84-001 pH

1. Application

1.1 The two main methods of measuring soil pH are outlined in this procedure. They are 1:1 soil:water ratio and 1:2 soil:0.01M $CaCl_2$ ratio. The measurement of soil pH in 0.01M $CaCl_2$ is the preferred method for most purposes because of advantages pointed out by Peech (1965).

1. The pH is almost independent of dilution over a wide range.

2. The pH measured is almost independent of the concentration of soluble salt present in non-saline soils.

3. It provides a good approximation of the pH of the soil solution under field conditions.

4. Errors due to the liquid junction potential are minimized because the soil suspensions are flocculated.

Measurement of the pH of a saturated soil is not recommended because of theoretical (junction potential) and practical (difficulty of obtaining reproducible results) disadvantages.

There is no point in measuring the pH of most soils containing free carbonates of Ca and Mg as the value obtained depends upon the partial pressure of CO_2 which is generally uncontrolled during pH measurements (Turner and Clark, 1956). It is, however, useful to measure the pH of saline, calcareous soils as pH values above about 8.5 indicate sodium carbonate (Richards, 1954).

2. Apparatus

2.1 50 mL disposable paper cups or beakers.

2.2 pH meter and electrodes.

3. Reagents

3.1 0.01M Calcium chloride ($CaCl_2$): Dilute 1.1g of calcium chloride to 1 liter in a volumetric flask with distilled water. Alternatively, if large volumes are required make a stock solution of 3.6M $CaCl_2$ ($CaCl_2.H_2O$ 1059g/2L). Dilute 50 mL of this stock solution to 18 liters with distilled water. Check the pH of this solution; it should be between 5.0 and 6.5. If it is not adjust by adding $Ca(OH)_2$ or HCl. To check the concentration of the solution, measure its conductivity; the specific conductivity should be 2.32 $\pm$ 0.08 millisiemens per cm (mS/cm) at 25°C.

4. Procedure

4.1 pH in 0.01M $CaCl_2$ (1:2, soil:solution ratio)

4.1.1 Weigh about 10 g of 2 mm soil into a 50 mL disposable paper cup or beaker.

4.1.2 Add about 20 mL of 0.01M $CaCl_2$ solution and stir the suspension several times during the next 30 minutes. For organic soils that absorb all of the solution use a 1:4 soil:solution ratio.

NOTE: Weight and volume measurements are not critical as ± 1 will not affect pH in 0.01M $CaCl_2$.

4.1.3 Let the suspension stand for 30 minutes to allow most of the sediment to settle.

4.1.4 Measure the pH by immersing the glass electrode into the partly settled suspension (do not immerse it to the bottom of the container) and placing the calomel electrode in the clear supernatant solution. If a combination electrode is used immerse it in the supernatant solution. The pH meter is adjusted by setting it to the pH of buffer solutions at the same temperature as the soil suspension. The meter should be checked against two buffers one of which has a pH at the lower end and the other at the upper end of the range of the expected pH of the soils being measured.

4.1.5 Record the pH in 0.01M $CaCl_2$ to one decimal place.

4.2 pH in water (1:1 soil:water ratio).

4.2.1 Weigh 20 g of 2 mm soil into a 50 mL disposable paper cup or beaker.

4.2.2 Add 20 mL of distilled water and stir the suspension several times during the next 30 minutes. For samples with a high organic matter content use a 1:4 soil:water ratio.

4.2.3 Allow the suspension to settle for 30 minutes.

4.2.4 Measure the pH as outlined in step 4.1.4.

4.2.5 Record the pH in water to one decimal place.

5. Calculations

5.1 nil

6. Precision

6.1 Within the analytical service lab the coefficients of variation at pH levels of 4.6 and 7.6 in 0.01M $CaCl_2$ were 1.7% and 1.7% respectively.

7. References

7.1 Peech, M. 1965. Hydrogen-ion activity in Methods of Soil Analysis Part 2; C.A. Black, ed. pp. 914-926.

7.2 Richards, L.A., ed. 1954. Diagnosis and Improvement of Saline and Alkali Soils. U.S. Salinity Laboratory. U.S. Dept. Agr., Handbook 60, 160 pp.

7.3 Turner, R.C. and Clark, J.S. 1956. The pH of calcareous soils. Soil Sci. 82. 337-341.

Notes