

## Information Sheet No. 5-6 Composting Science for Industry

### Porosity, structure, texture and particle size

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#### Particle size characteristics and aeration

Porosity, structure and texture relate to the physical properties of the materials such as particle size, shape and consistency.

They affect the composting process by their influence on aeration (Rynk *et al.*, 1992).

The physical properties of a composting mix can be adjusted by selecting suitable raw materials and by grinding or mixing.

Materials added to adjust these properties are referred to as *bulking agents* (Rynk *et al.*, 1992).

Bulking agents reduce the density of a compost mix, enabling improved air flow.

Some compost mixes that do not contain sufficient bulking agents tend to be too dense, reducing air flow and often quickly become *anaerobic*. These mixes produce odour and decompose slowly.

It is therefore very important that compost mixes are prepared consistently. If the recipe is incorrect, more time is required for decomposition and it is very difficult to produce a consistent product.

Getting the compost mix correct and using the recipe consistently saves time and money.

#### Porosity

Porosity is a measure of the air space within the composting mass and determines the resistance to airflow.

Porosity is determined by particle size, the size gradation of the materials, and the continuity of the air spaces.

#### Structure

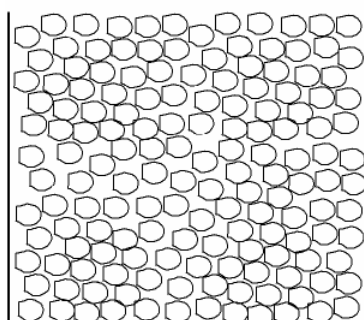
Structure refers to the rigidity of particles — that is, their ability to resist settling and compaction.

Good structure prevents the loss of porosity in the moist environment of a compost pile.

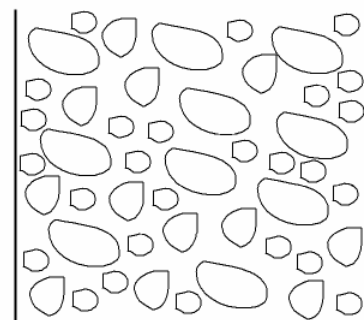
#### Texture

**Figure 1.** Particle size and its effect of porosity and air flow resistance. Mixes comprising very small particles (left) undergo rapid decomposition and are susceptible to the development of anaerobic conditions. Mixes comprising a range of small and large particles are less susceptible to the development of anaerobic conditions (right).

Small particle size, low porosity,  
high resistance to air flow



Variable particle size, high porosity,  
low resistance to air flow



Texture refers to the available surface area for microbial attack. (Figure 1).

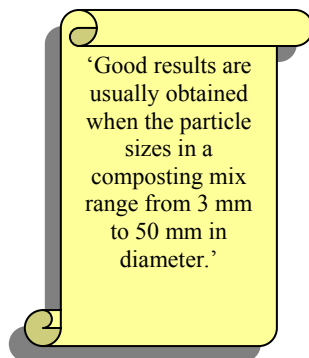
Most decomposition during composting occurs on the surfaces of particles. As particle size reduces, the amount of surface area for decomposition increases.

For example, an apple chopped up into many pieces will decompose much more rapidly than a whole apple in a composting system because there are more surfaces for microbial attack.

When the majority of particles in a mix are small (<3 mm), anaerobic conditions can develop because of the resistance to air flow (Figure 1). This occurs because the mix is too dense, thereby reducing porosity.

When the majority of particle sizes in a composting mix are large (>50 mm), decomposition proceeds slowly because of the low surface area for microbial attack.

Thus, a compromise is needed between small particle sizes to encourage rapid decomposition and large particles to maintain porosity



For most raw materials, an acceptable porosity and structure can be achieved if the *moisture content* is less than 65% (Rynk *et al.*, 1992).

## Definitions\*

### Bulking Agent

An ingredient in a mixture of composting raw materials included to improve the structure and porosity of the mix. Bulking agents are usually rigid and dry and often have large particles (for example, straw or wood chips). The terms “bulking agent” and “amendment” are often used interchangeably.

### Anaerobic

In the absence of oxygen, or not requiring oxygen. Composting systems subject to anaerobic conditions often produce odorous compounds and other metabolites that are partly responsible for the temporary phytotoxic properties of compost. Anaerobic conditions are important for anaerobic digestion systems.

### Moisture Content

The fraction or percentage of a substrate comprised of water. Moisture content equals the weight of the water portion divided by the total weight (water plus dry matter portion).

\* Recycled Organics Unit, (2002).

## Important references

- Rynk, R., van de Kamp, M., Willson, G.B., Singley, M.E., Richard, T.L., Kolega, J.J., Gouin, F.R., Laliberty Jr., L., Kay, D., Murphy, D.W., Hoitink, H.A.J. and W.F. Brinton (1992). On-Farm Composting Handbook. Natural Resource, Agriculture, and Engineering Service. Ithaca, New York, USA.
- 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>

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## 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](http://www.recycledorganics.com)

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