Kevin Zhang Lab Report 8

Introduction

The goal of this lab is to find the molar solubility of calcium hydroxide in two solutions: one of saturated calcium hydroxide, and another of saturated calcium hydroxide with calcium ions. This is done by titrating samples of the two solutions with HCl and measuring how much HCl was used to neutralize the base.

Chemical Responsibility

Some chemicals are toxic or corrosive. In particular, calcium hydroxide and HCl are corrosive. The methyl orange indicator is toxic when ingested.

Report Sheet

Saturated Calcium Hydroxide

Temperature of Calcium Hydroxide Soln: 20.6 °C.

Trial	HCl (mL)	$Ca(OH)_2$ (mL)	$[OH^-]$ (M)	$[Ca^2+]$ (M)
1	11.4	24.8	0.0460	0.0230
2	11.5	24.95	0.0461	0.02305
Average	--	--	0.04605	0.0230

Solubility of $Ca(OH)_2$ = 0.0230 M

Calculated K_{sp} = 4.88×10^{-5}

Saturated Calcium Hydroxide/Calcium Chloride

Temperature of Soln: 20.1 °C

Trial	HCl (mL)	Soln (mL)	$[OH^-]$ (M)
1	9.4	25.0	0.0376
2	9.4	25.0	0.0376
Average	--	--	0.0376

Solubility of $Ca(OH)_2$ = 0.0188 M

Sample Calculations

$$[OH^-] = \frac{11.4\ \text{mL} \times 0.1M}{24.8\ \text{mL}} = 0.0460M$$

$$[Ca^{2+}] = 1/2 \times [OH^-] = 0.0230M$$

$$K_{sp} = [Ca^{2+}][OH^-]^2 = (0.0230)(0.0460)^2 = 4.88 \times 10^{-5}$$

Discussion of Results

The results show that the K_{sp} of calcium hydroxide is approximately 4.88×10^-5. Furthermore, the molar solubility in the original solution and calcium chloride solution are 0.0230 M and 0.0188 M, respectively.

Post-Lab Questions

1. Determine the molar solubility of PbI_2. The K_{sp} value is 8.7×10^{-9}.

$$K_{sp} = [Pb^{2+}][I^-]^2 = (x)(2x)^2 = 4x^3$$

$$x = \sqrt[3]{K_{sp}/4} = 1.296 \times 10^{-3}M$$

2. Determine the molar solubility of 100 mL of a solution of PbI_2 in which 0.01 mole of $Pb(NO_3)_2$ have been added. Assume total volume remains at 100 mL.

$$K_{sp} = [Pb^{2+}][I^-]^2 = \left((\frac{0.01mol}{0.1L}) + x\right)(2x)^2$$

$$x = \sqrt{\frac{K_{sp}}{0.1 \times 4}} = 1.475 \times 10^{-4}M$$

3. The molar solubility of $Cd(OH)_2$ is 1.842×10^{-5} M. What is the K_{sp} value?

$$K_{sp} = [Cd^{2+}][OH^-]^2 = (1.842 \times 10^{-5})(0.921 \times 10^{-5})^2 = 1.562 \times 10^{-15}$$

4. The indicator used was methyl orange. What pH range does methyl orange change color? pH range is approximately 3 to 4.5.
5. The K_{sp} value of $CaCO_3$ is 4.5×10^{-9}. Calculate the solubility in g/L.

$$K_{sp} = [Ca^{2+}][CO_3^{2-}] = x^2$$

$$x = \sqrt{K_{sp}} = 6.708 \times 10^{-5}M$$

$$\text{solubility} = 6.708 \times 10^{-5}M \times 100.086g/mol = 6.714 \times 10^{-3}g/L$$

Conclusion

This lab demonstrates how to calculate the molar solubility and K_{sp} of calcium hydroxide via titration.