

Portable water and Water Treatment

Potable Water:

- ▶ Water is essential to life on earth. **All living organisms** rely on **water** for their survival and need this water to be **safe** to consume.
- ▶ All water contains at least **small quantities** of contaminants in the form of **dissolved salts** and **naturally occurring bacteria** and contaminants will **cause sickness**.
- ▶ For example, water with a high concentration of **bacteria** can spread **diseases** when consumed.
- ▶ Water that contains concentrations of salts or bacteria that are too **low** to cause harm is known as **potable water**.
- ▶ Portable water Vs chemically pure water: Potable water is not to be confused with **pure water** (in the chemical sense). **Chemically pure** water contains **no other molecules** other than H₂O whereas potable water, though safe to drink, is likely contain **small quantities** of **dissolved matter** and **micro-organisms**.
- ▶ Water can be non-potable for a number of reasons. **Sewage water** is non-potable because it contains a high level of **bacteria** that would lead to sickness if consumed where as **sea water** is non-potable due to its **high salt concentration**.

Fresh Water Sources of Potable Water

- ▶ In the UK, the majority of our freshwater comes from the **filtration** and **sterilization** of **freshwater sources**.
- ▶ The rainy climate of the UK provides a source of water with a **low concentration** of **dissolved salts**. This rain water falls to the earth, where it collects to form **surface water** (e.g. rivers and lakes) and **ground water** (water that is stored underground).
- ▶ Which sources of water are used to produce **potable water** will depend on the area of the country and the time of year.
- ▶ For example, in the south of the country where temperatures are highest, surface water often dries out in the summer. During this period, water is taken from **ground water** sources like **aquifers**. In the north where temperatures are lower and conditions are wetter, water often comes from sources such as **reservoirs** and **lakes**.

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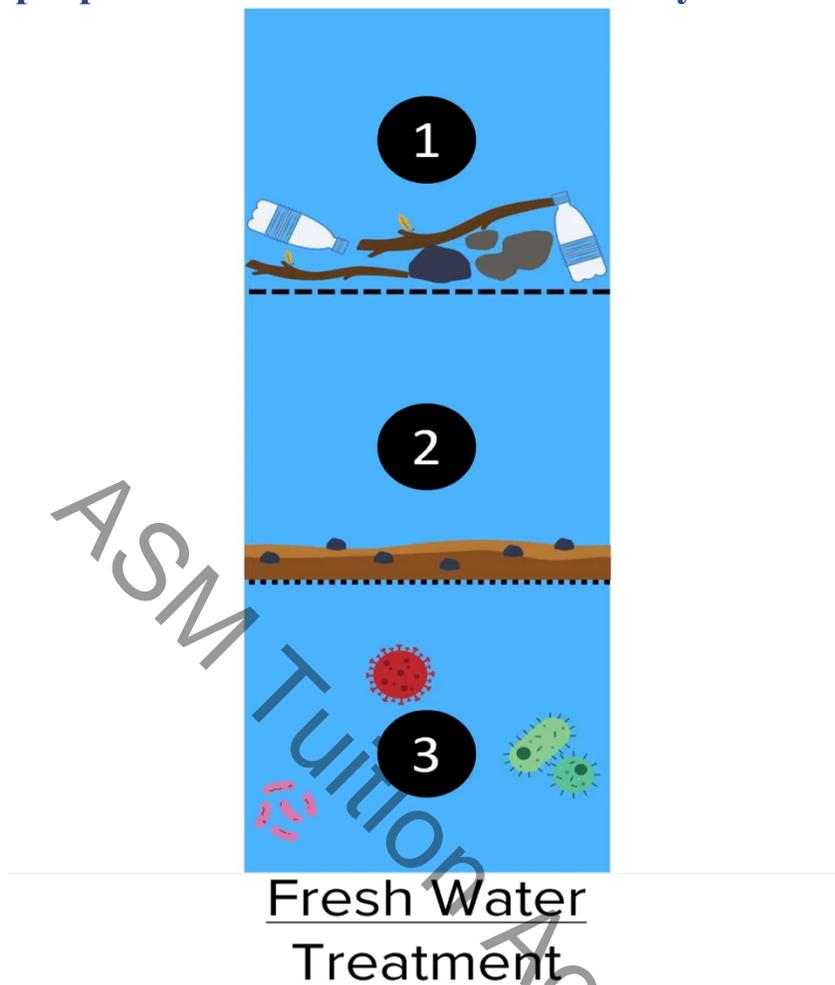


Treatment of Fresh Water

- Though fresh water does not contain high concentrations of salts, it must still be **treated** before it becomes **potable**.
- This treatment is typically done in **three stages**, two **filtration** steps and then a **sterilisation** step.
 1. **Filtration of Large Contaminants:** In this stage, water is passed through a **large mesh filter** to remove larger **solid contaminants**. This step will remove objects like **sticks** and **rocks** as well as waste pollution like **plastics** and **refuse**.
 2. **Filtration of Sediment:** This stage uses a **finer mesh** called **sand and gravel beds** to remove sediments such as **soils**, **sand**, and **gravel**.
 3. **Sterilization:** Finally, the water is treated to remove **bacteria** and other **micro-organisms**. This is done by treating the water with **chemicals** such as **chlorine** or **ozone** and by exposing it to **ultraviolet**. This **kills** the vast majority of micro-organisms present, **preventing sickness**.

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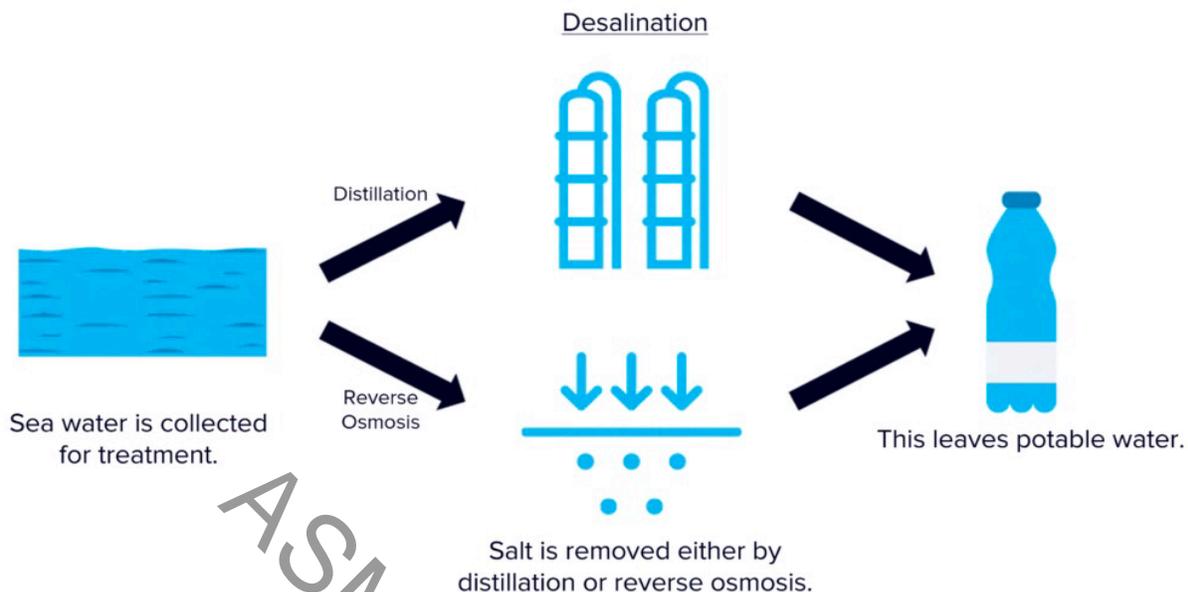
Treatment of Sea Water

In dry countries like Kuwait sea water treatment occur from following methods

1. Desalination

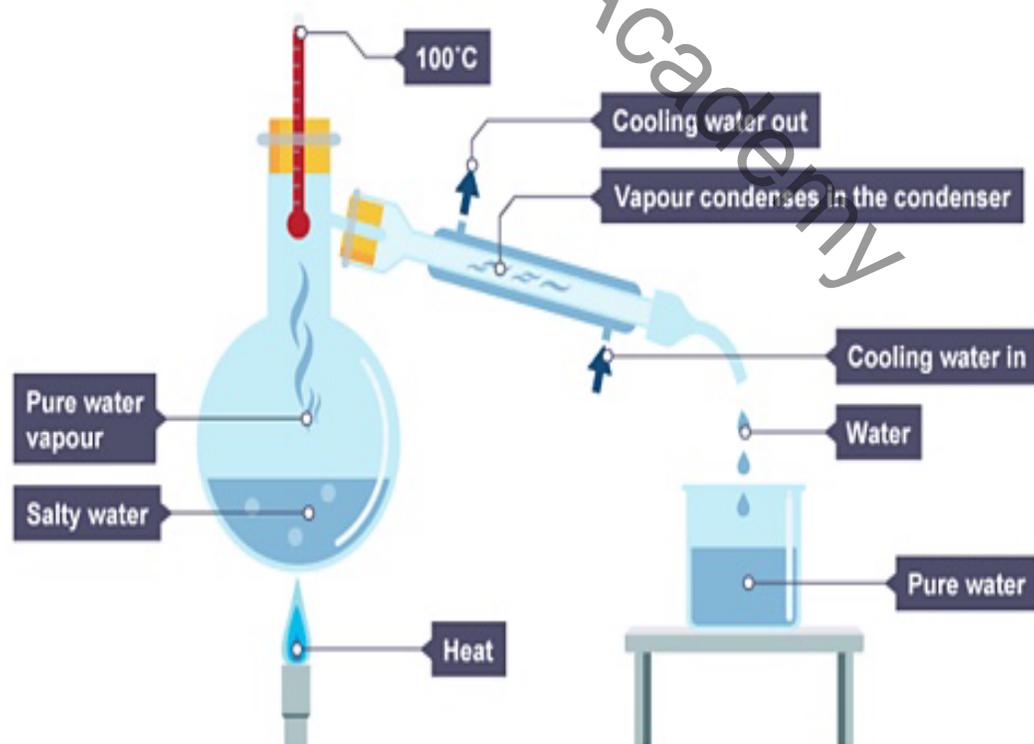
- The UK has a fairly rainy climate and this give us access to a lot of fresh water. In some countries however, there is significantly **less rain** and so less access to **fresh water**. In these circumstances, countries must turn to the **sea water** to meet their needs.
- Sea water is non-potable without treatment due to its high salt concentration. To convert sea water into potable water it is necessary to **remove the salt** using a process known as **desalination**. This can be done using one of two methods, **distillation** or **reverse osmosis**.

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2. Distillation

- In the **distillation** method, sea water is **boiled** to produce **steam**. The steam is piped away leaving only the now **solid salt**.
- The steam is then allowed to **condense** back into water in another vessel. This water will have had its salt content, as well as any **solid contaminants**, removed. The water can then be further **treated** to remove any remaining contaminants, leaving only **potable water**.



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3. Reverse Osmosis

- In **reverse osmosis**, salt water is passed through a **permeable membrane**. This membrane is designed so that **only** water molecules can pass through it.
- Any **larger molecules** or **ions** are **unable** to pass through the membrane and so are **left behind** when water is passed through. This leaves **potable water**.
- Both reverse osmosis and distillation require **large amounts of energy**. This makes desalination **impractical** for use on a large scale due to its sizeable **cost**.



Test and distill water in lab

There are many methods to test and distil water in lab

1. Titration

- I. For water to be safe to drink it must have a **neutral** pH.
- II. Using a **digital** pH meter, measure the pH of the sample of water.
- III. If the water has an **acidic or basic** pH, use a **titration** to neutralise it.

2. Chemical Tests

- I. Neutralising the water will likely have created a **salt**. The presence of a salt can be tested for using simple **chemical tests**.
- II. Pipette a **small sample** of the water into a **test tube**.
- III. Dip a **splint** into the test tube sample and then place the **damp end** into flame of a splint. If the flame turns **yellow**, sodium is present in the water.
- IV. Add a solution of **aqueous silver nitrate** to the **test tube sample**. If a **white precipitate**, chlorine is present.
- V. These two tests will indicate the presence of salt in the original sample.

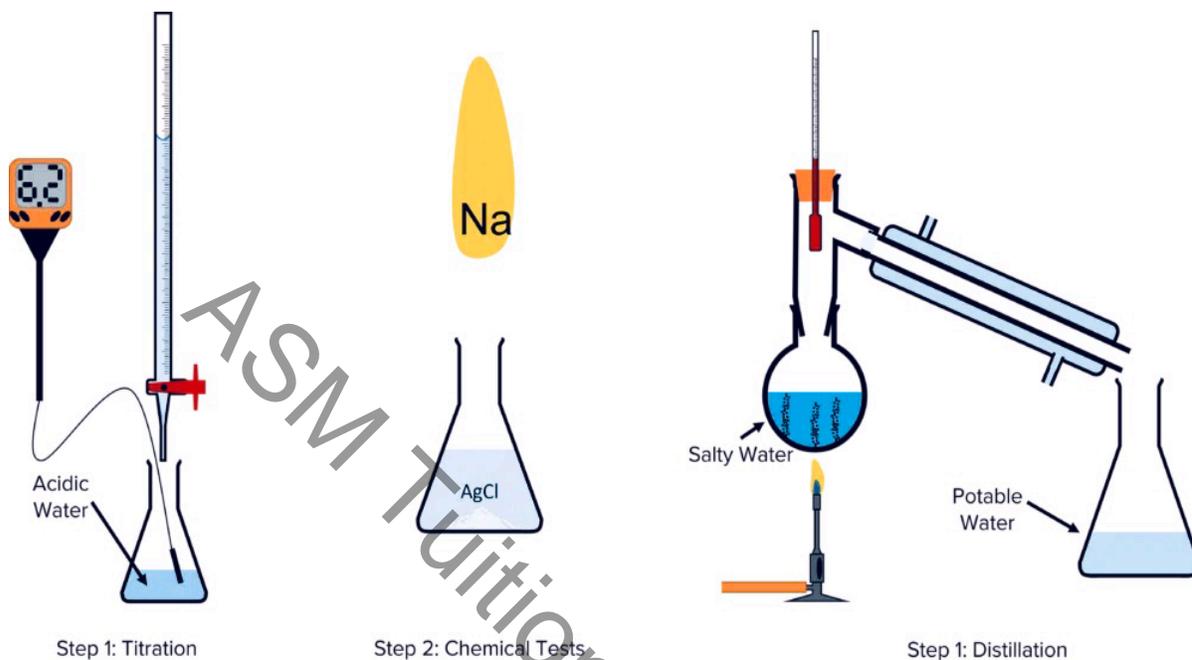
3. Distillation

- I. Finally, this salt must be **removed** to produce a sample of potable water.
- II. The sample of water should be transferred to a **round bottomed flask** and connected to a **condenser**. (Remember to ensure that the water flowing into the the condense enters at the bottom).

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- III. The sample should be heated using a **Bunsen Burner** and brought to the **boil**.
- IV. Collect the **liquid** water that is produced in the condenser in a **conical flask**.
- V. When all of the water has been distilled **solid salt** should remain in the condenser, with a sample of **potable water** collected in the conical flask.



Waste Water Treatment

- **Urban lifestyles produce waste water:** Through urban lifestyles and industrial processes, humans create a lot of **waste water**. Some examples include sewage, washing-up water and waste water from fields.
- **Waste water requires treatment:** The waste water in sewers requires **treatment** before it can go back into the environment. We must remove any harmful substances from the water.
- **Organic matter, microbes and chemicals must be removed:** More specifically, we must **remove** high levels of organic matter, harmful microbes and chemicals from waste water. These could have entered the water system through industrial processes, sewage and agricultural processes.

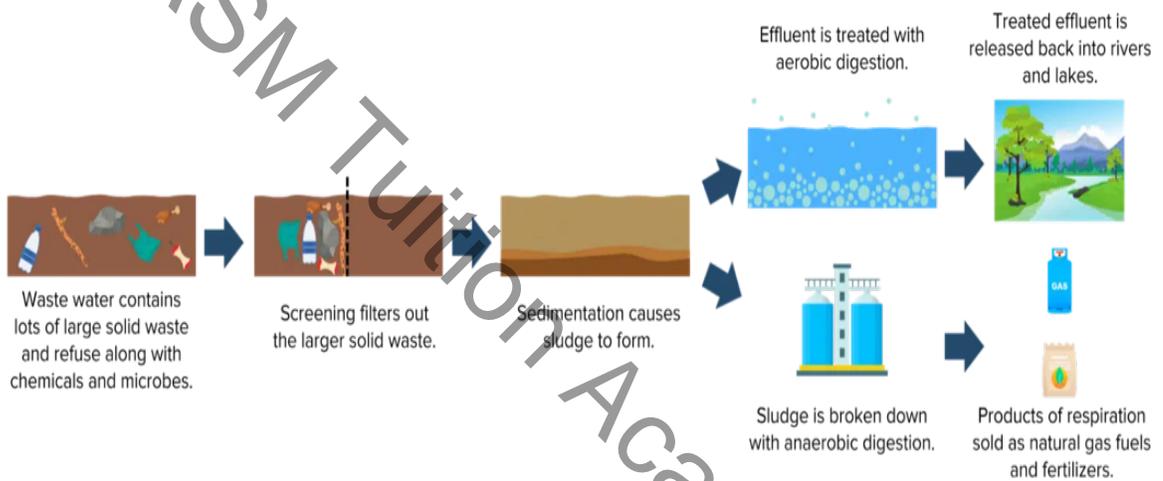
Sewage Treatment

- **Waste water requires treatment** before it can go back into the environment. We can do this using a **four step process**, outlined here.

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1. **Sewage screening:** Before the waste water can be properly treated, any large particles must be removed from the water. This is done through a process called **screening**, which removes large particles and grit.
2. **Sedimentation:** We can then let the waste water stand in a tank. This will let any heavy particles sink down towards the bottom of the tank. This process is called **sedimentation**, where sludge sinks to the bottom and effluent floats to the top.
3. **Bacterial treatment:** We can then use **bacteria** to treat the effluent from the waste water. This bacteria will start a process of aerobic digestion, which breaks down any microbes in the water.
4. **Anaerobic digestion:** Now that the effluent has been treated, the sludge should be treated. This is done via the process of **anaerobic digestion**, which releases methane gas. Methane gas can be used as an energy source.



Waste water Treatment