



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L417

Soil Aggregate Stability – Wet Sieving Method

Standard Operating Procedure

SOP Number	SOP-L417
Revision	0.1
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Date	2026-06-26
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1. Purpose

This procedure describes the determination of soil aggregate stability using the wet sieving method. Aggregate stability quantifies the resistance of soil structural units to disintegration when subjected to disruptive forces such as wetting, raindrop impact, and mechanical disturbance. It is a key

indicator of soil physical quality, erosion susceptibility, and the effects of management practices (tillage, cover cropping, organic amendments) on soil structure (Kemper & Rosenau, 1986; Nimmo & Perkins, 2004).

2. Scope

- **Applies to:** Air-dried mineral soil samples sieved to a defined aggregate size class (typically 1–2 mm or 2–4 mm). Samples must have been collected and processed per [SOP-F400 Soil Sampling](#).
- **Does not apply to:** Sandy soils with negligible aggregation, organic soils (histosols), or aggregate characterization by dry sieving alone
- **Location:** EA Program laboratory, SGM 133

3. Responsibilities

Role	Responsibility
Lab PI	Approve SOP, ensure training compliance
Lab Manager	Maintain wet sieving apparatus
Trained Personnel	Follow this SOP, report results
New Students	Complete training before independent use

4. Definitions

- **Aggregate:** A cluster of soil particles (sand, silt, clay, organic matter) bound together by organic compounds, fungal hyphae, microbial exudates, and electrostatic forces; the basic structural unit of soil.
- **Aggregate stability (wet-sieve method):** A measure of soil aggregate resistance to disruption by the mechanical action of water immersion and oscillation; expressed as the percentage of aggregates retained on a defined sieve size (e.g., 0.25 mm or 2 mm) after wet sieving.
- **Dispersant (sodium hexametaphosphate):** A chemical added to the control (dispersed) sample to break down all aggregates; used to measure the sand correction in aggregate stability calculations.
- **Mean weight diameter (MWD):** A summary statistic for aggregate size distribution calculated as the weighted mean of aggregate size fractions after wet or dry sieving; higher MWD indicates better structural stability.
- **Slaking:** The rapid collapse of aggregates upon sudden immersion in water, caused by compression of entrapped air; fast wetting promotes slaking and reduces aggregate stability measurements.
- **Water-stable aggregate (WSA):** An aggregate that remains intact after defined wet-sieving; the fraction used to calculate aggregate stability.

5. Safety and Hazards

Hazards

- **Chemical:** Sodium hexametaphosphate (dispersing agent) is a mild irritant. Hydrogen peroxide (if used for organic matter correction) is a strong oxidizer.
- **Physical:** Drying oven operates at 105 C; burn risk from hot containers.

5.1. Required PPE

- ☐ Safety glasses
- ☐ Lab coat
- ☐ Nitrile gloves (when handling dispersing solution or H₂O₂)
- ☐ Heat-resistant gloves (when handling containers from the oven)

5.2. Emergency Procedures

For chemical splashes, flush with water for at least 15 minutes. Refer to [SOP-L002 Laboratory Safety](#) and [SOP-L003 Hazardous Materials Handling](#).

6. Equipment and Materials

6.1. Equipment

Item	Location	Notes
Wet sieving apparatus (Yoder-type or Eijkelkamp)	SGM 133	Oscillating sieve holder
Nested sieves (e.g., 2 mm, 1 mm, 0.5 mm, 0.25 mm, 0.053 mm)	SGM 133	Stainless steel, 8 cm diameter
Drying oven (105 C)	SGM 133	
Analytical balance (0.001 g)	SGM 133	See SOP-L200
Desiccator with active desiccant	SGM 133	
Pre-weighed aluminum drying tins	SGM 133	

6.2. Reagents and Consumables

Item	Notes
Deionized water	For wetting and sieving
Sodium hexametaphosphate solution (5 g/L)	For dispersing residual aggregates (sand correction)

Item	Notes
Hydrogen peroxide (30%), optional	For removing organic matter if sand correction requires it

7. Procedure

7.1. Sample Preparation

1. Air-dry soil samples at room temperature until friable (typically 48–72 hours)
2. Gently break large clods along natural planes of weakness by hand; do not grind or crush
3. Dry-sieve the sample through a nest of sieves to isolate the desired aggregate size class (e.g., 1–2 mm or 2–4 mm)
4. Discard material outside the target size range for this analysis
5. Weigh out replicate subsamples (typically 4.0 g each, minimum 3 replicates per sample) into labeled containers

7.2. Pre-Wetting (Capillary Wetting)

Rapid wetting causes slaking, which may overestimate instability for some research questions. If slow pre-wetting is desired:

1. Place each subsample on a moistened filter paper in a closed container
2. Allow capillary wetting for 10 minutes (or a duration standardized for the study)
3. Proceed to wet sieving

If the goal is to assess slaking resistance under rapid wetting (the more common approach), omit the pre-wetting step and place air-dried aggregates directly onto the sieve.

7.3. Wet Sieving

1. Place the pre-weighed aggregates on the top sieve of the wet sieving apparatus (e.g., 0.25 mm for a single-sieve method, or the top of a nested stack)
2. Raise the water level in the sieving cans until the sieves are submerged to the appropriate depth (typically 1–2 cm above the sieve mesh)
3. Allow the aggregates to soak for 5 minutes (standardize this time for the study) before starting oscillation
4. Start the wet sieving apparatus. The standard cycle is 3 cm stroke at 34 cycles per minute for 3 minutes (Kemper & Rosenau, 1986). Record the exact settings used.
5. After sieving, carefully raise the sieves from the water

7.4. Collection and Drying

1. Backwash the material retained on each sieve into a pre-weighed aluminum tin using a wash bottle with deionized water

2. Transfer any material that passed through the finest sieve (the material in the sieving can) into a separate tin if size fractionation is desired
3. Dry all tins at 105 C for 24 hours (or until constant mass)
4. Cool in a desiccator and weigh to the nearest 0.001 g

7.5. Sand Correction

The material retained on the sieve after wet sieving includes both water-stable aggregates and primary sand particles that are inherently larger than the sieve openings. To correct for sand:

1. Add 50 mL of 5 g/L sodium hexametaphosphate to the dried residue in each tin
2. Allow to soak for at least 2 hours (or overnight) to fully disperse remaining aggregates
3. Pour the dispersed slurry back through the same sieve used in the wet sieving step
4. Rinse thoroughly with deionized water
5. Backwash the retained sand into a clean tin, dry at 105 C, cool, and weigh

7.6. Calculations

Water-stable aggregates (WSA) as a fraction of the total sample, corrected for sand:

$$\text{WSA}(\%) = \frac{M_{\text{stable}} - M_{\text{sand}}}{M_{\text{total}} - M_{\text{sand}}} \times 100$$

where:

- M_{stable} = oven-dry mass of material retained on the sieve after wet sieving (g)
- M_{sand} = oven-dry mass of sand retained after dispersal (g)
- M_{total} = initial oven-dry equivalent mass of the subsample (g; corrected for moisture using gravimetric moisture from [SOP-L400](#))

If a nested sieve set is used, calculate the mean weight diameter (MWD):

$$\text{MWD} = \sum_{i=1}^n \bar{x}_i w_i$$

where $\bar{x}_i$ is the mean diameter of the i th size fraction and w_i is the proportion of the total sample weight in that fraction (after sand correction) (Van Bavel, 1950).

8. Quality Control and Acceptance Criteria

- Run a minimum of 3 replicates per sample; report the mean and standard deviation
- The coefficient of variation among replicates should be less than 15%
- Include a laboratory reference soil in each batch to monitor method consistency over time
- Record all apparatus settings (stroke length, frequency, sieving duration) so results are reproducible
- *TBD – identify or prepare a reference soil for long-term QC tracking*

9. Waste Disposal

Waste Type	Disposal Method
Sieved soil and sand	Standard trash or return to sample stock
Sodium hexametaphosphate solution	Drain with copious water (non-hazardous at this concentration)
H ₂ O ₂ waste (if used)	Dilute and drain, or collect for EH&S
Used aluminum tins	Clean and reuse, or recycle

10. References

- Kemper, W. D., & Rosenau, R. C. (1986). Aggregate stability and size distribution. In A. Klute (Ed.), *Methods of soil analysis, part 1: Physical and mineralogical methods* (2nd ed., pp. 425–442). Soil Science Society of America. <https://doi.org/10.2136/sssabookser5.1.2ed.c17>
- Nimmo, J. R., & Perkins, K. S. (2004). Aggregate stability and size distribution. In J. H. Dane & G. C. Topp (Eds.), *Methods of soil analysis, part 4: Physical methods* (pp. 317–328). Soil Science Society of America. <https://doi.org/10.2136/sssabookser5.4.c14>
- Van Bavel, C. H. M. (1950). Mean weight-diameter of soil aggregates as a statistical index of aggregation. *Soil Science Society of America Journal*, 14, 20–23. <https://doi.org/10.2136/sssaj1950.036159950014000C0005x>

11. Training Record

Before performing this procedure independently, personnel must:

1. Read this SOP in full
2. Complete [SOP-L002 Laboratory Safety](#) training
3. Complete [SOP-L400 Soil Moisture](#) training (required for moisture correction)
4. Observe a trained operator perform the full procedure including sand correction
5. Perform the analysis under supervision with acceptable replicate precision (CV less than 15%)
6. Be signed off by the PI or lab manager