

# SOP: Gravimetric Water Content (GWC) Standard Operating Procedure

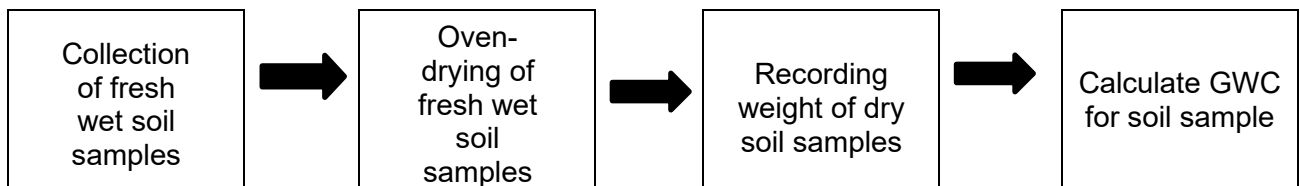
---

## Overview:

The following standard operating procedure (SOP) for gravimetric water content (GWC) in soils is accomplished through oven drying fresh wet soil samples. GWC in soils is defined as the mass of water per mass of dry soil for a given sample<sup>1,2</sup>. The following SOP is non-destructive, where oven-dried soil samples can be used for soil texture or total phosphorus analysis after recording weight for GWC. The following equation is the typical formula used for GWC ( $\theta_g$ )<sup>3</sup>:

$$\theta_g = \frac{m_{water}}{m_{dry}} = \frac{m_{wet} - m_{dry}}{m_{dry}}$$

Where  $\theta_g$  is GWC,  $m_{water}$  is the weight of the water in the soil sample,  $m_{wet}$  is the weight of the fresh wet soil sample before drying, and  $m_{dry}$  is the weight of the soil sample after drying.



## Safety:

All standard safety protocols and online safety training via UIUC [Division of Research Safety \(DRS\)](#) are required.

Personal protection (PPE) for this procedure include:

Eye Protection: Safety goggles

Body Protection: Lab coat

Hand Protection: Oven mittens

Particularly hazardous substances: None

## Instrumentation & Consumables:

### Instrument used:

- Oven (must be able to sustain at least 105°C)

### Preparations for Procedure

- Round aluminum trays (to hold at least 10 g soil)
  - Trays should be reused between samples.
- Soil samples (at least 10 g for GWC procedure)
- Analytical balance (two decimal places sensitivity)

## Detailed Procedure:

### I. Soil Sample Preparation

1. **At least 10 g of soil samples** are needed to determine GWC.
  - i. **Note:** also keep in mind any additional amounts of fresh soil you will need for further analyses, as soil used for GWC will be dried and promptly discarded.
  - ii. Use small aluminum trays and record the weight of the tray.
    - To differentiate between multiple samples, write the sample ID on each tray. Sharpie works best for keeping writing intact during drying period.
    - Weight of aluminum trays must be subtracted from total mass after drying (dry soil + tray mass).
  - iii. Place <10 g of fresh wet soil into aluminum tray, and record weight (wet soil).
    - Recommendation is 10 g (+/- 0.1 g) of wet soil.

### II. Oven Drying Soil Samples

1. Set oven to 105°C. Wear oven mittens to avoid risk of burns.
2. Carefully place samples into oven and leave to dry for <24 hours or until constant weight.
3. Once samples are dried for at least 24 hours, remove from oven and record weight of the dry soil + tray mass immediately or after short (<15min) cooling period. Samples can reabsorb atmospheric moisture if left for an extended period before weighing.
  - i. Note: Trays can damage the analytical balances. Having cardboard underneath the trays while weighing is recommended.

### III. Calculating GWC

#### Percentage GWC

1. To calculate the GWC of a given soil sample on a percentage basis, the following equation is used:

$$\theta_g(\%) = \frac{m_{wet}(g) - m_{dry}(g)}{m_{dry}(g)} \times 100$$

The equation above assumes that the weight of wet and dry soil does NOT include the weight of the tray.

#### Mass GWC

2. To convert to a mass basis, the following equation is then used:

$$\theta_g(g) = \frac{m_{wet}(g) - m_{dry}(g)}{m_{dry}(g)}$$

Equations 1 and 2 can be used to determine how much wet soil is needed for X amount of soil on an oven-dried basis.

Example 1 under “*Example Calculations*” also provides an example where 6 g soil on an oven-dried basis are needed for further analysis.

#### I. Clean Up

1. After weighing of soils before and after oven drying, clean up all spills.
2. Clean off balance that was used to measure the weight of each soil.
3. Oven-dried soil should be properly disposed of in accordance with your laboratory’s requirements for soil disposal.

## Example Calculations:

**Example 1.** Calculation to determine fresh weight needed on an oven dried basis. This GWC procedure was conducted to determine how much fresh(wet) soil weight was needed for the desired 6 g of soil on an oven-dried basis (labeled as “Fresh weight needed”) in the example.

<u>Sample ID</u>	1	<b>Sample ID:</b> sample name/number
<u>Soil before drying (g)</u>	9.97	<b>Soil before drying (g):</b> weigh 10 g (+/- 0.5) of wet soil and record exact weight to 0.00 decimal place.
<u>Tin Mass</u>	1.76	<b>Tin mass:</b> record weight of tin that soil sample is placed in.
<u>Soil + Tin after drying (g)</u>	9.85	<i>Soil samples should be oven dried @ 105°C for at least 24 h.</i>
<u>Soil after drying (g)</u>	8.09	<b>Soil and Tin after drying:</b> record weight of soil and tin after samples has been oven dried.
<u>GWC (%)</u>	23.23856613	<b>Gravimetric Water content (GWC):</b> = ( [soil before drying - soil after drying] ) / [soil after drying] * 100 = (9.97-8.09)/(8.09)*100 = 23%
<u>GWC in 6 g soil</u>	1.394313968	<b>GWC in 6 g soil:</b> =6*(Water content %) = 6*23% = 1.39 g
<u>Fresh Weight needed</u>	7.394313968	<b>Fresh weight needed:</b> =6+(WC in 6 g soil) = 6+1.39 = 7.39 g fresh weight needed
<u>Actual Weight (g)</u>	7.4	<b>Actual weight:</b> Actual fresh weight recorded, +/- 0.05 of the fresh weight calculated above. = 7.40 g
<u>Weight (g) oven dried basis</u>	6.004613842	<b>Oven dried basis weight:</b> =(Actual Weight) / ( 1+[Water Content %] /100 ) = (7.4) / (1+ 23/100) = 6.005 g oven dried basis used



Weighing GWC samples post 24 hour drying period to record Soil + Tin weight after drying. Cardboard is used to protect scale if samples are weighted immediately after removal from oven.

## References:

1. Bilskie, J. (2001). Soil water status: Content and potential. Campbell Scientific, Inc. <https://s.campbellsci.com/documents/fr/technical-papers/soilh20c.pdf>
2. How to convert gravimetric soil water content to volumetric soil water content. (n.d.). Edaphic Scientific. Retrieved April 20, 2023, from <https://edaphic.com.au/soil-water-compendium/how-to-convert-gravimetric-soil-water-content-to-volumetric-soil-water-content/>.
3. Voroney, P. (2019). Chapter 4—Soils for Horse Pasture Management. In P. Sharpe (Ed.), *Horse Pasture Management* (pp. 65–79). Academic Press. <https://doi.org/10.1016/B978-0-12-812919-7.00004-4>

## Citation:

SOP: GWC Standard Operating Procedure. 2023. Soils Lab, University of Illinois Urbana-Champaign. Urbana, IL. Accessed at: <https://margenot.cropsciences.illinois.edu/methods-sops/>

Questions can be directed to Andrew Margenot at [margenot@illinois.edu](mailto:margenot@illinois.edu)