

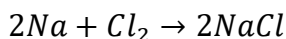
## Preparation of Salts

Generally, the method of preparation of a salt depends on whether it is soluble or insoluble. There are three main methods of preparing salts; these are:

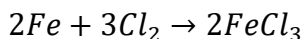
1. The Direct Combination of Elements:

This method is used to prepare binary salts, i.e. salts which are made up of two elements only. The salts being prepared can be soluble or insoluble.

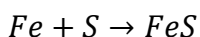
E.g. NaCl (soluble)



FeCl<sub>3</sub> (soluble)



FeS (insoluble)



2. Ionic Precipitation or Double Decomposition:

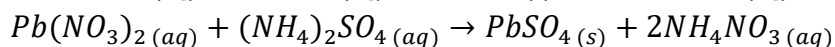
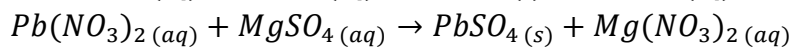
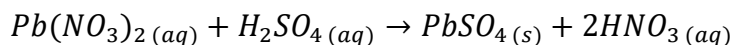
This method is used to prepare insoluble salts.

*Principle* – two solutions are used; one solution will provide the necessary cations and the other solution will provide the anions. When the cations and anions come together a precipitate is formed, i.e. the insoluble salt.

Method:

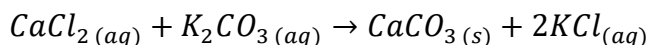
- i. Add one solution to the next. Stir the mixture.
- ii. Filter the mixture. The precipitate, that is, the desired salt, is left on the filter paper.
- iii. Rinse the precipitate with a small amount of distilled water.
- iv. Dry the salt, for example, place it between two sheets of filter paper.

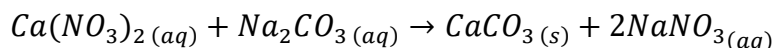
E.g. 1 – Preparation of Lead (II) sulphate:



(write ionic equations)

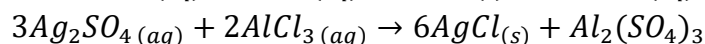
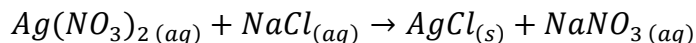
E.g. 2 – Preparation of Calcium carbonate





(write ionic equations)

E.g. 3 – Preparation of Silver chloride



(write ionic equations)

### 3. Crystallization Method:

This is used to prepare soluble salts.

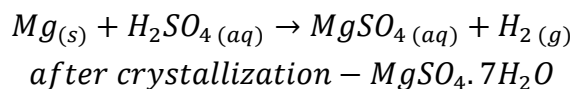
*Ways of preparing soluble salts using crystallization method:*

- Reacting a metal with an acid
- Reacting insoluble bases with acids
- Reacting insoluble carbonates with acids
- Reacting soluble bases or soluble carbonates with acids (i.e. Titration method)

#### *Preparation of a Soluble Salt by Reacting a Metal with an Acid*

- The metal is added to the acid in excess. The reason is to use up all the hydrogen ions from the acid. The addition of the metal is stopped when effervescence stops.
- The mixture is filtered to remove excess metal.
- The mixture (salt solution) is poured in an evaporating dish and is gently heated.  
(A hydrated salt is one which has water of crystallization loosely held within its structure, e.g.  $CuSO_4 \cdot 5H_2O$ . An anhydrous salt is one without the water, e.g.  $CuSO_4$ . If the salt is a hydrate, not all of the water is evaporated off. If the salt is anhydrous, then all the water can be evaporated off).
- The evaporating dish is put aside to cool.
- If the crystals are surrounded by a solution, filter or pour off the solution.
- Rinse the crystals with a small amount of distilled water and dry them between two sheets of filter paper.

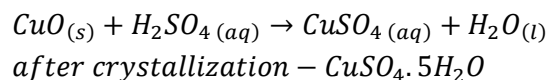
Example: Preparation of Magnesium sulphate heptahydrate or hydrate magnesium sulphate/magnesium sulphate 7-water ( $MgSO_4 \cdot 7H_2O$ )



### *Preparation of a Soluble Salt by Reacting an Insoluble Base with an Acid*

The method for the most part is similar to the first two preparations. The only exception is that the addition of the insoluble base is stopped when no more “dissolves”. Usually, the mixture is heated.

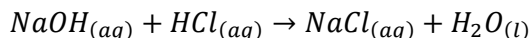
Example: Preparation of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$



### *Preparation of a Soluble Salt Using Titration*

This method is normally used to prepare a soluble salt when reacting an alkali or a soluble carbonate with an acid.

Example: Preparation of NaCl



Method:

1. Place the acid in the burette.
2. Use the volumetric pipette to take up the alkali or soluble carbonate. Place the solution into a conical flask.
3. Add an indicator to the solution (this is so to identify when neutralization occurs).
4. Titrate the alkali or soluble carbonate with the acid until the neutralization point is reached.
5. Read off the volume of acid used. Repeat the titration until the volumes of acid used are the same.
6. Add this volume of acid to the fixed solution of alkali or soluble carbonate without using an indicator.
7. Evaporate off some of the water. Leave the saturated solution to crystallize.
8. Rinse with a small amount of distilled water and dry the crystals between two sheets of filter paper.

Test yourself:

1. Describe in detail how you would prepare a) calcium sulphate b) calcium nitrate starting from calcium carbonate. Write molecular and ionic equations for the reactions using state symbols.
2. Outline the preparation of pure samples of:
  - a.  $\text{ZnSO}_4$  from Zn
  - b.  $\text{MgCl}_2$  from  $\text{Mg}(\text{OH})_2$
  - c.  $\text{Cu}(\text{NO}_3)_2$  from CuO
  - d.  $\text{Na}_2\text{SO}_4$  from  $\text{Na}_2\text{CO}_3$
  - e.  $\text{PbCl}_2$  from  $\text{Pb}(\text{NO}_3)_2$

<https://www.youtube.com/watch?v=tGmeWp5ZO1s>