# Information Sheet No. 5-2

## Composting Science for Industry

## Composting systems

Information Sheet No. 5-2
3rd Edn. January 2007

### Inside This Sheet





ISBN 1-876850-13-2

### Overview of composting systems

At least eight different forms of composting systems are available for processing a wide range of organic materials.

Turned *windrow* systems have been the predominant form of composting in Australia, particularly for *garden organics*.

Higher technology composting systems are now being implemented for processing materials that have traditionally been difficult to process in outdoor turned windrow systems, such as *food organics*.

*In-vessel* composting systems are becoming more common, although infrastructure costs are usually higher.

This Information Sheet on composting systems gives readers some basic information about the distinguishing characteristics of the main types of systems that are commercially available.

### General comparisons between the composting systems

Composting systems are often described in terms of a complete process from the reception of raw material through to the handling of the end-product.

However, when only the composting process itself is considered, most systems are nearly always variations of a common theme.

All systems aim to control and/or optimise compost production by manipulating temperature, oxygen and moisture during composting.

> 'Rubbish in, Rubbish out! All composting systems are limited by the nature of the raw material they process; poor quality starting materials makes poor quality compost.'

Another important control over compost quality is achieved by the selection, pre-treatment and mixing of the raw materials prior to composting.

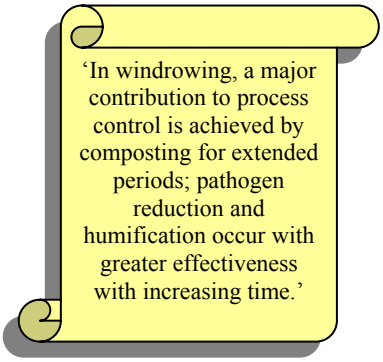
Some composting systems can more effectively deal with specific types of organic materials.

For example, highly odorous material (e.g. food organics and some industrially-produced organics) are more easily processed in systems with *forced aeration* and odour control equipment.

This technology allows for better control and minimises negative environmental impacts such as odour.

The most common form of composting is the turned windrow system.

This system is adequate for many organic materials, but requires a high degree of *process control* in order to maintain optimum composting conditions. Temperature and aeration control is managed by physically turning the mass by either a front-end loader or specialised windrow turner.




Capital outlays for windrow type systems are relatively small (unless a concrete pad is installed), but operating costs can be high because they are usually labour intensive.

Improved process control is achieved by utilising forced aeration systems. Forced aeration improves control of both temperature and oxygen during composting.

Systems using forced aeration do not necessarily produce a compost of higher quality than windrow systems, but shorter processing times are usually possible.

Environmental control of odours and leachate can usually be built in with systems utilising forced aeration.

Forced aeration systems are usually more expensive to install, but operating costs can be lower compared to turned windrow systems.

The major difference between composting systems sometimes only concerns the first stage of composting — preliminary decomposition or *pasteurisation.*

The aim of this stage of composting is usually to:

- maximise the rate of decomposition of the readily available organic fraction;
- eliminate pathogens and weeds from the starting materials- 'pasteurisation'; and
- control leachate and odours.

This period of intensive control is usually employed only for a short period (from 3 to 14 days in most cases).

Further decomposition, or curing, usually then takes place in windrows.

The curing phase requires significantly less management than the active composting phase. Minimal odour generation occurs during the curing phase.

## Definitions*

**Windrow (with or without aeration)**
System of composting involving the aeration of horizontally extended piles formed by a front-end loader or windrow turner. Extended piles are generally 1.5 to 3 m in height, and length is limited by the size of the composting pad. Aeration can be achieved by mechanical turning and/or the delivery of air from the base of the windrow (see aerated static pile).

**Garden Organics**
Any garden derived organic (plant) materials generated by domestic, C&D and C&I sources. Garden Organics is defined by its component materials including: putrescible garden organics (grass clippings); non-woody garden organics; woody garden organics; trees and limbs, and stumps and rootballs. Garden organics is one of the primary components of the compostable organics stream.

**Food Organics**
Food Organics includes organics generated by any one of the following activities: the manufacturing, preparation or consumption of food (including beverages); the processing of meat, poultry or fish, and the manufacturing of edible grocery products. Such materials may be derived from domestic or commercial and industrial sources. The definition does not include grease trap waste. Food organics is one of the primary components of the compostable organics stream.

**In-vessel**
System of composting involving the use of an enclosed chamber or vessel in which (in most cases) the composting process is controlled by regulating the rate of mechanical aeration. Aeration assists in heat removal, temperature control and oxygenation of the mass. Aeration is provided to the chamber by a blower fan which can work in a positive (blowing) and/or negative (sucking) mode. Rate of aeration can be controlled with temperature, oxygen or carbon dioxide feedback signals.

**Forced Aeration**
Means of supplying air to a composting pile or vessel which relies on blowers to move air through the composting materials.

**Process Control**
Stringent and documented monitoring of all critical control points in a composting operation so as to minimise defects and make products which can be guaranteed to customers.

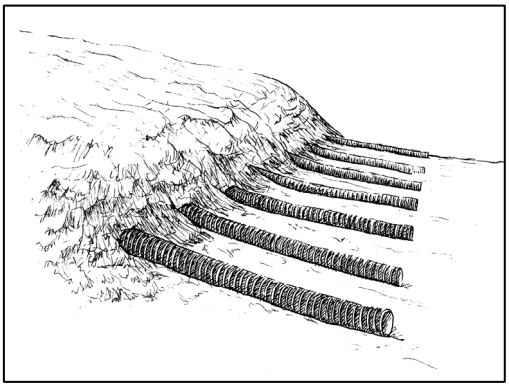
**Pasteurisation**
The process whereby organic materials are treated to kill plant and animal pathogens and weed propagules.

* Recycled Organics Unit, (2002).

Features of common composting systems

## Turned windrow

- Most common system for organics of low odour generating potential
- Low capital costs unless concrete pads are installed
- High operating costs
- Very flexible system - a range of organic materials can be composted and adjustments can be made within a composting cycle
- Aeration by turning with front-end loader or specialised machine
- Slow rate of decomposition due to varying conditions in pile
- Stable compost in 3-6 months
- Windrows can be outdoors or formed under a roof (no sides)
- Great care needed for effective odour and leachate control



## Passively aerated windrow

- Cheapest system; no turning
- Windrows must be covered with finished compost to reduce odours
- May be more space efficient than turned windrows
- Reduced flexibility - careful preparation of starting materials essential
- Little control of temperature and aeration during composting
- Compost in 3-6 months

## Aerated static pile

- Medium capital costs
- Medium operating costs
- Forced aeration
- Reduced flexibility - careful preparation of feedstock is essential
- Space efficient
- Piles are usually covered (e.g. with compost) to reduce odours
- Some control of temperature and aeration resulting in faster composting (6-12 weeks); further curing usually required

## Aerated covered windrow

- Medium capital costs
- Medium operating costs
- Cover for windrows reusable
- Forced aeration; computer control of composting possible
- Reduced flexibility - careful preparation of feedstock essential
- Space efficient
- Improved control of temperature and aeration resulting in faster composting (3-6 weeks); further curing usually required

## Rotating drum

- High capital cost
- Medium operating costs
- Less preparation of starting materials required due to constant mixing and size reduction
- Rapid initial decomposition in drum (up to seven days)
- Further decomposition required in windrows or aerated static piles
- Provides mixing and aeration by means of drum rotation and forced aeration

## Agitated bed or channel

- High capital cost
- Medium operating costs
- Flexible system – both forced aeration and mechanical mixing used
- Space efficient
- Beds are covered in a fully enclosed building or roof
- Good capacity for odour and leachate control
- Rapid composting: 2-4 weeks; further curing usually required

## In-vessel (horizontal configuration)

- High capital cost
- Automated system
- Uniform temperature and oxygen profile throughout contents of vessel
- Composting vessels can be housed in a building or outdoors
- Excellent control of odours and leachate
- Can be located with minimal buffer distances
- Very fast composting (7-14 days)
- Further curing in windrows or in-vessel usually required

## In-vessel (vertical configuration)

- High capital cost
- Automated system and low operating cost
- Uniform temperature and oxygen profile throughout contents of vessel
- Composting vessels can be housed in a building or outdoors
- Excellent control of odours and leachate
- Can be located with minimal buffer distances
- Very fast composting (7-14 days)
- Further curing in windrows or in-vessel usually required

## *Important references*


- Recycled Organics Unit (2002). Recycled Organics Industry Dictionary & Thesaurus: standard terminology for the recycled organics industry. Recycled Organics Unit, internet publication: http://www.rolibrary.com


## *Acknowledgement*


The Recycled Organics Unit acknowledges the support of Resource NSW in funding the development of this package of information resources, thereby enabling the Recycled Organics Unit to make these publications freely available for global access via internet publication.

Note this Information Sheet is partly based on content published in the *Best Practice Guide—Composting Green Organics* by EcoRecycle Victoria (1998). The Recycled Organics Unit acknowledges the excellent work involved in the original publication by the Institute for Horticultural Development (Department of Natural Resources and Environment, Victoria) and thanks EcoRecycle for supporting the significant adaptation and expansion of the original publication for broader Australian and international application.




## *Produced by:*


Recycled Organics Unit
PO Box 6267
The University of New South Wales
Sydney Australia 1466


## *Online contact details:*


| | |
|---|---|
| ROU | Angus Campbell |
| Internet | www.recycledorganics.com |