EXPERIMENTAL DESIGN ASSIGNMENT

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Section 5

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**Transmittal letter**

Dear Professor Hamade:

It’s an honor for me to write this paper. I hope you can know my train of thought and my concern about this experiment through this letter.

This assignment requires me to design an experiment to measure the concentration of Ca in commercial products and make Ca precipitations. I think it’s very helpful for me to obtain knowledge about chemistry, it also improves my design capability. At first, I want to titrate EDTA to measure the calcium but later I think is not efficient enough because it can’t make Ca precipitate. Therefore, I think Na2CO3 solution can kill two birds with one stone. However, there are too many substances unfamiliar to me in milk and I’m not sure whether my method can wipe off all of them. Through knowledge from Internet, organic substances and alkali metal salt wouldn’t form precipitation when reacting with NaOH or Na2CO3 except for Mg2+. So I decide to add some NaOH solution first to remove Mg2+. I hope my experiment won’t be disturbed by other unknown factors. I paid much effort to perfect the experiment so I hope it’ll be a success.

Anyway, this is the first time I design an experiment by myself and I gain many experience and knowledge through the process of designing. In addition, I think VC211 is a meaningful course because I learned a lot from these experiments. Thank you for your excellent instruction.

sincerely

Pan Chong dan

**Abstract**

In this experiment, I want to study the concentration of Ca in ordinary milk but calcium exists in milk as the form of cations. Therefore, I need to use kinds of solution to make Ca precipitation from the milk. Afterwards, we can calculate the concentration of Ca by weighing out the precipitation.

I set three objectives for this experiment:

1. Learn to design an experiment by myself.
2. Review the usage of pH meter and Metter balance.
3. Learn how to make precipitation from commercial products

**Introduction**

 Milk is very common and healthy drink in our daily life because it contains various beneficial elements such as calcium and sodium. When we’re children, our parents often asked us to drink milk because it has a good effect on improving the growth of our bones. Mike is rich in calcium, which is quite helpful for children’s growth. By controlling the concentration of various substances in milk, researchers can increase the performance cost ratio of milk.

**Background**

Calcium is one of the most common metal elements on the world. In periodic table, calcium is in the fourth period and IIA group. As a result, calcium is an active metallic element which is easy to form precipitations when calcium cation reacts with other anions such as CO32-. It is very useful in our daily life. For example, it can be used to make alloy of high strength. In addition, it always plays a role as reducing agent in redox reaction

Calcium is also an essential element for human being because it is the most abundant [metal](https://en.wikipedia.org/wiki/Metal) by mass in many [animals](https://en.wikipedia.org/wiki/Animal) and an important constituent of [bone](https://en.wikipedia.org/wiki/Bone), [teeth](https://en.wikipedia.org/wiki/Tooth), and [shells](https://en.wikipedia.org/wiki/Exoskeleton).

Sodium Carbonate, also known as washing soda or soda ash, often occurs as a crystalline decahydrate, which readily effloresces to form a white powder, the monohydrate. Na2­CO3 solution is very common in industry raw materials. It is of strong basicity because it will ionize Na+ and CO32- when it dissolves in water. It is CO32- that can react with Ca2+ and form white precipitations

**Theory**

Except calcium cations, milk also contains a large amount of potassium, sodium, phosphorus, magnesium, and other organic substances. To make calcium cations precipitate, we should wipe off disturbance of other substances through other reaction and filtration.

First, we need to use solution which doesn’t react with calcium cations to wipe off other elements. When PH is lower than 12.5, we can use NaOH solution to remove the Mg2+. Afterwards, we can use Na2CO3 solution to precipitate CaCO3 and calculate the concentration of Ca2+ by measure the weight of CaCO3.

Mg2+(aq) + 2NaOH(aq) → Mg(OH)2(s) + 2Na+(aq)

Ca2+(aq) + Na2CO3(aq) → CaCO3(s) + 2Na+(aq)

**Experimental Setup**

|  |  |
| --- | --- |
| Chemicals Used | Materials Used |
| 0.5M NaOH solution  0.5M Na2CO3 solution  Milk  Calibration stock buffer of pH = 4.003 | pH Meter  Beakers & Graduation cylinders  Weighing paper & Desiccator  Metter balance  Funnel & glass rod |

**Procedure**

**PART A: Use the calibration stock buffer to calibrate the pH meter like experiment 2.**

1. Using a clean beaker (50-mL) pour enough volume of the calibration stock buffer to be able later to completely immerse the head of the pH meter electrode.

2. Turn on the pH meter, rinse electrode thoroughly with deionized water and carefully wipe the tip with clean dry tissue.

3. Insert the electrode tip thoroughly into the 50-mL beaker buffer. Push the calibration button and wait (about 15 seconds) until the pH reaches 4.00.

4. Remove the electrode, rinse with deionized water, and wipe with clean dry tissue.

5. Immediately stow away the electrode in its storage buffer bottle. Now the meter is ready to measure pH of all the samples for the entire experiment.

**PART B: Use the NaOH solution and pH meter to remove the Mg2+**

1. Pour 50 mL milk into a beaker.
2. Use a calibrated pH meter to measure the pH of the solution. The pH should be around 6.5.
3. Keeping adding NaOH solution to the beaker until the pH is close to 12.5.
4. NaOH should react with the Mg2+ and form white precipitation.
5. Separate the reaction mixture by filtration.

**PART C: Use the Na2CO3 solution to precipitate Ca2+ and measure its weight**

1. Pour the solution after filtration into another beaker.
2. Keeping adding Na2CO3 solution to the beaker until it doesn’t precipitate white solid.
3. Separate the reaction mixture by filtration.
4. Use the Mettler balance to weigh out the mass of the solid
5. Repeat the three parts for 3 times and record the weight of the solid as m1, m2 and m3 (mg).
6. Use the data recorded to calculate the Ca concentration in milk.

**Pre-Lab**

1. Determine the mass percent of Ca in CaCO3.

M% = [40/(40+12+16\*3)]\*100%=40%

1. Suppose we already know m­1, determine the calcium content.

PPM = (0.4\*m1/50)\*20 = 0.16\*m1 (mg/L)

1. According to nutrition board of milk on the Internet, there is 104 mg calcium in 100g milk and milk’s density is 1.03 g/ml, calculate the ppm of calcium.

PPM = 104/(100/1.03)\*1000=1071.2 (mg/L)

**Data Analysis & Post-Lab**

To get a more accurate result, we should record the data of three experiments so the final result of the concentration of calcium in milk should be ( m1+m2+m3) \*0.16 /3 (mg/L). The expected result should be about 1000 mg/L according my calculation in pre-lab. However, there are other elements of small amount in the milk, which may cause the following error in my experiment:

1. The organic substances may react with Na2CO3 solution and produce some precipitations.
2. When pH is smaller than 12.5, there is a high possibility that a slight amount of Ca2+ has already react with the NaOH solution, which may reduce the output of CaCO3.

**Conclusion**

This experimental report includes background and introduction about my study target. It also contains the experimental procedure, analysis and some pre-lab calculations.

In the assignment, I’m required to design my own experiment to determine the concentration of calcium in common commercial products. I think this assignment is pretty cool because it’s the first time I design an experiment. It is very helpful to improve my design ability. I choose milk to examine because milk is quite common in our daily life and we can know more about the nutrition contained in milk through the experiment. The experiment also involves the usage of other common solution so it helps me get a rough idea about its properties.

In addition, I choose to use pH meter and Mettler balance in part of the procedure of the experiment because I have just learned how to use these equipment in this term. I think this experiment help me review the usage of these equipment and deepen my understanding of these equipment

**References**

Prof. T. Hamade,” 8E1 CHEM OF KITCH ACID BASE”, UM-SJTU JI & SJTU Chemistry Department

Prof. T. Hamade,” The Properties of Buffers: Resisting Change in a Turbulent Word”, UM-SJTU JI & SJTU Chemistry Department

Calcium. <https://en.wikipedia.org/wiki/Calcium>

Sodium Carbonate. https://en.wikipedia.org/wiki/Sodium\_carbonate