercury or breathing it in. Heavy metals are removed from the water by PRECIPITATION.

## **Sewage treatment. ( Removing yo' mama's food )**

This is done in order to clean the water before letting it back into a river. If the water was not treated before being let into the river, it would be a source of pollution and significantly reduce the amount of dissolved oxygen in the water.

### 1. Primary Treatment

This is the physical part as we all know very well that physics > chemistry and biology combined.

- Like water treatment, the sewage is "screened". It removes items like yo mama's belongings which are just too big and dirty and could interfere with the machinery.

- They are then allowed to settle in large settlement tanks where it remains for a few hours. The suspended particles sink to the bottom and form a sludge.

## 2. Secondary Treatment

Biological. They sewage is decomposed by bacteria. This is known as the activated sludge process. It's transferred into a large tank known as an aeration tank into which oxygen is continually pumped and has the nutrients required for microorganisms to grow. These microorganisms break down the sludge other than having this happen in a river. The oxygen is kept constant by constantly mixing the mix or by feeding oxygen by pumping it.

## 3. Tertiary Treatment

Removal of nitrates and phosphates, remember you learned them before as they cause eutrophication? This is bad so we don't want that to happen. Phosphates are removed using precipitation just the same way that heavy metals are removed from the water. Nitrates on the other hand are done using biological and ion exchange methods.

# Methods of water analysis.

## 1. pH meter

.. use a pH sensor? or a pH meter! They try to make the pH of water to be consistently 7.2.

## 2. AAS

yea.. Like you used it to check dissolved heavy metals.

## 3. Calorimetry

basically, measuring the concentration of a substance by checking the amount of light absorbed by the substance. They are proportional.