# Soil pH

# Application and Principle

A common method of measuring soil pH is performed by placing a glass electrode in a mixture of soil and deionized water. Various modifications exist for determining soil pH. The most common ratio used for soil-water pH is 1:1 soil:water. Some laboratories measure pH in a 1:2 ratio of soil to deionized to improve the fluidity of the slurry; particularly for soils with high organic matter and clay concentrations that can absorb a significant volume of water. Electrolyte solutions, such as 0.01 M CaCl2 or 1 M KCl, can be added to soil rather than deionized water with the resultant pH referred to as salt pH. Use of electrolyte solutions avoids variable soil-water pH due to varying background salt levels in different soils and improves electrical conductivity in the electrical circuit for pH measurement (Miller and Kissel, 2010). Soil pH measurement in deionized water or 0.01 M CaCl2 in 1:1 and 1:2 soil:solution ratios are official methods adopted by the Association of Official Analytical Chemists (Kalra, 1995).

**NOTE:** This protocol uses the 1:1 soil:water method

# Equipment and Reagents

1. pH meter
2. standardization buffers
   * pH 4
   * pH 7
   * pH 10
3. analytical balance
4. clean glass beakers for making a soil slurry
   * **20 mL???**
5. clean glass rods for stirring the slurry
6. dried soil
7. deionized water
8. a lab notebook for recording values

# Procedure

1. Measure out 10 g of dried soil and transfer to a clean glass beaker
2. Dispense a volume of DI water equal to the soil weight.
   * 1 mL water = 1 g water
3. Stir the soil and solution vigorously to completely homogenize the slurry
4. Allow the slurry to sit for 30 minutes.
5. **While you are waiting:** Calibrate the pH meter!
   * Perform at least a 2-point callibration with the pH 4 and 7 buffers.
   * It wouldn't hurt to do a 3-point callibration with the pH 4, 7, and 10 buffers.
   * Rinse the electrode thoroughly with DI water.
6. Ensure room temperature is between 20 and 25oC before proceeding with pH measurement.
7. Place electrode in the soil slurry and measure pH.
   * Measurements may be taken with or without continuous stirring.  
      If measurement is made without continuous stirring, stir the sample with a stir bar before placing electrode in the sample.
   * Allow adequate time for pH to reach a stable reading.
8. Record the pH measurement.
9. Rinse the electrode thoroughly with DI water.

# Analytical Performance

## Range and Sensitivity

1. Soil-water pH is most often within a range from 4 to 8.

## Precision and Accuracy

1. pH measurements can be made to the nearest 0.1 or 0.01 pH unit. There is no need to measure pH with more than 2 decimal places since this level of accuracy is not achievable or required. If measurements are made to the nearest 0.01 pH unit, pH can be rounded to 0.1 pH units before reporting to clients.

## Interferences

1. Differences in pH will occur with electrode placed in a soil-slurry or in the supernatant after the soil has settled. The differences are more pronounced with soil pH in water compared to electrolyte solutions. To avoid this variability in pH, it is important to stir the soil slurry right before measurement. With sandy soils, the settling time of soil particles is rapid and continuous stirring during measurement is recommended.
2. Glass electrodes have a short life span when measuring pH of sandy soils. The sand particles are abrasive to the glass resulting in electrode breakage or malfunction. When electrodes fail to measure pH of calibration buffers or quality control samples show more error than expected, replace electrodes.

## Effects of Storage

1. Air-dried soils may be stored several months without affecting the soil pH measurement provided they are stored in an ammonia free environment or in a tightly sealed container.
2. The electrodes used for pH measurement should be maintained and stored according to the manufacturer's instructions.

## Safety and disposal

1. Autoclave the soil slurry before disposal.

# References

Kalra, Y.P. 1995. Determination of pH of soils by different methods: Collaborative study. J. AOAC Int. 78: 310-321.

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