



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L413

Compost Maturity – Solvita CO₂/NH₃ Test

Standard Operating Procedure

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Author(s)	Marc Los Huertos
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Organization	EA Program, Pomona College

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Table of contents

1 Purpose	2
2 Scope	2
3 Responsibilities	2
4 Definitions	3
5 Safety and Hazards	3
5.1 Required PPE	3
5.2 Emergency Procedures	3
6 Equipment and Materials	4
6.1 Equipment	4
6.2 Consumables	4
7 Procedure	4
7.1 Sample Collection and Preparation	4
7.2 Setting Up the Test	5
7.3 Incubation	5
7.4 Reading Results	5
7.5 Determining the Compost Maturity Index (CMI)	6
7.6 Cleanup	6
8 Quality Control and Acceptance Criteria	6
8.1 QC Requirements	6
8.2 Complementary Tests	7
9 Waste Disposal	7
10 References	7
11 Training Record	7
12 Appendix A: Solvita Compost Maturity Index Lookup Table	7

13 Appendix B: Interpreting Results in Context	8
13.1 CO ₂ Color Number Interpretation	8
13.2 NH ₃ Color Number Interpretation	8
13.3 Common Patterns	8
14 Appendix C: Troubleshooting	9

1. Purpose

This procedure describes the determination of compost maturity and stability using the Solvita Compost Maturity Test (Woods End Laboratories). The test simultaneously measures carbon dioxide (CO₂) and ammonia (NH₃) emissions from a compost sample during a 4-hour incubation, providing a dual indicator of biological activity and nitrogen stabilization. The intersection of the two readings yields a Compost Maturity Index (CMI) that indicates whether compost is immature, active, curing, or finished (Vargas et al., 2005).

CO₂ evolution reflects ongoing microbial decomposition of organic carbon. NH₃ volatilization indicates incomplete nitrogen stabilization and is associated with odor, phytotoxicity, and high pH. True compost maturity is reached when both gases have declined to low levels. Because the CO₂ and NH₃ cycles do not always track together, the dual-measurement approach provides a more reliable maturity assessment than either gas alone.

This SOP is distinct from [SOP-L408 Solvita CO₂ Burst](#), which measures rewetted *soil* respiration over 24 hours using only a CO₂ paddle.

2. Scope

- **Applies to:** Assessment of maturity and stability of composted organic materials, including green waste, food waste, biosolids compost, manure compost, and vermicompost
- **Does not apply to:** Soil respiration measurements (see [SOP-L408](#)); raw feedstock characterization; long-term (7–28 day) laboratory respirometry; finished potting mixes where compost is a minor component
- **Location:** EA Program laboratory, SGM 133

3. Responsibilities

Role	Responsibility
Lab PI	Approve SOP, ensure training compliance
Lab Manager	Maintain Solvita kit inventory, stock gel paddles
Trained Personnel	Perform assay, record and report results
New Students	Complete training before independent use

4. Definitions

- **Compost maturity:** A measure of how fully decomposed and stabilized a compost product is; mature compost no longer undergoes rapid decomposition, does not cause phytotoxicity, and can be safely applied to crops or soils.
- **CO₂ index (Solvita):** The Solvita scale value (1–8) corresponding to the CO₂ concentration in the headspace above moist compost; lower values indicate more active decomposition (less mature); higher values indicate stabilization.
- **Maturity index:** A combined score calculated from the CO₂ and NH₃ Solvita indices; the primary output of the Solvita compost maturity test; used by USCC, US Composting Council, and others to certify compost quality.
- **NH₃ index (Solvita):** The Solvita scale value (1–5) corresponding to the NH₃ concentration in the headspace above moist compost; high NH₃ (low index) indicates immature compost with excess ammoniacal nitrogen that can harm plants.
- **Phytotoxicity:** Inhibition of plant germination or growth caused by immature compost; typically results from high NH₃ concentrations, volatile fatty acids, or other metabolites produced during active decomposition.
- **Solvita paddle:** A plastic stick holding two gel-pad sensors (CO₂ and NH₃) inserted into the compost jar headspace during the test incubation; color changes are read with the Solvita DCR reader.

5. Safety and Hazards

Hazards

- **Biological:** Compost may contain elevated microbial loads, fungal spores, and trace pathogens. Handle as a potential biohazard. Avoid inhaling dust when opening bags or scooping dry compost.
- **Chemical:** NH₃ released from immature compost is an irritant at high concentrations. Work in a well-ventilated area when handling fresh or actively decomposing compost.
- **Physical:** Minor risk of glass breakage from incubation jars.

5.1. Required PPE

- ☐ Nitrile gloves
- ☐ Safety glasses
- ☐ Lab coat
- ☐ Dust mask (recommended when handling dry or dusty compost)

5.2. Emergency Procedures

If compost dust is inhaled and respiratory irritation occurs, move to fresh air. For skin contact with compost, wash thoroughly with soap and water. Refer to [SOP-L002 Laboratory Safety](#).

6. Equipment and Materials

6.1. Equipment

Item	Notes
Solvita Compost Maturity Test kit	Includes CO ₂ and NH ₃ gel paddles, incubation jars, scoop, and color charts
Solvita Digital Color Reader (DCR)	Recommended for quantitative readings; provides numerical color values
Incubation jars (approx. 475 mL)	Glass or polycarbonate; provided with kit
Timer	4-hour countdown
Thermometer	For recording ambient and sample temperature
Lab notebook or data sheet	For recording results

6.2. Consumables

Item	Notes
Solvita CO ₂ gel paddles	One per test; store sealed at room temperature in the dark
Solvita NH ₃ gel paddles	One per test; store sealed at room temperature in the dark
Solvita CMI Calculator spreadsheet	Available from Woods End / solvita.com for precise index calculation

7. Procedure

7.1. Sample Collection and Preparation

1. Collect a representative compost sample of at least 500 g from the pile or windrow. Sample from the interior of the pile (at least 30 cm below the surface) to avoid surface drying artifacts.
2. If the compost is very heterogeneous, collect from multiple locations and composite the sub-samples
3. The sample should be at “natural” moisture, not artificially wetted or dried. Compost that has been stored at 4 C should be brought to room temperature (20–25 C) before testing. Allow at least 30 minutes.
4. Gently break up large clumps by hand but do not sieve or grind the compost. The test is designed for material in its as-produced condition.

! Important

Do not test compost that is above 40 C (i.e., still in the thermophilic phase). Elevated temperatures accelerate gas production and will give artificially high CO₂ and NH₃ readings

that do not reflect the maturity of the material once cooled.

7.2. Setting Up the Test

1. Fill a clean Solvita incubation jar loosely to the fill line with compost using the supplied scoop. Do not pack or compress the material. The volume should be approximately 150–200 mL.
2. Remove one CO₂ gel paddle and one NH₃ gel paddle from their sealed foil packets
3. Inspect each paddle: the gel should be uniform in color with no cracks, discoloration, or signs of prior exposure. Discard any compromised paddles.
4. Insert both paddles into the jar so that the gel faces are exposed to the headspace above the compost surface. The paddles should stand upright and not be buried in the compost.
5. Seal the jar immediately and securely
6. Record the jar number, sample ID, compost source, ambient temperature, and start time
7. Start the 4-hour timer

7.3. Incubation

1. Place sealed jars at room temperature (20–25 C) in a location shielded from direct sunlight and drafts
2. Do not open, move, or disturb jars during the 4-hour incubation

i Note

The standard incubation time is 4 hours. This is shorter than the 24-hour incubation used for the Solvita soil CO₂ burst test ([SOP-L408](#)) because compost produces gas at much higher rates than soil.

7.4. Reading Results

1. After exactly 4 hours, open the jar and immediately remove both paddles
2. Read each paddle promptly. Prolonged exposure to ambient air will alter the gel color.

Using the Solvita Color Charts (visual method):

3. Compare the CO₂ paddle to the Solvita CO₂ color chart. Record the color number (1–8 scale, where 1 = highest CO₂ / least stable, 8 = lowest CO₂ / most stable).
4. Compare the NH₃ paddle to the Solvita NH₃ color chart. Record the color number (1–5 scale, where 1 = highest NH₃ / least mature, 5 = lowest NH₃ / most mature).

Using the Solvita Digital Color Reader (DCR, recommended):

3. Insert the CO₂ paddle into the DCR and record the numerical reading
4. Insert the NH₃ paddle into the DCR and record the numerical reading
5. The DCR values can be entered into the Solvita CMI Calculator spreadsheet for a more precise Maturity Index

7.5. Determining the Compost Maturity Index (CMI)

Use the CO₂ and NH₃ color numbers to determine the CMI from the Solvita lookup table (printed in the kit manual) or the CMI Calculator spreadsheet:

CMI	Interpretation	Recommended Action
1	Raw, very immature	Continue active composting
2	Immature, highly active	Continue active composting
3	Immature, active	Continue composting/curing
4	Moderately immature	Begin curing phase
5	Mid-range maturity	Continue curing
6	Moderately mature	Approaching readiness
7	Mature	Ready for most applications
8	Very mature, highly stable	Fully finished compost

Tip

Most regulatory agencies and compost quality programs consider a CMI of 6 or above as “mature” and suitable for unrestricted use. A CMI of 7–8 indicates a fully finished product with minimal phytotoxicity risk. For sensitive applications (seed germination, potting mixes), target CMI 7 or 8.

7.6. Cleanup

1. Dispose of used compost in the designated waste container or return it to the compost pile
2. Wash incubation jars thoroughly with soap and water; rinse with deionized water and allow to air-dry
3. Dispose of used gel paddles in standard trash

8. Quality Control and Acceptance Criteria

8.1. QC Requirements

- Run duplicate tests on at least 10% of samples (two jars from the same homogenized compost). Duplicate CO₂ readings should agree within 1 color number; NH₃ readings within 1 color number.
- Include a blank jar (empty, sealed with both paddles) in each batch to check for ambient CO₂ and NH₃ interference. Both paddles should read at or near their maximum (most stable) values.
- Verify that the compost sample temperature is between 20 and 40 C before testing. Record the temperature.
- Calibrate the DCR per the manufacturer’s instructions before each batch if using the digital reader.
- Store gel paddles sealed in their foil packets, at room temperature, away from light. Check expiration dates; do not use expired paddles.

8.2. Complementary Tests

For a comprehensive compost quality assessment, consider pairing the Solvita test with:

Parameter	SOP / Method
pH and electrical conductivity	SOP-L402 (1:5 compost-water extract)
Moisture content	SOP-L400 (105 C, 24 h)
Organic matter (LOI)	SOP-L406
Total C and N (C:N ratio)	SOP-L407 and elemental analysis
Seed germination bioassay	<i>TBD</i>

9. Waste Disposal

Waste Type	Disposal Method
Used compost	Return to compost pile or standard trash
Used gel paddles	Standard trash
Jar wash water	Drain

10. References

Vargas, D. C. nas., Monedero, M. S., Urpilainen, S., Kamilaki, A., & Stentiford, E. (2005). Assessing the stability and maturity of compost at large-scale plants. *Ingenier'ia*, 9(2), 25–30.

11. Training Record

Before performing the Solvita compost maturity test independently, personnel must:

1. Read this SOP in full
2. Complete [SOP-L002 Laboratory Safety](#) training
3. Review the Solvita Compost Maturity Test User's Guide (included in the kit)
4. Observe a trained operator perform the full procedure from sample collection through CMI determination
5. Perform at least one test under supervision with acceptable duplicate precision (within 1 color number)
6. Be signed off by the PI or lab manager

12. Appendix A: Solvita Compost Maturity Index Lookup Table

The following table reproduces the general structure of the Solvita CMI lookup. Consult the kit manual or CMI Calculator spreadsheet for the official version.

	NH ₃ = 1	NH ₃ = 2	NH ₃ = 3	NH ₃ = 4	NH ₃ = 5
CO ₂ = 1	1	1	1	2	2
CO ₂ = 2	1	2	2	3	3
CO ₂ = 3	2	2	3	4	4
CO ₂ = 4	2	3	4	5	5
CO ₂ = 5	3	4	5	6	6
CO ₂ = 6	3	4	5	6	7
CO ₂ = 7	4	5	6	7	7
CO ₂ = 8	5	5	6	7	8

Note: This table is approximate. Use the official Solvita color charts and CMI Calculator for definitive results.

13. Appendix B: Interpreting Results in Context

13.1. CO₂ Color Number Interpretation

Color No.	CO ₂ Level	Stability Interpretation
1–2	Very high	Actively decomposing; unstable
3–4	Moderate to high	Active composting phase
5–6	Low to moderate	Curing; approaching stability
7–8	Very low	Stable; decomposition essentially complete

13.2. NH₃ Color Number Interpretation

Color No.	NH ₃ Level	Maturity Interpretation
1	Very high	Strong odor; phytotoxic; immature
2	High	Significant ammonia; not ready
3	Moderate	Some ammonia; continue curing
4	Low	Approaching maturity
5	Very low / none	Nitrogen stabilized; mature

13.3. Common Patterns

CO ₂	NH ₃	Interpretation
High	High	Actively decomposing with unstable N; classic immature compost
High	Low	Carbon-rich material still decomposing but N is stabilized; may need more time
Low	High	Unusual; possible anaerobic conditions or recent N-rich amendment; investigate

CO ₂	NH ₃	Interpretation
Low	Low	Both carbon and nitrogen cycles complete; finished compost

14. Appendix C: Troubleshooting

Symptom	Probable Cause	Corrective Action
CO ₂ paddle reads 1 (max activity) after 4 h	Compost is very fresh or sample was too warm	Verify sample temperature was below 40 C; confirm composting has progressed past thermophilic phase
NH ₃ paddle reads 1 (max ammonia)	High free ammonia; fresh manure or urea input	Continue composting; ensure adequate C:N ratio (target 25:1–30:1)
Both paddles show no color change (max stability)	Compost is fully mature, or paddles expired	Verify paddle expiration date; confirm with a known immature sample
Duplicates disagree by more than 1 color number	Heterogeneous compost; inconsistent fill level	Homogenize sample more thoroughly; fill jars to consistent level
CO ₂ high but NH ₃ low	High-carbon, low-N material (e.g., wood chip compost)	Normal for C-rich substrates; continue composting until CO ₂ declines
CO ₂ low but NH ₃ high	Possible anaerobic pocket; recent N amendment	Turn the pile to aerate; reduce N inputs; retest in 1–2 weeks