Composting
FACTSHEET

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BLENDING MATERIALS FOR THE COMPOSTING PROCESS

The ingredients for composting are organic by-products or waste materials. On-farm materials include animal manures, bedding, crop residues and, possibly, some processing wastes. In order to blend these materials in suitable proportions (sometimes referred to as the recipe), several factors must be taken into consideration, particularly the C:N ratio, moisture content, and porosity.

SYMBOLS

a = total weight of ingredient *a*
b = total weight of ingredient *b*
c = total weight of ingredient *c*
M = desired Mix Moisture Content
Ma, Mb, Mc... = moisture content of ingredients *a, b, c, ...*
%Ca, %Cb, %Cc... = % carbon of ingredients *a, b, c, ...* (on dry weight basis)
%Na, %Nb, %Nc... = % nitrogen of ingredients *a, b, c, ...* (on dry weight basis)
R = desired C:N ratio of mix
Ra, Rb = C:N ratio of ingredients *a, b*

FORMULAS FOR ONLY TWO INGREDIENTS

Required amount of ingredient *a* per kg of *b*

To obtain desired C:N ratio:
$$a = \frac{\%\,Nb}{\%\,Na} \times \frac{(R - Rb)}{(Ra - R)} \times \frac{(1 - Mb)}{(1 - Ma)}$$

To obtain desired moisture content:
$$a = \frac{Mb - M}{M - Ma}$$

FORMULAS FOR A MIX OF MATERIALS

$$\text{C:N ratio} = \frac{\text{weight of C in ingredient } a + \text{weight of C in } b + \text{weight of C in } c + ...}{\text{weight of N in } a + \text{weight of N in } b + \text{weight of N in } c + ...}$$

$$= \frac{[\,\%Ca \times a \times (1\text{-}Ma)\,] + [\,\%Cb \times b \times (1\text{-}Mb)\,] + [\,\%Cc \times c \times (1\text{-}Mc)\,]...}{[\,\%Na \times a \times (1\text{-}Ma)\,] + [\,\%Nb \times b \times (1\text{-}Mb)\,] + [\,\%Nc \times c \times (1\text{-}Mc)\,]...}$$

$$\text{Moisture Content} = \frac{\text{weight of water in ingredient } a + \text{weight of water in } b + \text{water in } c + ...}{\text{total weight of all ingredients}}$$

$$= \frac{(a \times Ma) + (b \times Mb) + (c \times Mc) ...}{a + b + c + ...}$$

EXAMPLE

Assume a broiler breeder farm has manure to compost, and that sawdust will be used as a bulking agent.

How much sawdust and water needs to be added to the manure, to have a good compost mix.

Using values from ***Characteristics of On-Farm Composting Materials*****,** Factsheet No. 382.505-3, assume:

	% Nitrogen (Dry wt)	Carbon:Nitrogen Ratio	Moisture Content (%)	Bulk Density (kg/m^3)
Broiler Breeder Manure	3.6	10	46	470
Sawdust	0.1	500	20	350

1. Using the formula for two ingredients from page 1, determine the amount of sawdust (a) needed for each kg of manure (b), to give a desired C:N ratio (R) of 30.

Given: b = 1 kg of broiler breeder manure
Ma = 0.20 (20% moisture content of sawdust)
Mb = 0.46 (46% moisture content of manure)
Ra = 500 (C:N ratio of sawdust)
Rb = 10 (C:N ratio of manure)
%Na = 0.1 (% nitrogen in sawdust)
%Nb = 3.6 (% nitrogen in manure)

Determine: a (weight of sawdust needed) for a desired C:N ratio of R = 30

$$a = \frac{\%Nb}{\%Na} \times \frac{(R - Rb)}{(Ra - R)} \times \frac{(1 - Mb)}{(1 - Ma)}$$

Calculation:

$$a = \frac{3.6}{0.1} \times \frac{(30 - 10)}{(500 - 30)} \times \frac{(1 - 0.46)}{(1 - 0.20)} = \frac{3.6}{0.1} \times \frac{20}{470} \times \frac{0.54}{0.80} = 1.0$$

Answer: For each kg of manure, add 1.0 kg of sawdust to obtain a C:N ratio of 30.

2. Check the mix moisture content (M.C.) using the moisture content formula on page 1.

Given: a = 1.0 kg wt of sawdust from step 1
b = 1.0 kg wt of manure
Ma = 0.20 (20% moisture content of sawdust)
Mb = 0.46 (46% moisture content of manure)

Determine: mix moisture content $M.C. = \frac{(a \times Ma) + (b \times Mb)}{a + b}$

Calculation:

$$M.C. = \frac{(1 \times 0.20) + (1 \times 0.46)}{1 + 1} = \frac{0.20 + 0.46}{1 + 1} = \frac{0.66}{2} = 0.33 \text{ or } 33\%$$

Answer: This starting moisture content of 33% is too low, since ideal moisture content runs from 50 to 60%.

3. Adjust moisture content to 55% using the two ingredient formula on page 1.

Given: b = 1 kg of manure/sawdust mix
M = 0.55 (55% desired moisture content)
Ma = 1.0 (100% moisture content of water)
Mb = 0.33 (33% moisture content of manure/sawdust mix)

Determine: 'a' quantity of water required

$$a = \frac{Mb - M}{M - Ma}$$

Calculation:

$$a = \frac{0.33 - 0.55}{0.55 - 1.0} = \frac{-0.22}{-0.45} = 0.49$$

Answer: Add 0.49 kg of water for every 1.0 kg of manure/sawdust mix.

4. Determine: the volumes of manure, sawdust and water to mix.

Given: Tractor bucket volume = 2.0 m^3
Manure bulk density = 470 kg/m^3
Sawdust bulk density = 350 kg/m^3.

Calculation: One bucketful of manure weighs 2.0 m^3 x 470 $\frac{kg}{m^3}$ = 940 kg

Since an equal weight of manure and sawdust is wanted add 940 kg of sawdust
or $\frac{940\ kg}{350\ kg/m^3}$ = 2.7 m^3 of sawdust.
This is equal to 2.7 m^3/2.0 m^3 per bucket = 1.35 buckets of sawdust.

For each bucket full of manure used there will be a total manure/sawdust mix weighing
940 kg + 940 kg = 1840 kg
Similarly for each bucketful of manure used add; $\frac{0.49\ kg}{kg\ of\ mix}$ x 1840 kg = 902 kg water (equals 902 litres water)

Answer: For each bucketful of manure add
1.35 bucketful of sawdust, and
902 litres of water

5. Check porosity of mix.

Porosity cannot be predicted with accuracy from ingredient characteristics. However, porosities for materials having bulk densities less than 640 kg/m^3 are usually adequate.

$$\text{Bulk Density} = \frac{940\ kg + 940\ kg + 902\ kg}{2.0\ m^3 + 2.7\ m^3} = \frac{2782\ kg}{4.7\ m^3} = 591\ kg/m^3$$

The porosity of the mix is therefore expected to be adequate.

This is one of a series of Factsheets on Composting. A list of references used in producing this series is included in the Composting Factsheet "*Suggested Reading and References*."

COMPOSTING FACTSHEET SERIES PREPARED BY
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