

A Method for Observing Le Chatelier's Principle Using Cobalt(II) Chloride

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1 Abstract

Our goal was to test new experimental procedures that prioritized safety for learning Le Chatelier's principle using cobalt(II) chloride solution. We investigated different solvents, equilibrium shifts and temperature conditions. These new methods had clear quantitative observations as color changes, achieving an experiment that is both safe and effective.

2 Introduction

This principle states that in a reversible reaction at equilibrium, if conditions such as concentration, temperature, or pressure are altered, the equilibrium shifts in a direction that mitigates the effect of those changes.

We focused on how to perform highly reproducible experiments to verify this principle the allow the color change to be clear while using safe and easily handled familiar substances.

3 Theory and Experiment

In our first experiment, we investigated solvents for dissolving cobalt chloride. Referring to multiple previous studies, we conducted experiments using acetone, hydrochloric acid, and ethanol as solvents.

In our second experiment, we investigated the substances a added to change the equilibrium. Third, here are the experimental results for 0.20 mol/L..

Next, here are the experimental results for 0.10 mol/L. Overall, the color became lighter than at 0.20 mol/L, but the color change could still be observed.

Finally, in our last experiment, we carried out a study on how temperature affects the observation of Le Chatelier's principle.

4 Results and Discussion

According to our studies, it is impossible to do an experiment with these substances without there being some environmental impact and safety issues, but we were able to minimize these problems. Particularly, we eliminated poisonous substances by using NaCl and ethanol, which are safe for humans to experiment with, so we succeeded in causing chemical equilibrium without danger. And, our methods could reduce half the amount of heavy metal used by half. Procedure A, the sample solution is placed in water at 30°C. In procedure B, the sample solution is placed in water at 0°C. In procedure C, pure water is added to increase the concentration of H₂O. In procedure D, ethanol is added to decrease the concentration of H₂O. In procedure E, sodium chloride is added to increase the concentration of Cl⁻ ions. In procedure F, silver nitrate is added to decrease the concentration of Cl⁻ ions. When performing the experiment, 0.50 g of solid or 1.0 mL of liquid is added to 2.5 mL of the sample solution.

5 References

1)Aichi Prefectural Comprehensive Education Center, Science Corner, High School Chemistry Experiment to Confirm Le Chatelier's Principle.