Thermodynamic composting for commercial scale

Fact sheet 2025



On this page:

- Introduction (#introduction)
- Benefits of thermodynamic composting (#benefits-of-thermodynamic-composting)
- Microbial role in composting (#microbial-role-in-composting)
- Materials needed (#materials-needed)
- Step-by-step composting process (#step-by-step-composting-process)
- Quality control and troubleshooting (#quality-control-and-troubleshooting)
- End use of compost (#end-use-of-compost)
- Final tip (#final-tip)

Introduction

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Thermodynamic composting is an accelerated composting process that utilizes controlled heat, aeration, and moisture levels to efficiently break down organic matter into nutrient-rich compost. The heat generated in this process comes from the rapid growth and metabolic activity of bacteria and fungi, which break down organic materials and release energy in the form of heat, consuming oxygen in the process. This method is ideal for large-scale agricultural or commercial composting operations. By fostering diverse microbial life, this composting approach enhances soil fertility and ecosystem balance.

Benefits of thermodynamic composting

- Rapid decomposition (ready in 4-8 weeks)
- High-quality compost with balanced nutrients
- Pathogen and weed seed destruction
- Enhances beneficial microbial communities
- Reduces greenhouse gas emissions
- Cost-effective alternative to chemical fertilisers

Microbial role in composting

Microorganisms are essential in breaking down organic materials and transforming them into compost. Key players include:

- **Bacteria & Fungi:** The primary decomposers that consume organic matter, releasing nutrients and generating heat as a byproduct.
- **Protozoa & Nematodes:** These microscopic organisms regulate bacterial populations and help cycle nutrients into forms plants can absorb.
- **Earthworms & Arthropods:** Larger decomposers that break down organic material, aerate compost, and promote microbial activity.

A well-balanced microbial community is essential for effective thermodynamic composting, ensuring efficient decomposition and high-quality compost.

Materials needed

To ensure an efficient composting process, a proper balance of the following materials is required:

1. **Carbon-rich materials (browns):** Dry leaves, straw, wood chips, sawdust
2. **Nitrogen-rich materials (greens):** Fresh grass clippings, manure, food scraps, green plant trimmings
3. **Water:** Maintains moisture levels at 50-60%; should be low in salts
4. **Oxygen:** Facilitates aerobic decomposition through turning or forced aeration
5. **Microbial Inoculants (optional):** Enhances decomposition speed and supports beneficial microbial communities

Step-by-step composting process

1. Site selection & preparation

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- Choose a well-drained, shaded location.
- Construct windrows (1.5–2m high, 3–4m wide) or use composting rounds no more than 1.4 meters wide with sheep yard fencing.
- Ensure access to water and machinery for turning.

2. Layering & mixing

- Start with a base layer of coarse materials (wood chips or straw) for aeration.
- Alternate layers of greens and browns in a 2:1 ratio (carbon to nitrogen).
- Moisten each layer to maintain optimal moisture.
- Add **compost tea or beneficial microbial inoculants** to enhance microbial diversity and activity.

3. Aeration & temperature monitoring

- Turn the pile every 3-5 days for proper oxygen distribution.
- Use a compost thermometer to monitor temperature (aim for **55-65°C** for optimal microbial activity). A minimum of 55°C for 3 days will kill seeds and pathogens.
- Temperatures over 70°C will kill beneficial microbes. Turn only when necessary.
- For commercial composting, maintain a minimum of 55°C for 10-15 days with a minimum of 5 turns.
- Maintain proper fungal and bacterial balance by adjusting carbon-to-nitrogen ratios.
- **Heat is generated by the metabolic activity of bacteria and fungi**, which consume oxygen and release energy as they break down organic materials.

4. Curing & maturation

- After 4-8 weeks, when temperatures stabilise below 40°C, move the compost to a curing area. Worms may now populate the compost as its temperatures drop to 30-35°C.
- Let it mature for an additional 2-4 weeks to allow microbial communities to stabilise and enhance soil-building properties. As populations stabilise, microbial activity diminishes, resulting in a loss of heat.
- Temperature does not elevate when turned and watered.
- Minerals start to become available as soluble nutrients

5. Stabilisation

- The compost reaches a humus-like state with no visible signs of the original organic matter.
- The material should have a dark, crumbly texture with an earthy smell.
- Further decomposition slows as microbial activity balances out, ensuring long-term stability when applied to soil.
- The stabilised compost is now ready for agricultural or Commercial use without causing nitrogen drawdown or further heat generation.
- 60-70 % of minerals are available as soluble nutrients.

6. Screening & storage

- Screen the compost to remove large particles.
- Store in a dry, ventilated area until ready for use.

Quality control and troubleshooting

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Issue	Cause	Solution
Foul odour	Excess moisture, lack of oxygen, not enough carbon-rich material	Turn pile, add dry materials
Slow decomposition	Imbalance in carbon/nitrogen	Adjust ratio, add inoculants
Pile too dry	Low moisture content, not enough nitrogen-rich materials	Water pile lightly
Low temperature	Small pile, poor aeration, not enough nitrogen-rich materials, not enough moisture	Increase size, turn more

End use of compost

- Soil amendment for farms and gardens
- Organic fertiliser replacement
- Supports microbial diversity and soil regeneration
- Erosion control and land restoration
- Landscaping and nursery applications

Final tip

Consistently monitoring moisture, aeration, and temperature will ensure a **high-quality compost** suitable for commercial use. Encouraging a diverse microbial ecosystem in composting enhances soil health and boosts plant productivity.

More information

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