

# Qualitative Analysis Lab - Fertilizer Components

**Purpose:** In this laboratory activity, you will be testing a fertilizer solution and determining the ions present in the fertilizer. The ions you will be testing for are nitrate ( $\text{NO}_3^-$ ), phosphate ( $\text{PO}_4^{3-}$ ), sulfate ( $\text{SO}_4^{2-}$ ), ammonium ( $\text{NH}_4^+$ ), iron (III) ( $\text{Fe}^{3+}$ ) and calcium ( $\text{Ca}^{2+}$ ).

## Part 1: Anion (Negative Ion) Tests

### Procedure:

1) Read the complete procedure and prepare a suitable data table to record your observations.

**$\text{BaCl}_2$  Tests:** Several of the ions you are testing in this activity can be identified by their reaction with barium chloride ( $\text{Ba}^{2+}$ ) and their behavior in the presence of an acid.

2) Place six drops of each anion reference solution (nitrate ( $\text{NO}_3^-$ ), phosphate ( $\text{PO}_4^{3-}$ ), and sulfate ( $\text{SO}_4^{2-}$ ) reference solutions) in its own test tube. Place the test tubes in a test tube rack.

3) Test each sample solution individually by adding 4 drops of 0.1 M barium chloride solution. Swirl to mix. Record your observations.

4) Carefully add 6 drops of 6 M hydrochloric acid to each of the test tubes containing the  $\text{BaCl}_2$  solution. Record your observations.

5) Repeat steps 2–4 for your unknown fertilizer solution. Record your observations.

6) Dispose of all solutions as instructed by your teacher.

**Brown-Ring Test:** In the presence of nitrate ions, mixing iron (II) ions ( $\text{Fe}^{2+}$ ) and sulfuric acid produces a distinctive result. This "brown-ring test" can be used to detect nitrate ions in solution.

7) Place 16 drops of the nitrate reference solution in a clean test tube. Place 16 drops of your unknown solution in a second clean test tube.

8) Add about 2 ml of iron(II) sulfate reagent to both test tubes. Swirl to mix.

9) Have your teacher carefully pour about 2 ml of concentrated sulfuric acid along the inside of each test tube. The acid will sink to the bottom, making two layers of liquid.

10) Allow the test tubes to stand- WITHOUT mixing- for 1 to 2 minutes. Any solution containing the nitrate ion will form a brown ring at the place where the two layers of liquid meet. Record your observations.

11) Dispose of all solutions as instructed by your teacher.

## Part 2: Cation Tests

**$\text{NaOH}$  and Litmus Test:** The ammonium ion ( $\text{NH}_4^+$ ) can be identified through their characteristic behavior in the presence of a strong base.

12) Add 8 drops of the ammonium ion reference solution to a clean test tube. Add 8 drops of your unknown solution to a second clean test tube.

13) Wet two pieces of red litmus paper with distilled water and set aside.

14) Add 10 drops of 3 M  $\text{NaOH}$  directly to the solution in each test tube. DO NOT allow any of the  $\text{NaOH}$  to come in contact with the test tube lip or inner wall. Immediately stick the litmus paper onto the upper inside wall of the test tube. The strip must not come in contact with the solution.

15) Record your observations, and then dispose of all solutions as instructed by your teacher.

**Oxalate Test:** Many metal ions can be identified by their color reaction with the oxalate ion. In this case, we will be using the oxalate ion to identify the calcium ion.

16) Place 6 drops of the calcium reference solution into a test tube. Place 6 drops of the unknown solution in another test tube.

17) Add 2 drops of 0.1 M  $(\text{NH}_4)_2\text{C}_2\text{O}_4$  solution to each test tube. Record your observations

18) Dispose of all solutions as instructed by your teacher.

19) Wash your hands before removing goggles and leaving the laboratory.

**KSCN Test:** When potassium thiocyanate (KSCN) is added to an aqueous solution containing iron (III) ions, a deep red color appears due to the formation of a complex  $\text{FeSCN}^{+2}$  cation. Appearance of this color confirms the presence of iron (III) ions in the solution.

20) Place 6 drops of the iron(III) reference solution into a test tube. Place 6 drops of the unknown solution in another test tube.

21) Add 2 drops of 0.1 M KSCN solution to each test tube. Record your observations

22) Dispose of all solutions as instructed by your teacher.

23) Wash your hands before removing goggles and leaving the laboratory.

#### **Data Table/List:**

#### **Questions:**

1) Describe how you can verify whether the fertilizer you researched had phosphate ions in it.

2) Explain how the information in this lab helps you identify what ions are present. What are the purposes of the reference ions? How can they help you identify the presence of ions in an unknown solution?

3) Each of these tests are called confirming tests. What is a confirming test?

4) Does this lab help you to determine how much of the ion is in the unknown solution? Why or why not?

#### **Conclusion:**

Unknown Sample # \_\_\_\_\_ contains the following ions: \_\_\_\_\_