

Fertiliser Sulfate Content

Aim: To calculate the percentage of sulfate in a fertiliser product.

Equipment:

- 0.01 Mol L⁻¹ Barium Chloride
- Buchner filtering apparatus
- Fertiliser
- Mortar & Pestle
- 0.1 mol L⁻¹ Hydrochloric acid
- Matches
- Clean beakers
- Ice
- Ethanol
- Bunsen Burner
- Distilled Water
- Digital Balance
- Burette
- Auto-clave
- 5ml pipette
- Filter paper
- Filter pump
- Buchner flask

Method:

1. Approximately one gram of fertiliser was ground into a fine powder using a mortar and pestle.
2. This was weighed before being dissolved in about 250ml of 0.1 mol L⁻¹ HCl. Stirred to dissolve as much solid as possible.
3. Insoluble material was filtered off.
4. The solution was heated to near boiling, then barium chloride was slowly added from a burette with continuous stirring. Excess barium chloride was added.
5. The mixture was digested for about 30 minutes with intermittent stirring, then allowed to cool to room temperature. The precipitate was allowed to settle to the bottom.
6. The beaker and contents were then cooled in ice water.
7. A dry piece of filter paper was weighed and put in the Buchner filtering apparatus.
8. The solution was poured through the Buchner filtering apparatus. The solution was washed through first with distilled water, then with ethanol.
9. The filter paper was allowed to dry in an oven overnight and its mass recorded.
10. The percentage of sulfate could then be calculated.

Results:

Mass of fertiliser: 1.08 g
Mass of dried filter paper: 0.68 g
Mass at end: 0.88 g

Calculations:

$$\text{Mass of precipitate} = 0.88 - 0.68 = 0.20 \text{ grams}$$

$$\text{Mass of sulfate in BaSO}_4 = \frac{\text{Molar Mass of Sulfate}}{\text{Molar Mass of BaSO}_4} \times 0.20$$

$$\text{Mass of sulfate in BaSO}_4 = \frac{32.1 + 4 \times 16.0}{137.3 + 32.1 + 4 \times 16.0} \times 0.20$$

$$\text{Mass of sulfate in BaSO}_4 = 0.08234 \text{ g}$$

$$\text{Percentage of Sulfate in Fertiliser} = \frac{0.08234}{1.08} \times 100$$

$$\text{Percentage of Sulfate in Fertiliser} = 7.62\%$$

Conclusion: The percentage of sulfate in the fertiliser is 7.62%.

Evaluation: As the experimentally calculated percentage of 7.62% is well below the printed 17% on the side of the packaging, experimental errors have occurred at some stage throughout the experiment. The experimentally calculated value has an error percentage of 123% and there are a number of possible reasons for this.

- A loss of barium due to its small but possibly significant solubility
- If the precipitate formed was extremely small, it could have passed through the filter paper.
- Some of the precipitate becoming stuck on the walls of the beaker while transferring the mixture.
- Loss of some precipitate through spillage
- Loss of some precipitate by dissolution while washing it if the volume of wash water is too great.