Field Method for Determining the Percent by Volume of Gravel
Water Volume Displacement Method

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1. Application

Because of the field requirements, there is a need for a quick, reliable, and repeatable method for determining the percentage of gravel in a given soil. This method had to be accurate and consistent between many soil scientists, and quick and easy to perform under field conditions. To meet this need, the water volume displacement method was developed.

2. Summary of Method

The water volume displacement method is very old and probably one of the first methods used to determine volume. This method simply measures the amount of water that is displaced by the amount of gravel, thus giving you the volume of gravel. This method can be used to determine the percentage of gravel in a given soil horizon, a family or series control section, or entire soil profile.

3. Interferences

The following is a list of problems that can give you erroneous readings:

- Nonrepresentative sample
- Spilling water or a leaking container
- Compacting the sample too much or too little
- Soil adhering to the gravel
- Counting very hard soil clods/peds as gravel

4. Equipment

This method requires standard equipment that can be found in most soil survey offices. The following is a list.

- 1000 mL graduated cylinder
- 1000 mL or 2000 mL plastic container. (We prefer one that has a 3-inch diameter so that cobbles are excluded)
- a Number 10 sieve
- bucket large enough to wash your sieve and gravel sample
- ample water

5. Procedure

1. Collect a representative sample and fill your plastic container (either a 1000 mL or a 2000 mL container) to the top. Pack firmly.
2. Sieve the sample with the Number 10 sieve, saving the gravel and not the fines.
3. Wash the gravel in the bucket to remove any soil that adheres to the gravel or hard soil clods/peds.
4. Place the washed gravel back into the plastic container.
5. Fill the graduated cylinder with 1000 mL of water.
6. Pour water from the graduated cylinder into the plastic container to the very top without going over the top.

7. Record the milliliters of water that were poured into the container.
8. If using a 2000 mL plastic container repeat 5 through 7 as necessary and add the milliliters together to get one total.

6. Calculations

We have recorded the number of milliliters of water poured into the plastic container, this number along with the total volume of your plastic container will give you the volume of gravel in your sample.

Subtract the milliliters of water added from the total volume of the plastic container. Divide this number by the total volume in the plastic container, multiply by 100, this is the percent by volume of your gravel sample.

mL in plastic container - mL of water added = mL for gravel

mL for gravel/mL in plastic container x 100 = % vol gravel

Examples: 1000 mL - 640 mL = 360 mL

360 mL/1000 mL x 100 = 36% gravel by volume

2000 mL - 1200 mL = 800 mL

800 mL/2000 mL x 100 = 40% gravel by volume

7. Report

This method accurately and repeatedly determines the percent by volume of gravel in a soil sample.

8. Precision

This method has been tested against a direct weighing method. When both methods are used on the same sample, the percentage of gravel were within 2 to 3 percent of each other.

Source: United States Dept of Agriculture-Soil Conservation Service. 1993. Soils Technical Note (August). Tucson Soil Survey Office, 2000 E. Allen Rd., Bldg. #320, Tucson, AZ 85719.