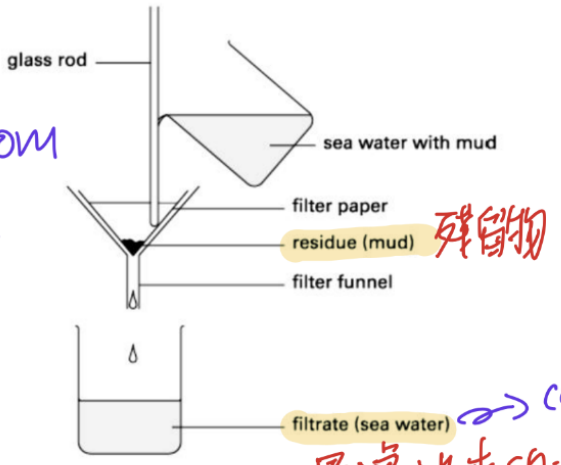
2.3 Extraction of common salts from sea water

To extract **sodium chloride powder** from sea water, **filtration** and **evaporation** are employed

Step 1: **Filtration** is a method of **separating an insoluble solid from a liquid or solution**. Mud is filtered off from the sea water.

remove insoluble solid from solution.



殘留物

Residue: Solid remains on the filter paper.
Filtrate: The liquid that passes through the filter paper.

contains sodium chloride and water

過濾出來的液體

Note:

1. There are many tiny holes in the filter paper. If the insoluble solid particles are **very small**, they **can pass through the pores** in the filter paper. Filtration becomes **ineffective**.

Step 2: **Evaporation** is a method for separating a high boiling soluble solid (solute) from a solution.

When the filtered sea water is evaporated to dryness, impure sodium chloride powder is left.

過濾了的海水 直至乾身 不純的 粉 留低

remove all water from sea water, finally, salt is obtained.

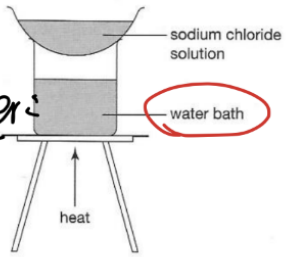
after evaporating all water from the solution

Finally, white solid (sodium chloride) is obtained.
得到.

Note: 粉狀的 雜質

1. The **powdery** sodium chloride obtained may contain some impurities.
2. A hot water bath, instead of direct heating may be used to prevent overheating or decomposition of the solute.

maximum temperature = 100°C



oil bath

boiling point of oil is higher, > 200°C.

Salts obtained from evaporation of sea water:
① powder
② impure (because sea water contains other substances, not only sodium chloride and water.)

Requirement for crystallization=

- saturated solution

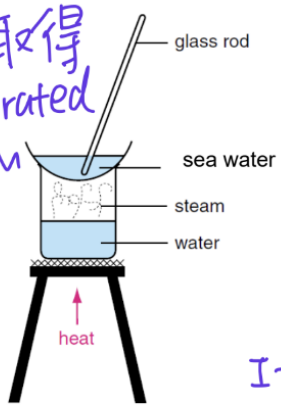
To extract **pure sodium chloride crystals** from sea water, **crystallization** (noun) is employed.

Step 1: **Filter** the insoluble solid from the solution by **filtration**. ⇒ remove insoluble solids (sand) from sea water

Step 2: **Warm** the filtrated sea water in an evaporating dish until a **saturated solution** is obtained.

obtain a saturated solution

Heat the solution until it becomes saturated.



> A saturated solution is a solution containing the **maximum amount of solute** at a certain temperature.

If there are some solids observed on the end of the glass rod, the solution is saturated enough for crystallization.

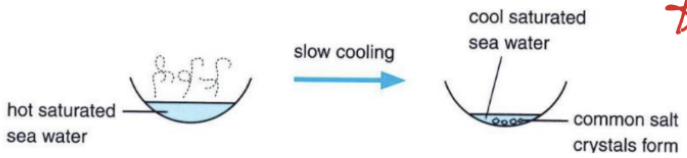
Note:

1. If the solution is not concentrated enough, no crystals will be obtained even after cooling.
2. To ensure the solution is saturated enough for crystallization, we dip a glass rod into the hot solution and take it out. If the immersed end becomes 'cloudy' with few seconds, the solution is saturated.

Step 3: **Cool** the solution **slowly**. Large sodium chloride crystals are obtained. (**Crystallization**)

> **Crystallization** is a method of separating a pure soluble solid (solute) from a solution. In crystallization, **pure sodium chloride crystals** can be obtained from a saturated solution of the filtered sea water.

crystallization

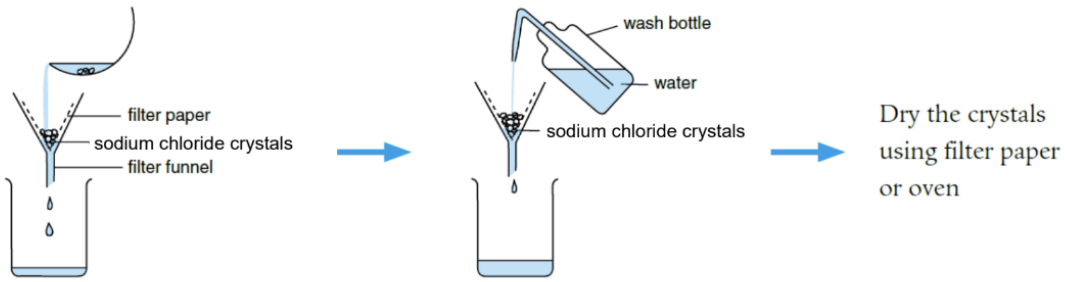


★ Cool the solution slowly at room temperature.

Note:

1. If the solution is cooled quickly, small and less pure crystals will be formed.

Step 4: **Filter** off the crystals. **Wash** them with small amount of **cold distilled water** to remove soluble impurities on the surface, and **dry** them with filter paper.



→ compare their difference
solubility

Example 2.1

(a) Explain why filtration can be used to remove mud particles from muddy water but cannot be used to remove sodium chloride from sea water.

泥的粒子

(b) Describe briefly the procedure used to separate each component from a mixture of sand and sodium chloride.

(c) You are given a sample of sugar solution.

distillation

(i) Suggest and describe how pure water can be obtained from sugar solution.

(ii) Draw a labeled diagram for the experimental set-up of the method stated in (i)

Answer

(a) Mud particles are insoluble in water while sodium chloride is soluble in water.

參考

(a) Sea water is a solution while muddy water is a suspension.

The size of sodium and chloride ions in sea water is much smaller than that of the mud particles in muddy water.

The ions in sea water can pass through pores in filter paper while mud particles cannot.

(b) 1. Dissolve the mixture in distilled water.

殘留物

2. Filter the mixture. Sand can be separated out from the mixture as residue.

3. Evaporate the filtrate to dryness, the solid obtained is sodium chloride.

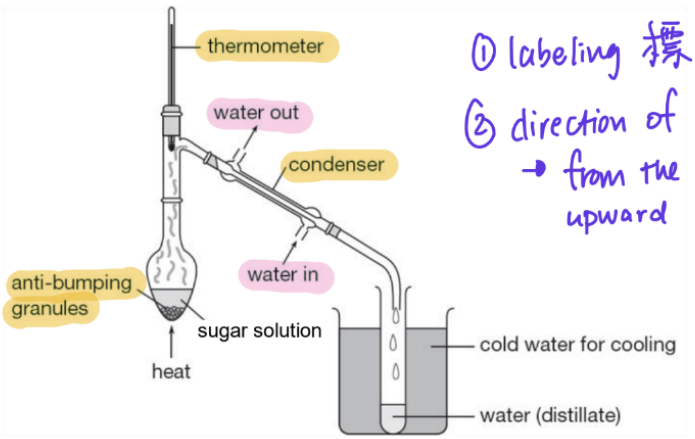
濾液 蒸乾

(c)

(i) Pure water can be obtained by simple distillation.

During distillation, sugar solution is heated to boil and water changes into steam. Then the steam is cooled and condenses into water which is collected as distillate.

(ii)



① labeling 標籤

② direction of water flow
→ from the bottom to upward