Practical Work n°2 :

Soil pH and Ion Identification

1. Introduction

Soil pH is an important chemical property that characterizes the acidity or alkalinity of a soil. It is related to the concentration of hydrogen ions (H^+) in the soil solution.

The pH scale ranges from 0 to 14. A pH of 7 indicates a neutral soil, values below 7 indicate acidic conditions, and values above 7 indicate alkaline conditions.

Soils can be classified according to their pH as follows :

- < 3.8 : Extremely acidic
- 3.8–4.5 : Very acidic
- 4.5–5.0 : Acidic
- 5.0–6.5 : Slightly acidic
- 6.5–7.5 : Neutral
- 7.5–8.7 : Alkaline
- ≥ 8.7 : Highly alkaline

The ionic composition of soil can vary depending on the type and origin of the soil. The identification of specific ions can therefore provide useful information about the chemical composition of a soil sample.

2. Objective

Determination of soil pH and identification of selected ions in a soil extract.

3. Principle

Soil pH is determined by measuring the pH of a soil-water suspension using a calibrated pH meter.

For the identification of ions, specific chemical reactions are used. A suitable reagent is added to the soil extract, and the presence of a particular ion is determined from a characteristic observation, such as the formation of a precipitate, a colour change, or gas evolution.

The presence or absence of each ion is recorded according to the result of the corresponding identification test.

4. Materials and reagents

-Precision balance

-Beakers

-Magnetic stirrer

-Magnetic stir bars

-Funnel

-Filter paper

-pH meter

-Test tubes

-Pasteur pipettes or droppers

-Soil sample

-Distilled water

-pH 4 and pH 7 buffer solutions

-Barium chloride ($BaCl_2$)

-Hydrochloric acid (HCl)

-Silver nitrate ($AgNO_3$)

-Sodium hydroxide (NaOH)

5. Experimental Protocol

A. Determination of Soil pH

-Weigh 20 g of soil.

-Transfer the soil into a clean beaker.

-Add 100 mL of distilled water.

-Stir the suspension for 15-20 minutes using a magnetic stirrer.

-Filter the soil suspension and collect the filtrate.

-Calibrate the pH meter using pH 7 and pH 4 buffer solutions.

-Rinse the electrode with distilled water.

-Immerse the electrode in the soil extract.

-Record the pH value.

B. Identification of Soil Ions

To identify the presence of ions in a solution, tests involving a chemical reaction are performed. For this purpose, a small amount of the appropriate reagent is added to the test tube containing the solution to be tested, and the resulting reaction is observed.

Summary table of characteristic tests for ion identification :

Ion Name	Chemical Formula	Reagent	Positive Result
Sulfate	SO_4^{2-}	Barium chloride	Formation of a white precipitate
Carbonate	CO_3^{2-}	Hydrochloric acid	Evolution of carbon dioxide gas
Chloride	Cl^-	Silver nitrate	Formation of a white precipitate that darkens upon exposure to light
Phosphate	PO_4^{3-}	Silver nitrate	Formation of a yellowish precipitate
Copper	Cu^{2+}	Sodium hydroxide	Formation of a blue precipitate
Iron II	Fe^{2+}	Sodium hydroxide	Formation of a green precipitate
Iron III	Fe^{3+}	Sodium hydroxide	Formation of a rust-coloured precipitate
Aluminum	Al^{3+}	Sodium hydroxide	Formation of a white precipitate

-Transfer 2 mL of soil extract into clean test tubes.

-Add 3-5 drops of the appropriate reagent to the test tube according to the ion being tested. Mix gently and observe the reaction.

-Record the results in the table by placing a "+" when the test is positive and a "-" when the test is negative.

Ion Name	Sample
Sulfate	
Carbonate	
Chloride	
Phosphate	
Copper	
Iron II	
Iron III	
Aluminum	

-Based on the measured soil pH and the results of the ion identification tests**,** determine the chemical characteristics of soil sample.