
Standard Procedure SP 0006-1:2005

Chemical tests for identifying cations and anions in minerals – Part 1: Tests for anions

1 Scope

This Standard Procedure uses simple chemical tests to detect and distinguish between carbonate, chloride and sulfate ions. It may be used for minerals and ores containing one or more of these ions, and/or oxide or hydroxide ions. Other anions may interfere, giving misleading results.

2 Definitions

mineral

a naturally occurring solid, consisting mainly of one chemical with a fixed composition

ore

a mineral from which a metal is extracted on a commercial basis

anion

a non-metal atom, or group of atoms, carrying a negative charge

precipitate

a solid product formed when two solutions are mixed, making the mixture cloudy or opaque

3 Principle

The mineral is reacted with chemical reagents that give characteristic reactions with each of the three anions. Each test shows whether or not the mineral contains that particular anion.

4 Apparatus & Reagents

- pestle and mortar (unless the sample is already powdered)
- rack of 3 test tubes and 1 boiling tube
- sample tube or small bottle
- spatula
- 4 droppers (unless reagent bottles have built-in droppers)
- eye protection
- dilute nitric acid (approx 1 mol dm^{-3}) Caution: corrosive
- concentrated nitric acid Caution: highly corrosive
- limewater
- silver nitrate solution (approx 0.1 mol dm^{-3}) Caution: stains clothes and skin black
- ammonia solution (approx 1 mol dm^{-3})
- barium chloride solution (approx 0.1 mol dm^{-3}) Caution: harmful

5 Test Specimens

The mineral or ore should be ground to a fine powder with a pestle and mortar.

Note: Some minerals are too hard to crush in this way, so may be supplied to you already powdered.

The powdered specimen will also be needed for Parts 2 and 3.

6 Procedure

- To a spatula measure of powdered sample in a boiling tube add 3 drops of dilute nitric acid. Bubbles of gas evolved indicate carbonate ions. Test the gas with limewater. A positive test for carbon dioxide confirms that the sample contains carbonate ions CO_3^{2-} .
- Whether gas was evolved or not, add further drops of dilute nitric acid to dissolve the sample completely. Warm if necessary. **CARE!** (If the sample fails to dissolve, try concentrated nitric acid. **CARE!**)
- If gas was evolved in step 1, boil the solution for 1 minute to remove dissolved carbon dioxide. **CARE:** do not let it boil over or spurt out.
- Dilute the dissolved sample to about 10 cm using distilled water. Store this solution in a labelled sample bottle. It will also be needed for the cation tests in part 3.
- To 1 cm^3 of sample solution add 1 drop of silver nitrate solution. A white precipitate indicates that the sample contains chloride ions Cl^- .
- To another 1 cm^3 of sample solution add 1 drop of barium chloride solution. A white precipitate indicates that the sample contains sulfate ions SO_4^{2-} .

7 Expression of Results

Present your findings in a way that shows clearly what tests you performed, what you observed, and what these observations told you about the sample.

8 Test Report

Your test report should include:

- (a) reference to this Standard Procedure;

(b) the identity of the sample (for example, Sample A);

(c) which anion(s) you found in the sample.