

Particle Size Analysis: Protocol

Written by Kristen Siegel
March 2016



A. Sample Preparation

Materials:

- ❖ **Drying Oven**
- ❖ **600mL Beakers (one per sample)**
- ❖ **Distilled Water**
- ❖ **Na-HMP Solution (50g/L)**

Assuming samples have not yet been ground/processed, run soil cores through a 2mm sieve. Dry samples overnight at 105°C, and leave samples out to cool when finished. In a 600mL beaker, weight out 40g-60g of soil. Add 250mL of distilled water and 100mL of Na-HMP solution. Allow the sample to soak overnight.

Note: Weight of Soil Used

The exact amount of soil used does not matter, provided that it is roughly consistent across all samples. The amount of soil used will vary with texture. Fine textured soils may need as little as 10-20g to obtain accurate results, while coarse sands will require 60g-100g.



Fig. 1: (A) Dried and weighed soil sample; (B) A sample that has been soaked overnight in distilled water and Na-HMP.

B. Sedimentation Cylinder Preparation

Materials:

- ❖ **Dispersion Cup**
- ❖ **Electric Mixer**
- ❖ **1L Sedimentation Cylinder (one per sample)**
- ❖ **Distilled Water**
- ❖ **70% Ethanol**
- ❖ **Digital Instant Read Thermometer (one per sample)**
- ❖ **Na-HMP Solution (50g/L)**

Transfer soaked sample to a dispersion cup. Mix sample at medium speed for 5 minutes using an electric mixer. Transfer the suspension to a 1L sedimentation cylinder, and add distilled water to bring the volume up to 1L. A small amount of ethanol may be required to remove any foam. Finally, place a thermometer at the opening of each sedimentation cylinder, ensuring that its base is immersed in the soil suspension.

Note: Sedimentation Cylinders

As the means of calculating sand, silt, and clay fractions can be different based on the dimensions of your sedimentation cylinder, it is recommended that you use the same brand/type of cylinder whenever possible.



Fig. 2: (A) Transferring soaked sample to dispersion cup; (B) Mixing sample using electric mixer; (C) Transferring suspension to sedimentation cylinder; (D) Positioning of thermometer at the mouth of the cylinder

Note: Prepare Blank

Once you have prepared the sedimentation cylinder for each sample, you must also prepare a blank. This can be done by adding 100mL of Na-HMP solution to a 1L sedimentation cylinder, and filling the volume to 1L with distilled water.

C. Hydrometer Measurements

Materials:

- ❖ Plunger
- ❖ 2 Standard Hydrometers (ASTM 152H)
- ❖ 70% Ethanol

Allow suspension to equilibrate thermally and record initial temperature (T_i). Insert plunger into the sedimentation cylinder, and dislodge soil using a combination of slow strokes and quick upward strokes near the base. It is recommended that you finish mixing using 2-3 slow, smooth strokes that span the length of the cylinder. As soon as the mixing is finished, carefully lower a hydrometer into your sample and your blank. You may need to use ethanol to remove any foam. After 30 seconds, record the hydrometer reading for your sample (R), the temperature of your sample (R °C), and the hydrometer reading for your blank (R_L). After 60 seconds, record measurements again. Remove hydrometers from your sample and blank, and rinse them thoroughly. Record measurements again at 90 minutes and at 24 hours. Be sure to remove and clean the hydrometer after each reading.

Note: Reading Times

If you wish to improve the accuracy of your measurements or if you have few samples, you may use more than 4 reading times. The recommended additional reading times are at 3 minutes, 10 minutes, 30 minutes, 60 minutes, and 120 minutes. You can use any combination of these to determine the sand, silt, and clay fractions (though 30 second-, 60 second-, 90 minute-, and 24 hour-readings are mandatory).

Note: Hydrometer Readings

The upper edge of the meniscus surrounding the stem should be used when taking hydrometer readings.

This method has been adapted from

Gee G.W. and Bauder J.W. 1986. Particle-Size Analysis. In: Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods (editor Klute, A.). 2nd Edition. Soil Science Society of America, Madison, Wisconsin, USA.