SOP: Gravimetric Water Content

Overview:

This standard operating procedure (SOP) shows the calculations needed to determine gravimetric water content (GWC). GWC is then used to determine weight of field-moist soil needed for an analysis (e.g., nitrate-N) on an oven-dry basis.

Safety:

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

Instrumentation & Consumables:

- Aluminum tins (small, circular tins are best so you can fit more into the oven at once, but any size works)
- Analytical balance (at least two decimal places)

Detailed Procedure:

I. Sample preparation

1. Number aluminum tins, weigh each tin, and record that weight.
2. Weigh ~ 10 g of each sample of field-moist soil into its own tin.
3. Place tins into oven at 105 °C overnight (16 hours) or until constant weight.
4. Remove tins from oven and weigh each tin, recording the dry weight. Sometimes you need to put a piece of cardboard underneath the tins (tared out) so the heat doesn't cause the scale to fluctuate.

II. Clean up

1. Dispose of soil into buckets.
2. Rinse aluminum tins, dry them, and place them back into the cabinet.

III. Calculations

1. See attached excel sheet (calculation over dry weight is given)

There are two different ways to calculate GWC and the subsequent weight needed to achieve the oven-dry basis soil mass for a particular analysis. One uses the dry weight as the denominator and the other uses the wet weight as the denominator when calculating GWC which leads to two different equations to calculate the field-moist weight needed. The dry weight as the denominator is typically the standard and will be the example used on the excel sheet, but both calculations are shown below.

To determine GWC, the wet weight and dry weight (both minus the tin weight) is needed.

GWC can be expressed as a percentage, but for this SOP, we keep it in decimal form with the units of g water/g soil (field-moist or dry).15.33-11.

Dry weight as denominator:

GWC = $\frac{(Wet\ Weight - Dry\ Weight)}{Dry\ Weight}$

Example: $\frac{(15.33\ g - 11.88\ g)}{11.88\ g} = 0.290\ \frac{g\ water}{g\ dry\ soil}$

Once GWC is calculated, use the GWC decimal to determine the weight of field-moist soil needed for the mass of oven-dry basis soil for the analysis.

Field-moist soil weight needed = $Oven\ dry\ soil\ weight\ needed\ for\ analysis * (1 + GWC)$
Example = $6\ g * (1 + 0.225) = 7.74\ g$ of field-moist soil needed for analysis

Wet weight as denominator:

GWC = $\frac{(Wet\ Weight - Dry\ Weight)}{Wet\ Weight}$

Example: $\frac{(15.33\ g - 11.88\ g)}{15.33\ g} = 0.225\ \frac{g\ water}{g\ field-moist\ soil}$

Once GWC is calculated, use the GWC decimal to determine the weight of field-moist soil needed for the mass of oven-dry basis soil for the analysis.

Fresh soil weight needed = $\frac{Oven\ dry\ soil\ weight\ needed\ for\ analysis}{(1 - GWC)}$
Example = $\frac{6\ g}{(1 - 0.225)} = 7.74\ g$ of field-moist soil needed for analysis

Example of template (see attachment) for data entry and calculations

										within 0.05 g
			Record	Record	Record	Record				Record
Plot	Sample Location	Depth	Tin Number	Tin Weight (g)	Wet Weight (g)	Tin + Dry Wt (g)	Dry Wt (g)	GWC	Weight Needed (g)	Actual Weight (g)
1	1st strip	0-3 in	1	1.26	15.13	13.5	12.24	0.191011	7.15	7.44

Citation:

SOP: Gravimetric Water Content Calculations. 2021. Soils Lab, University of Illinois Urbana-Champaign. Urbana, IL. Accessed at: https://margenot.cropsciences.illinois.edu/methods-sops/

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