Determination of Sodium Carbonate sample

Principle

Na_2CO_3 is salt of strong base & weak acid so can be titrated against strong acid using ph.ph or M.O.

$$Na_2CO_3 + 2\,HCl \longrightarrow 2\,NaCl + H_2O + CO_2$$

	CO_3^{--} $\xrightarrow{H^+}$	HCO_3^- $\xrightarrow{H^+}$	$CO_2 + H_2O$
pH	**11.7**	**8.3**	**3.8**
Ph.Ph. (8-10)	**Pink**	**Colorless** ½ neutralization	**Colorless**
M.O. (3.3-4.4)	**Yellow**	**Yellow**	**Orange**

a) Using M.O. as indicator:

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

Procedure

1) 10 mL sample in a conical flask + 2 dps M.O.
2) Titrate against 0.1 N HCl
3) End point: yellow to orange

Calculation

$$\text{Concn. of } Na_2CO_3 = [\text{mls} \times f \times F \times 1000] / 10$$

$$2\ HCl + Na_2CO_3 = 2\ NaCl + H_2CO_3$$

$$2 \text{ mole } HCl = 1 \text{ mole } Na_2CO_3$$

$$1\ L\ 1\ M\ HCl = \text{Mwt } Na_2CO_3 / 2$$

$$1\ mL\ 0.1\ N\ HCl = \text{Mwt } Na_2CO_3 / 2 \times 10 \times 1000$$

$$F = 0.0053\ g$$

b) Using Ph.Ph. as indicator:

2 Steps

$$Na_2CO_3 + 2\,HCl \longrightarrow 2\,NaCl + \boxed{H_2O + CO_2}$$

$$Na_2CO_3 + \boxed{H_2O + CO_2} \longrightarrow 2\,NaHCO_3$$

$$2\,Na_2CO_3 + 2\,HCl \longrightarrow 2\,NaCl + 2\,NaHCO_3$$

Na_2CO_3

+ HCl

$NaHCO_3$

+ HCl

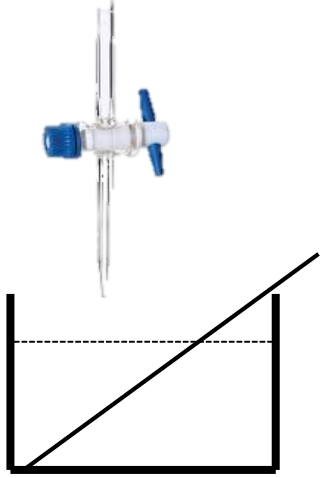
$CO_2 + H_2O$

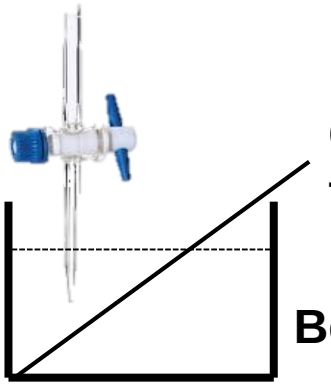
Occurs in 2 steps

How to avoid the escape of CO_2?

1	Dilution
2	Cooling
3	Slow titration
4	Stirring
5	Dipping the nozzle of the burette in the solution surface

- Dilution → To increase solubility of CO_2
- Slow titration → To avoid sudden formation of large amounts of CO_2
- Stirring → To distribute CO_2 in the solution to allow all CO_2 to react





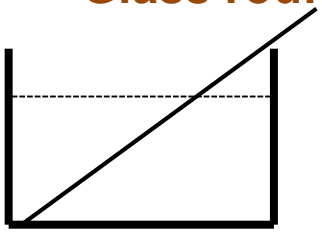
Glass rod for stirring

Beaker

Procedure

In Beaker (250 ml)

Glass rod: Once it's put, NEVER removed until the end of titration



1. **10 ml sample + 10 dps Ph.Ph.**
2. **Dilute till 2/3 beaker with distilled water**
3. **Cool very well in ice bath**
4. **Titrate against 0.1N HCl with dipping nozzle of burette in the solution with stirring till disappearance of pink color**

Calculation

Concn. of Na_2CO_3 = [mls × f × F × 1000] / 10

$$2\ Na_2CO_3 + 2\ HCl \longrightarrow 2\ NaCl + 2\ NaHCO_3$$

1 mole HCl = 1 mole Na_2CO_3

1 L 1 M HCl = Mwt Na_2CO_3

1 mL 0.1 N HCl = Mwt Na_2CO_3 / 10 × 1000

F = 0.0106 g

Determination of Calcium Carbonate sample

Uses

- Source of Calcium in tablets
- Antacid
- Chalk

Types of Titration

Direct Titration

Acid ≠ Base

Back Titration

Indirect Titration

Sample + Reagent

Acid ≠ Base

1) Insoluble substances, e.g. ZnO $CaCO_3$
2) Volatile substances, e.g. formic acid or ammonia.
3) Reactions that need heat.
4) Slow reactions.

1- Principle

Back Titration

.. Why ?

Because $CaCO_3$ is water insoluble

.. How ?

$CaCO_3$ react with Known Excess Standard HCl ➡ produce H_2CO_3 (CO_2 and H_2O)

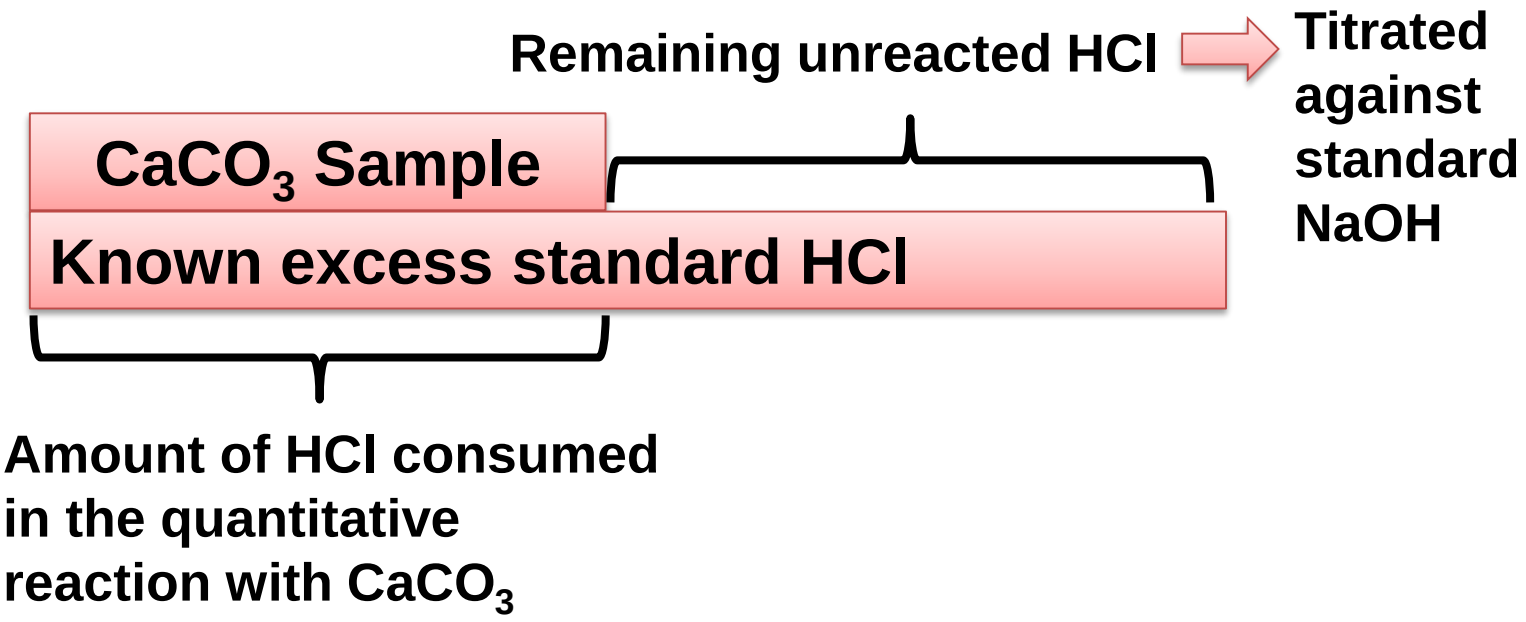
Excess Unreacted (Remaining) HCl is Back Titrated with standard NaOH using Ph.Ph. as indicator till first pink color

N.B.1

Back titration is for …

1) Insoluble substances, e.g., ZnO or $CaCO_3$
2) Volatile substances, e.g., formic acid or ammonia.
3) Reactions that need heat.
4) Slow reactions.

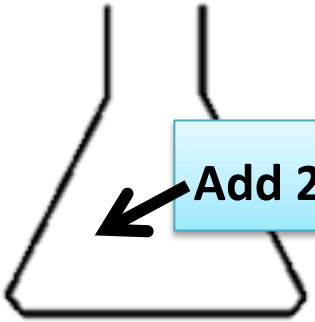
N.B. 2



2- Procedure

Weigh about 0.3g $CaCO_3$ *powder* on glazed paper

Transfer to conical flask



Add 25ml **0.5N** HCl

(with bulb pipette or burette)

Boil for 2 min

Why

- Help $CaCO_3$ to react with HCl
- To evolve CO_2

Cool

Why

Ph.Ph. is prepared in alcohol

Add 10 drops Ph.Ph.

Titrate against **0.5N** NaOH

End Point: first pink

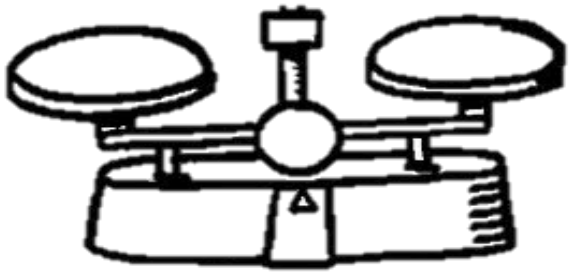
3- Calculation

F

We have 2 standards but F is a relation between sample and standards reacting with each other

i.e. first standard that meet the sample

HCl



$CaCO_3$

Balanced equation

$$1\ CaCO_3 + 2\ HCl \rightarrow CaCl_2 + H_2O + CO_2$$

$$\text{Concn. of } CaCO_3 = \frac{(25 \times f_1 - mls \times f_2) \times F \times 100}{weight\ of\ sample(g)} = \boxed{g\%}$$

f_1:Standardization factor for HCl standard

f_2: Standardization factor for NaOH standard

Remember:

The sample is Solid

2 mole HCl = 1 mole $CaCO_3$

1 mL 0.5 N HCl = M.Wt. $CaCO_3$ / (2× 1000 × 2)

F = 100 / (2× 1000 × 2) = 0.025 g

Thank You