
Lab Report On Chemical Testing Of Water Sample For Contaminants

Introduction

Chemical testing, whether qualitative or quantitative is done by running several chemical tests or reactions to establish the identity of a chemical through properties unique to that chemical. In the real world this type of testing could be used for many different reasons. Knowing which chemical one is working with is always very important, necessary, and safe. For example, in a crime scene investigators and forensic scientists may use chemical testing to figure out what substances are present at the scene and even figure out who committed the crime as well. To study chemical properties and figure those out reactions are done with other substances to see what the unknown would react with and then a hypothesis could be made on what it possibly could be.

Based off that hypothesis the substance is further tested to determine if it was accurate or not. After completing the first part of the experiment with the objective to test the substance for basic properties to be able to rule out some possibilities and narrow it down, it was believed that unknown A could be Ammonium Sulfate. In the first part of the experiment PH, flame, solubility, and a conductivity test was performed. In the second part of the experiment the objective that was focused on was completing a volumetric analysis through titration to determine what the substance actually was.

Methods

Part 1 of the experiment consisted of four different tests that were carried. The first test that was done was the conductivity test. The substance was given in solid form so a solution with water was made with the unknown substance. The solution was a 5% concentration made with 0.1 g of the unknown and 19.9 g of water. After the solution was made inside a beaker the conductivity meter was taken with the cap still on and put into the solution making sure the meter is submerged all the way into the solution covering both of the marks on the instrument. From the conductivity test it was found that the average conductivity of the substance was 11.05 S/m. The second test that was done was a PH test using the same solution that was made for the conductivity test. Three PH strips were taken and using a pipette drops of the solution was put onto the strips. The color of the strips compared to the graph of the PH and the colors associated with each PH value suggested that the PH of the substance was 7 or neutral. Another PH test was done with the actual PH instrument being submerged into the solution to determine the value also suggested a PH of 7. For the solubility test the substance was tested in water, ethanol, and acetone. There were three trials done for each solvent that was being tested. A little amount of the solvents was poured into beakers and some of the substance in its solid form was added in and the beaker was swirled for a couple of seconds and either the substance dissolved or didn't. The tests resulted in the substance being soluble in water only and insoluble in both ethanol and acetone.

The last test that was done for part 1 of the experiment was the flame test. The wire loop was

dipped into the solid form of the substance to get some of it on the wire and then it was burned in the flame with three trials. The substance smoked a little bit and gave off a pale yellow color. These observations ruled out a couple of the substances off the list and pointed towards the direction of Ammonium Sulfate suggesting a Titration may be needed to be done.

Part 2 of the experiment consists of a titration done for the unknown substance. Since it was hypothesized that the substance was Ammonium Sulfate which is acidic, the titration was done with Sodium Hydroxide with the indicator Phenolphthalein. A 0.1 M solution of the unknown substance was made using 1.32 g of Ammonium Sulfate and 100 mL of water and 4 drops of the indicator. This solution was split into 3 flasks to ensure three trials could be done with it. The base was made using 3.3 mL of NaOH diluted up to 100 mL mark on the volumetric flask. A burette was taken and clamped to the stand and rinsed with the NaOH solution and then afterwards was filled up with the NaOH up to its mark. The burette was turned to allow the titrant solution to pour out slowly and the flask was swirled as it poured into it until the solution reached a faint pink color and stayed that way. The volume was recorded and the same thing was repeated two more times. The endpoint was reached on average with 31 mL of NaOH solution.

Safety

Laboratory coat, splash proof goggles, and gloves were worn the whole time while in the laboratory. Solutions or samples were not poured down the drain but were instead put in appropriate waste bins. Small amounts of reactants were used. There were many safety precautions to keep in mind for all of the chemicals present for the experiment. Calcium chloride: causes serious eye irritation, if in eyes it should be rinsed cautiously with water for several minutes. It may form combustible dust concentrations in air during processing so avoid the spreading of its dust in air and store in a cool location with ventilation provided. Use under a fume hood with proper PPE and gloves and glasses with face shields on (Fisher Scientific).

Sodium nitrate: is an oxidizer and may intensify fire. It also causes serious eye irritation, if in eyes, rinse well with water. Minimize dust generation and avoid the spread of dust in the air. Store it in a cool location and avoid storing on wood floors. Gloves and safety glasses with side shields must be worn at all times (Fisher Scientific).

Ammonium sulfate: is harmful if swallowed and causes skin and serious eye irritation and may also cause respiratory irritation. Wear proper PPE when handling and if swallowed, on skin, or inhaled, call poison control center. If in eyes rinse well with water for a couple of minutes. Store in a cool location (Fisher Scientific).

Ammonium chloride: is harmful if swallowed and causes serious eye irritation. Wear PPE when handling. If in eyes rinse for several minutes and if swallowed call poison control center, rinse mouth and collect spillage. Wash hands after done handling. Ensure dust does not collect on surfaces and store in a cool location (Fisher Scientific).

Magnesium sulfate: not classified for physical or health hazards. May form combustible dust concentrations in air when handling so use only in well ventilated areas. Avoid contact with eyes, skin, and clothing. PPE of gloves and goggles with face shields must be worn. Store in a cool, dry location.

Calcium nitrate: is an oxidizer, may intensify fire. May cause damage to organs through long or repeated exposure. Keep away from heat/sparks/open flames. Do not mix with combustibles, wear protective gloves, clothing, and eye and face gear. If exposed or feeling unwell call poison control center. Minimize dust collection, avoid storage on wood floors, and store in a cool place (Fisher Scientific).

Sodium acetate: not classified for physical or health hazards. Avoid the spread of dust in the air. Use only in well ventilated areas. Avoid contact with eyes, skin, and clothing. Wear PPE when handling and work with under fume hood. Store in a cool location (Fisher Scientific).

Sodium carbonate: causes serious eye irritation. Wear PPE and wash hands after handling. If in eyes rinse cautiously for several minutes. Use in well ventilated areas. Avoid generation of dust particles. Store in a cool location.

Sodium oxalate: harmful if swallowed, in contact with skin, and if in eyes causes serious eye irritation. Wash face, hands, and any exposed skin. If on skin wash with water and soap and call poison control center if swallowed. Ensure ventilation and avoid dust formation.

Sodium chloride: may be harmful if swallowed or inhaled. Store in a cool and dry place with container tightly closed. Wear protective gloves, clothing, and eye protection. Wash hands after handling.

Hydrochloric acid: may be corrosive to metals. Causes serious skin burns and eye damage, may cause respiratory irritation. Wear protective gloves, clothing, and eye and face protection. If swallowed, rinse mouth but do not induce vomiting. If on skin take off all contaminated items and rinse with shower. If inhaled take victim outside to get fresh air. If in eyes rinse cautiously. Never use hot water and never add water to acid. Store in a cool location.

Sodium hydroxide: may be corrosive to metals. Causes severe skin burns and eye damage. Wear protective gloves, clothing, and eye and face protection. If on skin remove contaminated items and go in shower. If in eyes rinse with water. If inhaled take victim outside for fresh air. Do not mix with acids. Use only in well ventilated areas. Store in cool, dry conditions with sealed containers.

Ethanol: highly flammable liquid and vapor. Causes serious eye irritation. Causes damage to organs through long or repeated exposure. If on skin remove contaminated clothing and shower. If exposed call poison control center. If in eyes rinse for several minutes. In case of fire use CO₂, dry chemical, or foam extinguisher. Ensure well ventilation and store in a cool and dry place.

Acetone: highly flammable liquid and vapor. Causes serious eye irritation, may cause drowsiness or dizziness. Causes damage to organs through long or repeated exposure. If on skin remove contaminated clothing and shower. If exposed call poison control center. If in eyes rinse for several minutes. In case of fire use CO₂, dry chemical, or foam extinguisher. Ensure adequate ventilation and store in a cool and dry place.

Barium chloride: toxic if swallowed, harmful if inhaled. Wash face, hands, and exposed skin when handling. Use in well ventilated areas. If inhaled take victim outside for fresh air. If ingested call poison control center and rinse mouth. Use only under a chemical fume hood.

Silver nitrate: causes skin irritation, and severe skin burns and eye damage. If in eyes rinse cautiously for several minutes. If inhaled take victim outside for fresh air. If ingested call poison control center and rinse mouth. Use only under a chemical fume hood.

Discussion

The four tests that were done during part 1 of the experiment were conductivity, PH, solubility, and flame tests. These tests were the ones chosen to be conducted because they can be done using small amounts of the substance and are easily carried out without losing any quality or importance. These tests were also easier to do since the lab techniques prior to the lab project were based on the above tests. These tests gave classifying properties that allowed to sort out which possibilities the unknown could possibly be. The Average conductivity was recorded to be 11.05 S/m so by looking up the conductivities of the list of known substances that was provided some were able to be eliminated as a possibility. The average PH of the substance was measured to be 7 or relatively on the acidic side as a weak acid. This allows for the elimination of strong acids and strong bases that could not possibly be the unknown substance. The flame color that was burned from the unknown A which was a pale yellow. When the flame colors were researched for the list of remaining substances not yet eliminated it was found that Ammonium compounds burn with a yellow flame. Lastly, the solubilities for the unknown which only dissolved in the water and not in ethanol and acetone. These observations led to the assumption that the unknown compound could be ammonium sulfate.

In part 1 of the experiment it was claimed that the unknown A could be ammonium sulfate which is more acidic than it is basic. This led to the decision of conducting an acid-base titration with a strong base like sodium hydroxide. Since the endpoint of the titration will be a base the indicator that was chosen to be used was Phenolphthalein. The number of indicator drops that were used were 4. The average volume of the base that was used in order to complete the titration process which was 31 mL of NaOH. The concentration of the base was further calculated from the volumes recorded. The titration was the right experiment to do for the second part of the experiment and there was a faint pink color achieved all 3 trials so it was successfully conducted.

Sources of Error/ Changes to the Experiment

If there were any sources of error to the experiment and the results it could have possibly been from inaccurate measurements of the mass of the unknown substances needed when making the solutions or when measuring out the volume that was needed for the solution or during the titration process. While transferring the liquid from one glassware to another there might have also been some amount lost and added to the error of the experiment. Rounding in the calculations before the end could have also affected the outcome of the results a little.

Another error that was a part of the experiment was that the PH value of the unknown substance kept coming out to be exactly 7. Unknown A was supposed to have a slightly acidic PH so the value should have been around 5 or 6 even though what was measured was 7. Any changes that might be added to the experiment if it were to be conducted again would be to have only one person do the measurements to ensure consistency and pay more attention to make sure it is as accurate as can be.

Conclusion

The objective of the experiment in both parts was to determine inorganic contaminants present in the water samples and this was done by first conducting four tests to gather observations on the properties and characteristics of the unknown substance and then from those data to make a hypothesis on what the unknown given to the group could be. The data collected was carefully observed, the PH was not matching up to what the PH of the unknown was supposed to be theoretically. Still, the hypothesis for unknown A was that it could be ammonium sulfate from the observations collected. This hypothesis had to be tested in the second part based off properties of ammonium sulfate to figure out the amounts needed for the titration in the second part of the lab. The titration was successfully completed giving support that the unknown could be ammonium sulfate and the hypothesis could not be rejected.

Research Connection

Soil sampling is a very important chemical analysis done to test what contaminants are in the soil. The importance of these tests are for environmental reasons, as with the increase in number of factories the byproducts could be run off into the soils. External contaminants can enter soil through wet or dry means. Examples of contaminants include radionuclides, trace elements, or organic compounds. These all show different characteristics with regard to each soil type according to the absorption properties, texture, density, humidity, and other factors. Due to the variety it is very hard to carry out these chemical analysis tests on these soils. There have been many methods that became improved on to further the accuracy of the soil sample testing that was being conducted. Newest additions include the use of a portable gas chromatographs that allow for the preparation of a good sample from the soil for testing. For a sample to be good the sample must be representative of the soil that it is taken from. The sample achieved must have all possible contaminants and elements for an accurate test.

Data Quality Objectives have been outlined in a way to guide the process of collecting the sample, testing it, and obtaining the results to ensure it is within the scope of error that is permissible and meets all the criteria provided. The importance of such a test is to make sure that the environment is safe; since the amount of pollution is steadily increasing these kind of tests are needed even more. Soil is used for many purposes and is all around everyday life and humans. The food that grows is from those soils and if there are potential contaminants in the soil that will pose a threat to human health it is important to test this out. If contaminants could be found through chemical analysis tests, then there could be plans of action to be taken to fix the issue. The objective of the lab done was to test for contaminants in water sample which ties in very well to the test of contaminants in soil samples. Usually the contaminants from water samples runs off into the soil and thus contaminants the soil as well. There is a connection between these two tests not only in its fundamentals as similar tests of chemical analysis is carried out but the results could be very similar also.