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Chemistry Lab Report

Salt Analysis:

One method for identifying the presence of cations and anion in an unknown salt is salt analysis.

The identity of ions is ascertained using a type of qualitative examination.

Experiment Title: Classification of Radicals:

The two components that make up salts are known as radicals.

The negatively charged ion is known as an acidic radical (anion). eg Cl-, NO3-

Basic Radical(cation): The positive charged ion. such as Na^+ and Cu^{2+}

Chemical Equation:

$$NaCl + H2O \rightarrow Na^+ + Cl^-$$

Basic Radicals:

There are six categories for the fundamental radicals. Group I, Group II, Group III, Group IV, Group V, and Group VI, for example.

Acidic Radicals:

Acidic radicals fall into three categories.

- Concentrated acidic groups,
- diluted acidic groups
- special groups

Methodology:

NaCl is a member of Group VI since it dissolves in water.

Basic Radical (Cation) Test

Since Na^+ does not precipitate with any of the group reagents, Group I through V tests are omitted.

Na^+ Flame Test:

Method: After dipping a clean platinum wire in NaCl solution, it is placed in the flame.

The flame turns a golden yellow, as observed.

Acid Radical (Anion) Test

Cl^- Silver Nitrate Test:

Method: $AgNO_3$ is added to aqueous NaCl.

A white, curdy precipitate is seen to form.

The Outcome:

The salt contains sodium since it dissolves in water, and the flame text's golden yellow color indicates that sodium is present.

The presence of Cl is confirmed by the silver nitrate text.

Thus, NaCl is the provided salt.

Experiment No# 2

Title: Filter Ash Test

Cobalt nitrate and salt are combined, then ignited. Cobalt interacts with the metal oxide in the salt residue (filter ash) when heated to high temperatures, creating distinctive colored compounds:

1. For Aluminium (Al^{3+}):

   $Al_2O_3 + Co(NO_3)_2 \rightarrow^{heat} Co(AlO_2)_2$

   (Deep blue mass is formed)

2. For Magnesium (Mg^{2+}):

   $MgO+Co(NO_3)_2 \rightarrow^{heat} CoMgO2$

   (Pink ash is formed)

Methodology:

Dip a strip of filter paper into a solution of a small amount of magnesium salt (such as magnesium nitrate) or aluminum salt (such as aluminum nitrate). After drying, immerse the filter paper in a solution of cobalt nitrate. Using tongs, burn the prepared filter paper over a clean flame.

Examine the color of the ash that results from full combustion.

The Outcome:

The Filter Ash Test uses cobalt nitrate to produce a deep blue ash, which indicates the presence of the aluminum ion (Al^{3+}).

Cobalt nitrate is used to create pink ash, which contains magnesium ions (Mg^{2+}).

This test is very helpful for identifying metals that ignite to generate stable oxides.

Experiment # 3

Title: Borax Bead Test

Chemical Principle / Reactions:

The Borax Bead Test uses the distinctive color of beads that are created when borax is fused on a wire loop and reacts with a salt to identify certain metal ions. The transparent glass-like bead that is formed when borax is heated can react with metal oxides to produce colored metaborates.

Key reaction:

$$\mathbf{Na_2B_4O_7 \cdot 10H_2O \xrightarrow{heat} NaBO_2 + B_2O_3}$$

Metal Salt + B2O3 → Colored Metal Borate Bead

Methodology:

Make a little loop at one end of a platinum or nichrome wire. To that, add borax powder. To clean the wire, heat it with a Bunsen flame until it is red hot. After dipping the heated loop into borax

powder, reheat it until a transparent glass bead develops. Touch the bead to the salt (sample) to be examined after letting it cool a little.

Check the color of the beads after reheating the loop with the salt in the flame:

One hue is produced by an oxidizing flame (blue flame).

Yellow flame reduction could result in another.

The Outcome (Bead Colors):

Iron is indicated by yellow, while chromium is indicated by green.

The presence of copper is shown by the Green (hot)/Blue (cool) ratio.

Volumetric Analysis:

A form of quantitative chemical analysis called volumetric analysis uses a reaction between an unknown solution and a solution with a known concentration to ascertain the concentration of the unknown solution.

Titration:

The experimental method utilized in volumetric analysis is titration. It includes:

adding a titrant—a solution with a known concentration—from a burette

to an analyte solution in a flask with an unknown concentration

till the reaction is finished, which is typically signaled by a change in color (caused by an indicator).

Titrate:

Titrating is adding the titrant to the analyte gradually while mixing it until the chemical reaction is finished. Drop by drop, this procedure is carried out under observation, particularly to precisely identify the finish point.

Standard Solution:

A solution with a precise and known concentration is called a standard solution. It reacts with the unknown solution in titrations. Typically, standard solutions are made by standardizing another solution or by employing primary standard ingredients, which are extremely stable, pure, and easy to weigh.

For instance, 0.1 M HCl or 0.1 M NaOH are typical standard solutions.

Equivalence Point

The hypothesized point during titration at which the moles of analyte and titrant are equal is known as the equivalency point. This indicates that the chemical process is finished.

It is not always visible to the naked eye and is computed using stoichiometry.

End Point

The exact titration point at which the indicator changes color and indicates that the titration should stop is known as the end point.

Although they are not the same, the end point should ideally be fairly near the equivalency point.

Experiment: Acid-Base Titration

By titrating a sodium hydroxide (NaOH) solution against a hydrochloric acid (HCl) solution with a known molarity, we can ascertain the unknown concentration (molarity) of the NaOH solution.

HCl is the titrant.

NaOH is titrate.

Chemical Reaction

$$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H2O$$

Methodology

Pour the usual 0.1 M HCl solution into the burette. Transfer 10 mL of the NaOH solution into a conical flask using a pipette. Fill the flask with two to three drops of phenolphthalein indicator. While continuously whirling the conical flask, gradually add HCl from the burette to titrate it. When the pink hue simply vanishes, signifying neutralization, the end point has been reached.

Record the volume of HCl used.

Calculation:

Using the formula:

$M_1V_1 = M_2V_2$

Where:

- M_1=0.1 M
- V_1=8 mL
- V_2=10.0 mL
- M_2=?

$0.1 \times 8 = M_2 \times 10$

$0.8 = 10 \times M_2$

$M_2 = 0.08$

The Outcome:

The molarity of the NaOH solution is **0.08 M**

EXPERIMENT: Gravimetric Estimation of Barium as Barium Chromate ($BaCrO_4$)

By precipitating a solution as barium chromate ($BaCrO_4$) and weighing the dry precipitate, this experiment determines the amount of barium ion (Ba^{2+}) in the solution.

CHEMICAL EQUATION:

$BaCl_2$ (aq) + K_2CrO_4 (aq) → $BaCrO_4$ (s, yellow ppt) + 2KCl (aq)

Methodology:

• To prevent contamination, a sterile beaker was utilized.

• A measured 25 mL solution of barium chloride ($BaCl_2$) was added to the beaker.

• To acidify the solution and reduce interference from other ions, 1-2 milliliters of diluted hydrochloric acid (HCl) were added.

• To promote precipitation, the $BaCl_2$ solution was gradually heated to 60–70°C.

• Separately, a heated potassium chromate (K_2CrO_4) solution was made.

• With constant stirring, the heated $BaCl_2$ solution was gradually supplemented with the K_2CrO_4 solution dropwise.

• Immediately after, a vivid yellow precipitate of barium chromate ($BaCrO_4$) formed.

• To ensure full precipitation, the mixture was left undisturbed for sixty minutes.

• Filtration was done using a pre-weighed filter paper (mass recorded).

• To get rid of contaminants, the precipitate was repeatedly cleaned with hot distilled water.

• The $BaCrO_4$-containing filter paper was thoroughly dried.

• Following drying, the ultimate mass was measured.

CALCULATIONS:

• Filter paper + $BaCrO_4$ (W_2): 2.0 g; • $BaCrO_4$ obtained ($W_2 – W_1$): 0.5 g; • Dry filter paper mass (W_1): 1.5 g

Molar Masses:

253.37 g/mol for $BaCrO_4$ and 137.33 g/mol for Ba^{2+}

How to Calculate Stoichiometry:

The mass of Ba^{2+} in 0.5 g $BaCrO_4$ = (137.33 / 253.37) × 0.5 = 0.271 g since 1 mole of $BaCrO_4$ (253.37 g) includes 1 mole of Ba^{2+} (137.33 g).

The OutCoome:

- Excess chromate and chloride ions were removed by thorough washing, and the production of $BaCrO_4$ was confirmed by a noticeable yellow precipitate.
- The sample's estimated mass of barium ions was 0.271 g.

CONCLUSION:

To ascertain the concentration of barium ions through precipitation as barium chromate, this experiment effectively used gravimetric analysis. The findings validated the accuracy of the gravimetric approach by confirming that there was 0.271 g of Ba2+ in the provided solution.