Determination of Na2CO3 with a Standard HCl

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Introduction:

The goal of our experiment is to determine the percentage composition of sodium carbonate in a salt mixture. In order to do the latter, we have to titrate the treated sample with a standardized solution of hydrochloric acid. To standardize the hydrochloric acid solution, we use tris(hydroxymethyl)aminomethane [THAM] as a primary standard.

Procedure: Refer to the Lab manual.

# Equipment Conventional Error Estimate (from handout):

* Analytical Balance ± 0.1mg per measurement
* 50-mL Graduated Buret ± 0.02 mL per reading
* 250-mL Volumetric Flask ± 0.1 mL in total volume
* 50-mL Volumetric Pipette ± 0.02 mL per delivery

# Data collection:

To calculate the mass of unknown, we first weigh the mass of the vile and the unknown, and then weigh the vile after disposing the unknown into the volumetric flask.

Mass of unknown + vile = 18.7101g

Mass of empty vile = 17.7350g

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| --- | --- | --- | --- |
|  | THAM masses (g) | Volumes of HCl from first set of titrations (mL) | Volumes of HCl from second set of titrations (mL) |
| Trial 1 | 0.4995 | 51.7 | 21.9 |
| Trial 2 | 0.4872 | 50.8 | 22.0 |
| Trial 3 | 0.4892 | 50.3 | 22.0 |
| Trial 4 | 0.4865 | 50.1 | 22.1 |

# Reactions:

THAM + HCl (aq) -- > (HOCH2)3-C-NH3+ (aq) + Cl-(aq)  (1)

 Na2CO3(s) + HCl (aq)   -- >   CO2 (g) + H2O (l) + NaCl (aq) (2)

Calculations: Next pages.

# Results:

* We were given the 0.1 M standard of HCl

|  |  |
| --- | --- |
|  | [HCl] in mol/l |
| Trial 1 | 0.07923 |
| Trial 2 | 0.07864 |
| Trial 3 | 0.07873 |
| Trial 4 | 0.07964 |
| Mean of Trials 2,3, and 4 | 0.07900 |
| Standard deviation | 0.000338 |
| 95% confidence interval | 0.07906 + or – 0.00047 |

|  |  |  |
| --- | --- | --- |
|  | [HCl] | % mass of Na2CO3 |
| Mean | 46.14 | 0.07953 |
| Q test for bad value | 0.26 - retained | 0.618 - retained |
| 95 % confidence interval | 0.07953 + or – 0.00093 | 46.14 + or - 5.92 |

# Sample number 2 of Na2CO3.

* Mass percentage of Na2CO3 is 47.28
* The estimated uncertainty of the mean percentage is + or – 47.28

# Conclusion:

In this experiment we successfully utilized titration techniques to standardize am HCl solution and consequently to find the percentage by mass of Na2CO3 in an unknown sample of salt and Na2CO3 mixture.

Sources of error:

* Misjudging the color change, especially since we are going from pink to colorless when we use phenolphthalein.
* Misreading the volume because of a parallax problem or due to an error in counting the graduated marks.
* Using a wrong amount of indicator which could shift the equivalence point and we could, as a result, obtain a different volume that could, in turn, correspond to a different concentration.