Ministry of higher Education &
Scientific Research
Al-Rasheed University College/
Pharmacy Department

Practical Inorganic pharmaceutical chemistry I

Third class / 1st semester

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Lab 6

Assay of Borax

Done by:

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Assay of Borax

$Na_2B_4O_7.10H_2O$ (M.Wt. 381.4)

- Powdered borax is white, consisting of soft crystals that dissolve easily in water. Considered as (weak base)
- Borax, also known as sodium borate, sodium tetraborate, is an important boron compound, and a salt of boric acid.
- Borax synthesized from the reaction of boric acid with sodium carbonate

$$4H_3BO_3 + Na_2CO_3 \rightarrow Na_2B_4O_2 + 6H_2O + CO_2$$

Pharmaceutical application of borax:

1. Used as buffering agent, and antiseptic.
2. Borax is used as natural preservative
3. For the treatment of fungal foot diseases

Chemical principle:

- Borax samples may sometimes be contaminated with boric acid or sodium carbonate, Thus **two titrations** are carried out;

1. Borax with Hydrochloric acid (sodium carbonate if present).
2. Borax with sodium Hydroxide (Boric acid if present).

- Borax is a salt derived from a weak acid and a strong base, so its aqueous solution can be assayed using a standard 0.5N hydrochloric acid solution in (acid-base titration). Titrate Borax with 0.5N HCl Boric acid is liberated

$$Na_2B_4O_7.10H_2O + 2HCl \rightarrow 4H_3BO_3 + 5H_2O + 2NaCl$$

Borax **Boric acid**

- The reaction between borax and Hydrochloric acid liberates boric acid a very weak acid that needs to increase its acidity (by converting it into a strong acid) so that it can react with sodium hydroxide by direct titration. This is achieved by the addition of **excess?** of **mannitol** (polyhydroxylated alcohol).

- Mannityl boric acid complex is formed which is a strong enough to titrate directly with 1N NaOH.

Mannitol

$$4H_3BO_3 + 4NaOH \longrightarrow 4NaBO_2 + 8H_2O$$

Sod. Metaborate

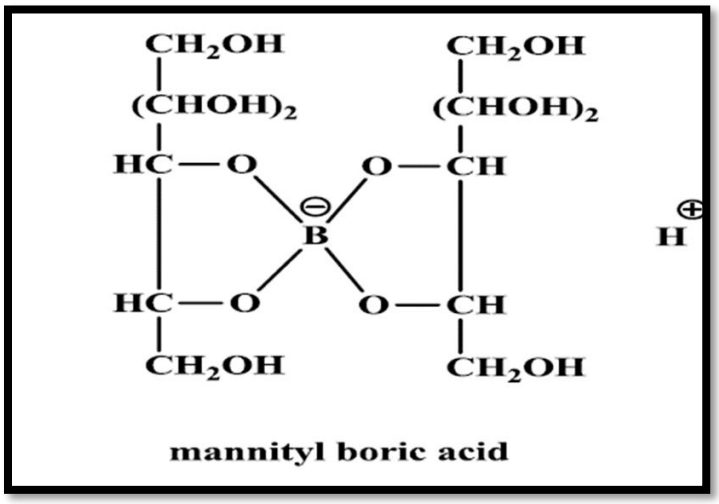

Figure (1-1) structure of Mannityl boric acid complex

Procedure:

1. dissolve the sample of Borax, in 40 ml. distilled water, add 2 drops of methyl red as indicator.
2. Titrate with 0.5 N HCl
   The color changes from yellow → p***ink***.
3. Boil? and cool the solution, then Record the volume of HCl used.
4. Add 4gm. of mannitol using phenolphthalein as indicator (add 2 drops). and titrate with 1N sodium hydroxide, The color changes from
   Pink → ***colorless*** → pink
   Record the volume of NaOH solution used.

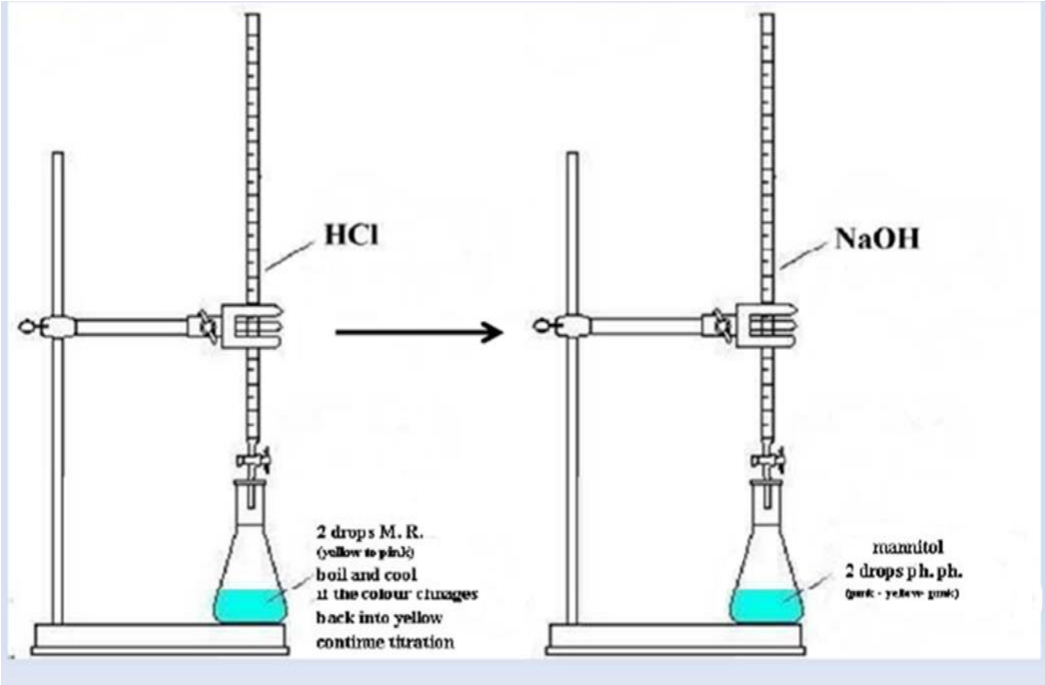

Figure (1-1) Titration apparatus.

➢ **Note**

The solution of the titration should be boiled after the endpoint to expel (if any) carbon dioxide generated (if sodium carbonate is present):

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

This is to prevent the formation of **carbonic acid** which may affect the result of the second titration with sodium hydroxide solution.

Calculation:

Each 1 eq.wt. of NaOH ≡ 1 eq.wt. of Boric acid
Each 4 eq. wt. of boric acid ≡ 1 M. Wt. of Borax
[Each 4 eq. wt. of NaOH ≡1 M. Wt. of Borax] /4
Each 1 eq. wt. of NaOH ≡ 1/4 M. Wt. of Borax **(N= no. of eq.wt / V.L)**
V.L * 1N NaOH ≡ 381.4gm * 1/4 of Borax
[1000 ml 1N NaOH≡381.4gm * 1/4 of Borax] /1000

$$1\text{ml. of 1N NaOH} \equiv \frac{381.4}{1000*4}$$

Each 1ml. of 1N NaOH equivalent to **0.09535 g.** of **Borax**.

V1 = Volume of 0.5N HCl

V2 = Volume of 1N NaOH

- The correct volumes of the two titrations can then tell the presence and type of impurities, besides the quantities of each.

1. If $V_1 = V_2$

This mean that the sample of borax is **pure**. Sometimes a difference of **not more than 0.3ml** between the two volumes is allowed, in this case use the average.

Each 1ml. of 1N NaOH equivalent to **0.09535 g.** of **Borax**.

Wt. of borax = V * chemical factor

2. **If $V_1 > V_2$**

The volume of 0.5N HCl solution consumed is more than the volume of 1N NaOH solution consumed. Then the sample of borax is **impure** and contains, in addition to borax, **sodium carbonate.**

$V_1 - V_2$ = the volume of 0.5N HCl solution consumed by sodium carbonate.

Each 1ml. of 1N NaOH equivalent to **0.09535 g.** of **Borax**.

Each 1ml. of 0.5N HCl equivalent to **0.0265 g.** of **sodium carbonate**.

3. **If $V_2 > V_1$**

The volume of 1N NaOH solution consumed is more than the volume of 0.5N HCl solution consumed

Then the sample of borax is **impure** and contains in addition to borax, **boric acid**

$V_2 - V_1$= the volume of 1N NaOH solution consumed by the contaminant boric acid.

Each 1ml. of 0.5N HCl equivalent to **0.09535 g.** of **Borax**

Each 1ml. of 1N NaOH equivalent to **0.06184 g.** of **boric acid**.