

# Preparation of salt

## I Soluble salt

### ACID - BASE → EXCESS INSOL. BASE + ACID

Required: prepare  $\text{ZnSO}_4(\text{s})$

Excess when:

- 1) no colourless gas bubbles
- 2) no longer dissolves

Why is excess insol. base required?

- If  $\text{ZnCO}_3(\text{s})$  is limited, the sol<sup>n</sup> contains  $\text{H}_2\text{SO}_4(\text{aq})$ .
- It is hard to separate  $\text{H}_2\text{SO}_4$  from mixture, even by fractional distillation (cannot obtain pure  $\text{NaNO}_3$ ).
- Resulting crystal will contain impurities ( $\text{H}_2\text{SO}_4$ ).

Crystallisation

1. Heat until saturated
2. Cool sol<sup>n</sup> (time is allowed for crystal to form)
3. Filter the sol<sup>n</sup> and obtain crystal as residue
4. Wash w/ small amt. of ice-cold distilled water
5. Dry crystal in filter paper

### ACID - BASE → TITRATION OF SOL. BASE + ACID

Required: prepare  $\text{NaCl}(\text{s})$

Why can't we use the above method?

- $\text{Na}^+$  不管配什么 -ve ion, compound 也溶于水
- 没有 insol. base

Titration

- 1a. Titrate known vol & known molarity  $\text{NaOH}(\text{aq})$  against  $\text{HCl}(\text{aq})$
- 1b. Use methyl orange as indicator
- 1c. Record vol. of  $\text{HCl}(\text{aq})$  used when end pt. is reached (yellow → orange)
2. Repeat exp. w/o indicator w/ same vol. of acid

Crystallisation

1. Heat until saturated
2. Cool sol<sup>n</sup> (time is allowed for crystal to form)
3. Filter the sol<sup>n</sup> and obtain crystal as residue
4. Wash w/ small amt. of ice-cold distilled water
5. Dry crystal in filter paper

## 2 Insoluble salt

### PRECIPITATION

Required: prepare  $\text{PbSO}_4(\text{s})$

Mix equal volume & equal molarity of  $\text{Pb}(\text{NO}_3)_2(\text{aq})$ ,  $\text{Na}_2\text{SO}_4(\text{aq})$

depends on salt to prepare

- eg.  $\text{PbCl}_2(\text{s})$
- $\text{Pb}(\text{NO}_3)_2 + 2\text{NaCl} \rightarrow \text{PbCl}_2 + 2\text{NaNO}_3$
- $\text{Pb}(\text{NO}_3)_2$  mol :  $\text{NaCl}$  mol = 1 : 2

Filtration

1. Filter mixture & collect  $\text{PbSO}_4(\text{s})$  as residue
2. Wash w/ large amt. of distilled water
3. Dry w/ filter paper

### SPECIAL CASE: prepare $\text{NaHSO}_4(\text{s})$

- $\text{H}_2\text{SO}_4$  的 ionization 其实有两个步骤:
  - a.  $\text{H}_2\text{SO}_4 \rightarrow \text{H}^+ + \text{HSO}_4^-$
  - b.  $\text{HSO}_4^- \rightleftharpoons \text{H}^+ + \text{SO}_4^{2-}$
- 如何逼使  $\text{H}_2\text{SO}_4$  只 ionize 一次?
  - > 只提供 complete rx 所需 mole 一半的  $\text{H}_2\text{SO}_4(\text{aq})$ .
  - > 本来:  $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ ,  $\text{NaOH} : \text{H}_2\text{SO}_4 = 2 : 1$
  - > 如果变成:  $\text{NaOH} : \text{H}_2\text{SO}_4 = 1 : 1 \Rightarrow \text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{NaHSO}_4 + \text{H}_2\text{O}$
- 如何确保  $\text{NaOH} : \text{H}_2\text{SO}_4 = 1 : 1$ ? → Procedure
  - > Mix equal volume & equal molarity of  $\text{NaOH}(\text{aq})$  and  $\text{H}_2\text{SO}_4(\text{aq})$ .
  - > Heat sol<sup>n</sup> until saturated then cool sol<sup>n</sup>.
  - > Time is allowed for crystal to form.
  - > Filter the sol<sup>n</sup>, obtain crystal as residue.
  - > Wash crystal w/ little amt. of ice-cold distilled water.
  - > Dry crystal in filter paper.
- Tip: 其他同类型的 salt 也能通过控制 mole ratio 而获得.
  - >  $\text{H}_3\text{PO}_4 \rightleftharpoons \text{H}^+ + \text{H}_2\text{PO}_4^-$  ———— ①  $\text{NaOH} + \text{H}_3\text{PO}_4 \rightarrow \text{NaH}_2\text{PO}_4 + \text{H}_2\text{O}$
  - $\text{H}_2\text{PO}_4^- \rightleftharpoons \text{H}^+ + \text{HPO}_4^{2-}$  ———— ②  $\text{NaOH} + \text{H}_3\text{PO}_4 \rightarrow \text{Na}_2\text{HPO}_4 + 2\text{H}_2\text{O}$
  - $\text{HPO}_4^{2-} \rightleftharpoons \text{H}^+ + \text{PO}_4^{3-}$  ———— ③  $\text{NaOH} + \text{H}_3\text{PO}_4 \rightarrow \text{Na}_3\text{PO}_4 + 3\text{H}_2\text{O}$