

Calculating Bulk Density at Home

Bulk Density Overview

Soil bulk density is a measure of the mass of soil particles in a known volume of space and can be impacted by a number of factors including compaction, particle size and field management. When you're delineating the area that you're going to sample, make sure that it appears homogenous (i.e. the same throughout). Within a single field, there may be different areas that should be investigated independently (i.e. the tops of knolls vs. two low areas between knolls). When measuring bulk density, we recommend taking a minimum of three separate samples in each area of interest. This will help account for variability.

Measuring Bulk Density with a Penetrometer

Use your penetrometer to determine compaction in your field of interest. When taking readings, ensure you are using the correct gauge (inner or outer) based on the tip you are using.

- Larger cone: best for softer soils to distribute force effectively.
- Smaller cone: best for harder or compacted soils to penetrate without excessive disturbance.

If most readings are less than 300 psi within the first 6" of soil, collect a single 6" deep soil sample at each of your three replicate areas within the field. To do this, pound a 2x6" metal sleeve (or any cylinder with a known volume) into the soil. Ensure the top of the cylinder is flush with the soil surface before carefully excavating it with a trowel. Take care not to lose any soil from within the cylinder, as this could affect your results.

If compaction reaches 300 psi or higher within the first 6", collect soil in two separate depth increments. Use a 2x3" sleeve to collect two samples from the same hole: the first at a depth of 0–3" and the second at 3–6". If you note a clear change in compaction while using the penetrometer (e.g. you hit hardpan or suddenly the soil becomes less compact), it is practical to separate samples into "above" and "below" the transition (hardpan) area.

Measuring Bulk Density Without a Penetrometer:

At each site, collect two samples using a 2x3" sleeve or a 2x6" sleeve: one from 0–3" and one from 3–6", respectively. Make sure to bag each sample separately and label them clearly, including the depth if you collected both 0–3" and 3–6" samples, so you know exactly where each sample came from.

How to Calculate Bulk Density at Home

1. Prepare the Samples

- a. Spread each sample out on a piece of cardboard (the bottom of a box without holes or cracks works well) or a cookie sheet. Make sure to include a label with each sample.

2. Drying Environment

- a. Leave the samples to dry in a safe area where they're unlikely to be knocked over and protected from wind. Let the samples air dry until there is no moisture left. This usually takes a few days.

3. Accelerate Drying (Optional)

- a. If you're eager to speed up the process, you can place the samples on a cookie sheet in the oven at a low temperature. Just be sure to keep an eye on them!

4. Weigh the Samples

- a. Once dry, weigh each sample as precisely as possible using a kitchen scale or similar device. This will give you the soil weight. Remember to subtract the weight of the container or bag holding the soil from the total weight on the scale.

5. Calculating Bulk Density

- a. Measure Volume: To determine the volume, measure the inside diameter of the metal sleeve used for sampling and measure the height of the sleeve (i.e. 3" or 6").
- b. Calculate Volume: Use the formula: $(\text{Diameter}/2) \times 3.14 \times \text{Height}$
- c. Calculate Bulk Density (BD): Divide the weight of the sample by the volume of the container to calculate the bulk density (BD) of your sample.

Important: Ensure you are consistently using either imperial or metric units, do not mix grams with inches! To avoid confusion and to ensure consistency, it is easiest to use metric units. For example, if you are measuring height, a measurement of 3" translates to approximately 7.6 cm.