**NaOH and HCl Solutions for Acid-Base Titrations**

Notre Dame University

FNAS, Department of Sciences

CHM215

**Done By:** (name)

**Presented To**: Dr. Robert Dib

**Date of Experiment**: -

**Abstract:**

Three prepared solutions of NaOH and HCl were titrated to determine their concentration. A solution of NaOH was used to titrate samples of KHP (weak acid). The same solution of NaOH was also used to titrate samples of HCl (strong acid). In both experiments, phenolphthalein was used as an indicator of end point that occurs after titration is complete. Based on this titration, the concentration of NaOH recorded was (0.09578$\pm 0.00039$) and the concentration of HCl recorded was ($0.1036\pm 0.02$).

**Introduction:**

In this report, titration of HCl and KHP which are strong and weak acids respectively is described.

Acid-Base titration is one of the most common processes of volumetric analysis. It is a quantitative measurement of an analyte by completely reacting with a reagent. The end point of titration is the point where analyte is completely consumed. It is determined by an indicator, which in our experiment is phenolphthalein. The endpoint is indicated once the experiment changes its color to light pink.

The exact volume of acid base solution can be determined by titration against a primary standard. KHP is a salt which is used to standard a solution of NaOH, to prepare a standard solution of HCl.

**Materials and Methods:**

Same as manual.

**Results and Discussions:**

**A-Standardization of NaOH:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sample** | **m KHP(g)** | **nKHP(moles)** | **V(NaOH) added(ml)** | **C NaOH (M)** |
| 1 | 0.3020 | 0.001478 | 15.4 | 0.09597 |
| 2 | 0.3030 | 0.001483 | 15.5 | 0.09567 |
| 3 | 0.3011 | 0.001474 | 15.4 | 0.09571 |
|  |  |  |  | Mean= 0.0958Stdev=0.00016 |

**Sample1:**

n (KHP)= n( NaOH)= m/M(KHP)= 0.3020/204.2215=**0.001478 moles**

C (NaOH) = n/V (NaOH)= 0.001478/0.0154= **0.09597 mol/L**

**Sample2:**

n (KHP)= n NaOH=0.3030/204.2215= **0.001474 moles**

C (NaOH) = 0.001474/0.0155= **0.09567 mol/L**

**Sample3:**

n (KHP)= n (NaOH)= 0.3011/204.2215= **0.001483 moles**

C (NaOH) = 0.001483/0.0154= **0.09571 mol/L**

**The mean, st dev, and 95% confidence level was found:**

$\overline{x}$= $\sum\_{}^{}\frac{xi}{N}=0.0958$

S= $\sqrt{\frac{\sum\_{}^{}(xi-\overline{x})^{2}}{N-1}}$= 0.00016

**At 95% and with degree of freedom equal to 2: t=4.30**

$$μ\_{95\%}=\overline{x}\pm \frac{ts}{\sqrt{N}}=0.09\pm 0.00039$$

**B- Standardization of HCl**:

|  |  |  |  |
| --- | --- | --- | --- |
| **Sample** | **V NaOH added(ml)** | **V HCl (L)** | **C HCl (M)** |
| 1 | 15.4 | 0.0153 | 0.09659 |
| 2 | 15.5 | 0.0134 | 0.1106 |
| 3 | 15.4 | 0.0142 | 0.1037 |
|  |  |  | Mean=0.104MSt Dev=0.007 |

**Sample1:**

$$n\_{HCl}=n\_{NaOH}$$

$$C\_{1}V\_{1}=C\_{2}V\_{2}$$

$C\_{1}=\frac{C\_{2}V\_{2}}{V\_{1}}$ = $\frac{0.09597×0.0154}{0.0153}=0.09659 M$

**Sample2:**

$$n\_{HCl}=n\_{NaOH}$$

$$C\_{1}V\_{1}=C\_{2}V\_{2}$$

$C\_{1}=\frac{C\_{2}V\_{2}}{V\_{1}}$ = $\frac{0.09567×0.0155}{0.0134}$ **= 0.1106 M**

**Sample 3:**

$$n\_{HCl}=n\_{NaOH}$$

$$C\_{1}V\_{1}=C\_{2}V\_{2}$$

$$C\_{1}=\frac{C\_{2}V\_{2}}{V\_{1}}= \frac{0.09571×0.0154}{0.0142}=0.1037 M$$

**The mean, st dev, and 95% confidence level was found:**

$\overline{x}$= $\sum\_{}^{}\frac{xi}{N}=$0.104

S= $\sqrt{\frac{\sum\_{}^{}(xi-\overline{x})^{2}}{N-1}}$=0.007

**At 95% and with degree of freedom equal to 2: t=4.30**

$$μ\_{95\%}=\overline{x}\pm \frac{ts}{\sqrt{N}}=0.104\pm 0.02$$

**Questions:**

Adding precisely 15 ml of HCl solution is important because this volume is used in later calculations. In order to avoid errors and to have a precise concentration of HCl, the measurement must be precise.

 On the other hand, diluting is approximately 50 ml because water volume won’t affect the number of moles present in the solution. (n=n)

**Conclusion:**

In brief, titrating a weak acid such KHP differs from titrating a strong acid like HCl.  Bigger amounts of KHP are required for its titration with a strong base, as for HCl, only simple amount is needed. At the equivalence point, all of the KHP acid will have been neutralized and only potassium ion remains in the solution, so the solution that remains is basic. As for HCl, hydrogen ions are totally neutralized and the solution will now be neutral with ph=7.

References

- D. A. Skoog, D. M. West, F. J. Holler, and S. R. Crouch Analytical Chemistry: An Introduction, 7th ed. Chapter 11 and 12, pp. 246-299. Chapter 27, pp. 732-737

- R. A. DAY and A. L. Underwood Quantitative Analysis: Laboratory Manual, 6th ed. Ch. 3, pp 42-51.