THE OHIO STATE UNIVERSITY

Ohio Compost Operator Education Course

An education program sponsored by the Ohio Environmental Protection Agency-Environmental Education Fund, the Organics Recycling Association of Ohio (ORAO) and the Ohio State University to promote compost operator technical knowledge and sound operating techniques.

Laboratory Workbook

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References:

Test Methods for the Examination of Composting and Compost. 2000. Eds: W.H. Thompson, P.B. Leege, P.Millner and M.E. Watson. US Composting Council, NY.

Keener, H.M., K. Ekinci, D.L. Elwell and F.C. Michel. 2000. Mathematics of Composting - Facility Design and Process Control. pp. 164-197. *In:* P.R. Warman and B.R. Taylor (eds). Proceedings International Composting Symposium (ICS ’99) Vol. 1 CBA Press Inc., Nova Scotia, Canada.

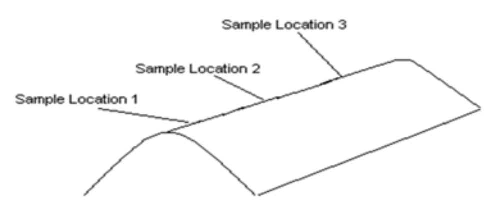
Lab Exercise 1: Sampling from a Compost Pile

Purpose: To learn how to collect a compost sample, which is representative of a complete windrow or pile, for laboratory analyses.

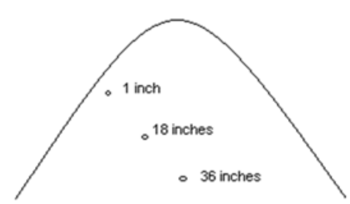
Equipment: Gloves, two 5-gallon buckets, 1-gallon Ziploc plastic bags, permanent marker, shovel (optional).

Procedure:

1. Collect equal handfuls (or shovelfuls) of compost at Location 1 from depths of 1”, 18” and 36” (See Views A and B). Place these sub-samples in one bucket.
2. Repeat Step 1 at about five locations along the length of the windrow (Location 2, 3, etc).
3. Repeat Steps 1 and 2 on the other side of the windrow.
4. Fill bucket approximately ¾ full and use second bucket to fully mix the samples.
5. Place a sample from the mixing bucket in a Ziploc bag.
6. Take sample to the laboratory for analysis. If the sample cannot be analyzed within 2 hours after collection, refrigerate sample. Pathogen analysis usually must be started within 24 hours.



View A. Sampling locations along a windrow



View B. Sampling locations within a windrow

Additional details on sampling procedures:
http://www.woodsend.org/pdf-files/sampli%7E1.pdf.

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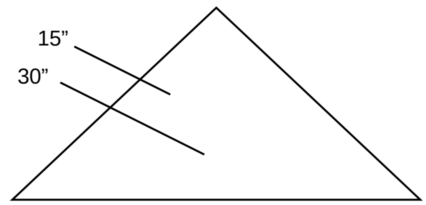
Lab Exercise 2: Measuring Oxygen Concentration and Temperature



Purpose: To measure compost temperatures and oxygen levels before and after windrow turning and determine the effect of turning on oxygen concentration and temperature within compost windrows.

Equipment: Compost windrow turner, thermometer, oxygen probe.

Procedure:
Measure temperature and oxygen level 1/2 of the way up the side of the windrow at 15" and 30" below the surface at two locations and record below. Also, record ambient (background) temperature and oxygen concentration.

Before turning
Temperature:
15" ___________ 30" _______________ Average: _________ Ambient _______
15" ___________ 30" _______________ Average: _________
Oxygen:
15" ___________ 30" _______________ Average: _________ Ambient _______

Immediately after turning
Time: _________
Temperature:
15" ___________ 30" _______________ Average: _________
15" ___________ 30" _______________ Average: _________
Oxygen:
15" ___________ 30" _______________

Approximately one hour after turning
Time: _________
Temperature:
15" ___________ 30" _______________ Average: _________
15" ___________ 30" _______________ Average: _________
Oxygen:
15" ___________ 30"

Lab Exercise 3: Determining Moisture Content

Purpose: To learn how to determine the moisture content of a compost sample. The **moisture content** is the fraction of the compost that is water and is expressed as a percentage of total wet weight. Composts less than 35% moisture may be dusty while those greater than 65% moisture may reduce oxygen levels, leading to anaerobic conditions that increase odors. The preferred moisture content for active compost is 55-60% and for finished compost is 40-50%. (From USCC Seal of Testing Assurance testing parameters, http://compostingcouncil.org/test-methods-parameters/)

Equipment: Compost sample, non-plastic container (~1 pint), scale, drying oven.

Procedure:
Part I. Estimating moisture content

Question: Can moisture content be estimated based on experience?

1. Examine the composts of different moisture contents (gloves provided)
2. Estimate the moisture content of unknown samples. Write values here.
    a. Unknown 1 ________ %
    b. Unknown 2 ________ %

Part II. Measuring moisture content. Sample #: _______

1. Place the container in drying oven for 24 hours at 70°C.
2. Label the container with name, sample type and date.
3. Weigh the empty container and record weight (**Wc**): _______ g
4. Fill the container approximately ½ full with a compost sample.
5. Record the weight of the container and the wet sample (**Wcsw**): _______ g
6. Place the container with the sample in a drying oven at 70°C for 24 hours.
7. Record the weight of the container and the dry sample (**Wcsd**): _______ g
8. Determine the moisture content as follows:
    a) Calculate the weight of the water lost:
       Wcsw – Wcsd = ______ g
    b) Subtract the weight of the container from the weight of the original sample. This is the sample wet weight:
       Wcsw – Wc = ______ g
    c) Calculate the moisture content by dividing the water lost by the original sample weight:

$$\frac{(Wcsw - Wcsd)}{(Wcsw - Wc)} \times 100 = \_\_\_\_\_\_\_\_ \%$$

For more information on moisture content, see pages 22-23, On-Farm Composting Handbook.

Lab Exercise 4: Determining Organic Matter, Volatile Solids, and Ash Content

Purpose: To determine the volatile solids content and the volatile solids loss during composting. Volatile solids is equivalent to the **organic matter** content if no carbon-based inerts, such as plastic, are present. It is measured as the carbon-based material in compost which volatilizes (burns) when heated to a high temperature. The remaining material is known as **ash**, or non-volatile solids. This is the mineral component of compost. Organic matter is important for soil structure, nutrient availability, and soil water holding capacity. The volatiles solids loss **(VS% loss)** is an indicator of how much organic matter conversion has occurred during composting. This value usually ranges from 30% for leaves to up to 90% for food wastes. It can be used as an indicator of compost stability. It assumes that ash is not lost during the composting process.

Equipment: Dried compost, porcelain ashing crucible, 550°C ashing oven

Procedure: Volatile Solids and Ash Content Sample # _______

1. Place a crucible in a drying oven for 24 hours at 70°C.
2. Crush dried compost from Exercise 3 to reduce particle size.
3. Remove crucible from drying oven; record weight of crucible (**Wc**) _______ g
4. Add the crushed compost sample to porcelain crucible.
5. Record weight of the crucible and dried sample (**Wcs**) ________ g
6. Place the sample in the ashing oven and heat for 2 hours at 550°C.
7. After ashing, remove crucible and allow it to cool in a dessicator (a drying chamber). Record weight of the ashed sample and crucible (**Wca**) ________ g
8. Calculate the weight of the dry sample. **Wd = Wcs-Wc** ________ g
9. Calculate the ash weight. **Wa = Wca-Wc**. ________ g
10. The ash% is the percent of ash in the dry original sample.

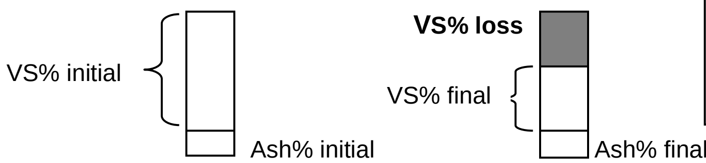
$$\textbf{Ash\%} = \frac{Wa}{Wd} * 100 = \underline{\hspace{4cm}}\% \quad \text{(g ash / g dry weight)}$$

Calculate percentage volatile solids (**VS%**); this is the material lost during ashing:

$$\textbf{VS\%} = 100 - \text{Ash\%} = \underline{\hspace{4cm}}\% \quad \text{(g VS / g dry weight)}$$

Procedure: Calculating Percent Volatile Solids Loss

11. The volatile solids loss during composting (**VS% loss)** is calculated using the ash values of the compost at two different points of time. For this procedure, the VS% and ash% of the fresh compost sample is used as **VS%** $_{\text{initial}}$ and **Ash%** $_{\text{initial}}$, and the VS% and ash% of the cured or finished compost is used as **VS%** $_{\text{final}}$ and **Ash%** $_{\text{final}}$.



Volatile Solids Loss (VS loss) is the percent of the initial volatile solids or organic matter that decomposes to CO_2 (disappears) during composting.

Calculate the percent volatile solids loss during composting (**VS% loss**) using the following formula:

$$\textbf{VS\% loss} = 1 - \frac{[VS\%_{\text{final}} / Ash\%_{\text{final}}]}{[VS\%_{\text{initial}} / Ash\%_{\text{initial}}]} * 100 = \_\_\_\_\_\_\_\_\_\_ \%$$

12. Once initial and final ash percents of a compost are known, this equation can be modified to calculate the loss of nearly any other component of the compost.

For example, the nitrogen loss (**N% loss**) during composting can be estimated by substituting the initial and final Total Nitrogen% (**TN%**) for the initial and final VS%. Composts can lose from 5 to 50% of their initial nitrogen as ammonia gas.

$$\textbf{N\% loss} = 1 - \frac{[TN\%_{\text{final}} / Ash\%_{\text{final}}]}{[TN\%_{\text{initial}} / Ash\%_{\text{initial}}]} * 100 = \_\_\_\_\_\_\_\_ \%$$

Lab Exercise 5: Determining Bulk Density and Air-Filled Pore Space

Purpose: To determine the bulk density and air-filled porosity of compost. The **bulk density** is the weight of a material for a given volume, usually 1 cubic yard or 1 cubic meter. The **air-filled pore space** is the space in a given volume of compost that is not filled by the particles or water. It allows oxygen to move through the compost, minimizing the risk of anaerobic conditions that can cause odor and reduce the rate of composting.

Equipment: Scale, bucket, water, compost sample

Procedure:

	Sample 1:	Sample 2:
1. Weigh the empty bucket, record weight (**Wb**):	_____ lbs	_____ lbs
2. Fill the bucket with water to the fill line.		
3. Weigh the bucket filled with water, record weight (**Wbw**):	_____ lbs	_____ lbs
4. Remove water and fill the bucket with compost to the fill line.		
5. Weigh the bucket filled with compost, record weight (**Wbc**):	_____ lbs	_____ lbs
6. Fill pore space with water by adding water to compost to the bucket fill line.		
7. Weigh bucket, compost and water, Record weight (**Wbcw**):	_____ lbs	_____ lbs
8. Pour the bucket contents outside into a disposal pile.		
9. Calculate the bulk density:		

$$= 1686 \text{ lbs } H_2O/yd^3 * \frac{(Wbc - Wb)}{(Wbw - Wb)} = \_\_\_\_\_\_\_\_ \text{ lb}/yd^3 \text{ (Sample 1)}$$

or

$$= 1686 \text{ lbs } H_2O/yd^3 * \frac{(Wbc - Wb)}{(Wbw - Wb)} = \_\_\_\_\_\_\_\_ \text{ lb}/yd^3 \text{ (Sample 2)}$$

10. Determine the air-filled pore space as follows:
    a) Calculate the weight of the water in the pore space:
       Wbcw – Wbc = ________
    b) Calculate the weight of the water only:
       Wbw – Wb = ________
    c) Calculate the air-filled pore space:

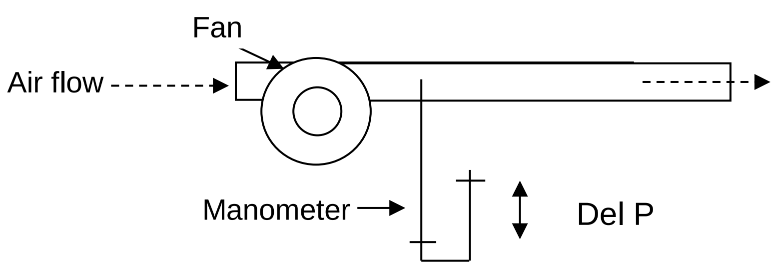
$$\frac{(Wbcw - Wbc)}{(Wbw - Wb)} \times 100 = \_\_\_\_\_\_\_\_ \%$$

Lab Exercise 6: Measuring Static Pressure and Determining Fan Airflow Rate

Purpose: To demonstrate the use of manometers and the fan curve to evaluate airflow through composts. Forcing air through a compost pile, often referred to as **forced aeration**, may be used to increase the rate of decomposition.

Equipment: U-tube manometer, fan, fan curve chart.

Procedure:
1. Measure static pressure using a U-tube manometer.
2. Read the airflow for the fan from the fan curve.
3. Determine the effect of doubling static pressure on fan airflow. Consider what happens to airflow as fan pressure increases, e.g., consider going from 2 in. H_2O to 4 in. H_2O.

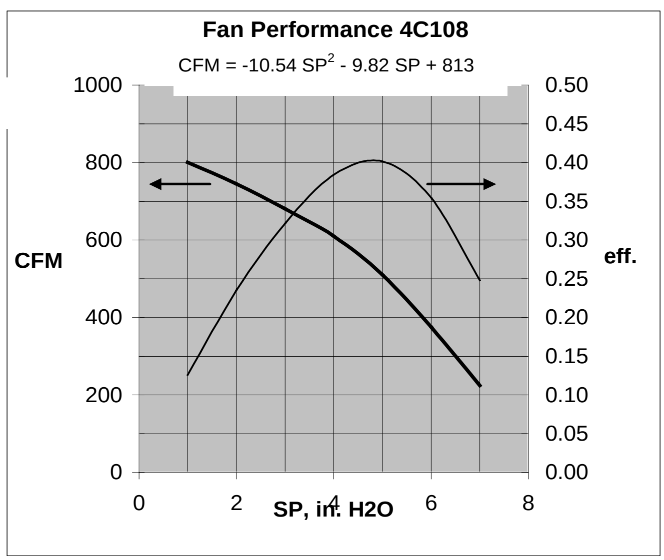


Example:

Fan data for 1 hp fan

P in. H_2O	CFM	Efficiency*
1	800	0.13
2	745	0.23
3	680	0.32
4	610	0.38
5	510	0.40
6	375	0.35
7	225	0.25

* Fan efficiency = (CFM * SP) / 6350 * HP)



Answer: Airflow dropped from 745 cfm to 610 cfm (18%) as the static pressure increased from 2 to 4 inches. As a result, fan efficiency increase from 23% to 38%.

Lab Exercise 7: Calculating Optimal Mixing Ratios

Purpose:
To optimize the composting process, different organic materials (feedstocks), are mixed together to form the composting pile and water is added, if necessary, to reach a desirable moisture content. The C:N ratio of the feedstock is a key indicator of the rate at which the feedstock will decompose. The optimum range for the initial C:N ratio is 30:1 to 35:1. Mixing feedstocks from different categories allows the C:N ratio to be balanced. There are three general categories of feedstocks. They are:

- **Primary** – Material to be composted.
- **Amendment** – Material added to adjust the ratio of carbon to nitrogen (C:N) and/or moisture content of the primary feedstock.
- **Bulking agent** – Material added to increase the amount of air-filled pore space.

This lab exercise uses a spreadsheet to determine the best mix of feedstocks that will maximize the efficiency of the composting process by balancing both C:N and moisture.

PROCEDURE: Optimizing Feedstock Mixing Ratios Based on C:N ratio and Moisture:

Mixing ratios, or the proportion of feedstocks that give the correct levels of C:N and moisture, can be calculated using the data on chemical composition and density of feedstocks in published tables (Table 1 or OFCH, Appendix A). However, as these properties vary considerably from source to source, it is recommended that a laboratory analysis be conducted for each feedstock.

Examples of feedstocks that might be co-composted to achieve desired C:N and moisture values are: a) grass, leaves and brush; b) biosolids, woodchips and leaves; c) food waste, yardwaste and chicken manure; and d) short paper fiber and poultry litter.

The volumes of different feedstocks can be varied to change the C:N ratio of the final mix. The most efficient way to do this is by using a computer spreadsheet that calculates the C:N ratio as the volumes of feedstocks are changed.

An **online spreadsheet** developed by Dr. Keener can be downloaded. Go to: www.oardc.ohio-state.edu/ocamm. Click on: Workshops. Click on: Calculations (dropdown menu). Click on: Optimizing Compost Mixing Ratios. This spreadsheet allows the user to vary the volume of common feedstocks to determine the C:N ratio.

To do an analysis: 1) insert the volume for one of the materials (primary feedstock) being composted and set the water mass to zero; 2) adjust the others feedstock(s) until an acceptable C:N is achieved (usually ranging from 30:1 to 35:1); 3) adjust the water until a satisfactory moisture content is found (usually 50 to 60%).

A second spreadsheet is also provided for formulating mixes on the basis of wet mass instead of volume. Procedures are given with the downloaded spreadsheets.

EXAMPLE. Yard trimming mixture of grass, leaves and brush. Grass is the primary feedstock and leaves and brush are added for adjusting C:N and providing air space. Table 1 (pg 10) is used to determine the values to be input to the spreadsheet. The mix composition (percentage of each feedstock) can be calculated on a mass or volume bases. For volume ratios of 1:2:0.5, the C:N ratio of the mix was 30:7 and moisture was 51.5% (pg 11). This C:N ratio is acceptable. A solution using feedstock weights is given on page 12.

A difficulty in using a calculated C:N ratio is knowing how much of the carbon and nitrogen are readily available. In actual use, field trials are always suggested to verify the best formulations.

Table 1. Compost Feedstock Properties

ITEM	Moist % (wb)	Ash* % (db)	C** % (db)	N % (db)	C/N % (db)	Bulk Den lb/yd3	
Mineral Nitrogen Source							
Ammonium Sulfate $(NH_4)_2SO_4$	0.0	99.0	0.0	21.00	0.0	2600	
Urea	0.0	99.0	19.8	46.00	0.4	1620	
Inoganics							
Sand (a)	6.2	100.0	0.0	0.00	0.0	2200	
Sand (b)	20.0	100.0	0.0	0.00	0.0	3040	**Average**
Organics Materials							
Biosolid (a)	78.0	35.0	46.8	5.50	8.5	1600	
Biosolids (b)	80.0	38.0	41.4	1.54	26.9	1600	
Broiler litter[1]	37.0		37.8	2.70	14.0	864	**Average**
Broiler litter[3]	39.7	10.6	41.2	6.09	6.8		**Average**
Chicken manure	70.0		33.9	5.87	5.8	1450	
Chicken manure[3]	42.1	17.2	49.0	6.07	8.1		
Corrugated Cardboard	21.0	4.0	40.0	0.20	200.0	150	
Dairy cow manure, free stall	81.2	15.0	44.6	2.64	16.9	1601	
Dairy cow/calf manure	88.4		47.5	5.68	8.4	1400	
Dairy heifer manure[2]	78.4	15.0	44.6	2.41	18.5	1400	
Fish waste[2]			38.2	10.60	3.6		**Average**
Food waste (a)	80.0	2.0	59.7	5.10	11.7	800	
Food waste (b)	69.0		36.0	2.40	15.0		**Typical**
Fruit waste[1]	80.0		56.0	1.40	40.0	1500	**Average**
Grass	82.0	5.0	44.6	3.30	13.5	350	
Grass clippings[1]	82.0	5.0	57.8	3.40	17.0	500	**Average**
Hay	15.0	7.0	50.4	2.10	24.0	640	
Horse manure (a)	72.0		48.0	1.60	30.0	1380	
Horse manure (b)	79.5	15.0	49.5	2.93	16.9	1601	
Leaves	38.0	15.0	39.60	1.1	36.0	300	
Leaves (a)	46.0	15.0	51.8	1.23	42.1	500	
Leaves (c)	62.1	7.0	46.8	0.85	55.0	640	
Leaves[1] (b)	40.0		40.0	0.90	44.4	300	**Average**
Leaves (d)	60.0	15.0	37.0	1.50	25.0	640	
Paper	10.0		37.1	0.03	1235.0	250	
Recycle Compost/BS/WC	43.8	20.0	41.50	3.0	13.7	738	
Recycled compost	50.0		43.5	1.50	29.0	1100	
Recycled dairy compost	45.0		23.4	1.80	13.0	1340	
Sheep/Ewe manure	69.0		31.3	2.27	13.8	1400	
Straw	8.0		45.5	0.70	65.0	200	
Straw-wheat[1]	10.0		10.0	0.40	127.0	300	
Swine manure, grower	80.0		43.8	3.62	12.1	1400	**Typical**
Swine manure, mature	80.0		38.2	2.83	13.5	1400	
Tree trimmings[1]	70.0		70.0	3.10	16.0	48	
Wood, brush	39.0	2.0	44.1	1.07	41.2	410	
Wood, chips	40.0	2.0	45.5	1.20	37.9	500	
Wood, chips (a)	40.2	2.0	48.0	0.35	137.0	612	
Wood, hardwood-chips (b)				0.10	560.0	525	
Wood, new chips	38.7	5.0	47.50	0.5	95.0	612	
Wood, swdust[1] (a)	39.0		106.0	0.24	442.0	410	
Wood, sawdust, dry[2] (b)	16.0	1.0	49.8	0.16	311.0	457	
Wood, sawdust, green (c)	45.0		57.7	0.12	481.0	410	**Average**
Wood, soft-shavings	13.0		51.0	0.07	729.0	410	
Yardwaste	31.8	20.0	46.8	0.65	72.0	500	

[1] On-Farm Composting Handbook [2] OARDC/Ohio State University research data Other sources vary.

* NOTE: If "ash" value not given chose value based on simialar matrial.

** NOTE: If only N and C/N known calculate C=N*(C/N)

Compost Mixing Spreadsheet: Volume Basis

Chemical/Physical Lab Input Values (See "Material Properties" worksheet.) <--Colored blocks can be changed

Volume Inputs for Materials | Mass Inputs for Materials <--Colored blocks can be changed

Because chemical/physical numbers can vary greatly, use actual laboratory test results when possible.

STEPS:

1. Copy Materials one line at a time from "Material Properties" sheet and paste into spreadsheet.
2. Adjust Mixing Shrinkage Factor. (volume mix/volume ingredients) Generally between 0.9 to 1.0
3. Adjust volume amounts - Vol column (I17:I21)
4. Make adjusments to one or more amounts till desired C/N ratio achieved (Usually C/N between 30-40).
5. Add Mass water if moisture needed. Moisture 50-70%. (IF "VS" given, ash free basis should be 50-60% range)

VOLUME BASIS Mixing Shrinkage Factor: 0.95

ITEM	Moist %wb	Ash %db	C %db	N %db	C/N	Den lb/yd3	Vol yd3	% of Mix *Volume*	Wet Mass lb	% of Mix *Mass*	Dry Mass	Water	Mass C	Mass N	Mass Ash
Grass	82.0	5.0	44.6	3.30	13.5	350	1.00	29	350	30	63	287	28.1	2.08	3.15
Leaves	38.0	15.0	39.60	1.1	36.0	300	2.00	57	600	52	372	228	147.3	4.09	55.80
Wood, brush	39.0	2.0	44.1	1.07	41.2	410	0.50	14	205	18	125	80	55.1	1.34	2.50
							0.00	0	0	0	0	0	0.0	0.00	0.00
							0.00	0	0	0	0	0	0.0	0.00	0.00
water	100.0		0.0	0.00		1686			0	0		0			0.00
AVE/SUM	**51.5**	**10.97**	**41.2**	**1.34**	**30.7**	**347**	**3.33**		**1155**		560	595	230.5	7.51	61.45
Moisture(ash free basis)	**54.4**														

note: mass =density*volume water = 1684 lb/yd3 water = 8.34 lb/gallon

Contact: Harold M. Keener (keener.3@osu.edu), OARDC/Ohio State Univ. Print Date 3/23/15

Compost Mixing Spreadsheet: Mass Basis

Chemical/Physical Lab Input Values (See "Material Properties" worksheet.) <--Colored blocks can be changed

Volume Inputs for Materials | Mass Inputs for Materials <--Colored blocks can be changed

Because chemical/physical numbers can vary greatly, use actual laboratory test results when possible.

STEPS:

1. Copy Materials one line at a time from "Material Properties" sheet and paste into spreadsheet.
2. Adjust Mixing Shrinkage Factor. (volume mix/volume ingredients) Generally between 0.9 to 1.0
3. Adjust mass amounts - Mass column (K18:K23)
4. Make adjusments to one or more amounts till desired C/N ratio achieved (Usually C/N between 30-40).
5. Add <u>Mass</u> water if moisture needed. Moisture 50-70%. (IF "VS" given, ash free basis should be 50-60% range)

MASS BASIS Mixing Shrinkage Factor: 0.95

ITEM	Moist %wb	Ash %db	C %db	N %db	C/N	Den lb/yd3	Vol yd3	% of Mix *Volume*	Mass lb	% of Mix *Mass*	Dry Mass	Water	Mass C	Mass N	Mass Ash
Grass	82.0	5.0	44.6	3.30	13.5	350	1.00	29	350	30	63	287	28.1	2.08	3.15
Leaves	38.0	15.0	39.60	1.1	36.0	300	2.00	57	600	52	372	228	147.3	4.09	55.80
Wood, brush	39.0	2.0	44.1	1.07	41.2	410	0.49	14	200	17	122	78	53.8	1.31	2.44
							0.00	0	0	0	0	0	0.0	0.00	0.00
							0.00	0	0	0	0	0	0.0	0.00	0.00
water	100.0		0.0	0.00		1686			0	0		0			0.00
AVE/SUM	**51.6**	**11.02**	**41.1**	**1.34**	**30.7**	**347**	**3.31**		**1150**		557	593	229.2	7.48	61.39
Moisture(ash free basis)	**54.5**														

note: mass =density*volume water =1684 lb/yd3 water = 8.34 lb/gallon

Contact: Harold M. Keener (keener.3@osu.edu), OARDC/Ohio State Univ. Print Date 3/23/15

Lab Exercise 8: pH and Soluble Salts

Purpose:
pH is an important indicator of aeration during composting and of compost phytotoxicity. Most composts have a pH of 7 to 8.5. Low compost pH values (below 5) are usually due to the presence of organic acids formed during the process and indicate poorly aerated and/or wet composts. The organic acids found in composts include acetate, propionate,\ and butyrate, which are both odorous and phytotoxic.

Soluble salts in compost may limit its ultimate end use. User groups (e.g., vegetable growers, nursery industry, etc.) have a set of salinity standards for growing specific plants or crops. Most composts have an **electrical conductivity** of between 1 and 5 dS/m. High salts in a growing media (> 5 dS/m) may be associated with high plant nutrient content, but can also damage plants, especially seedlings, by burning roots and preventing or delaying germination. Excessively high electrical conductivity (salt content) also decreases plant-available soil water and plant nutrient availability. Conversely, very low salt contents (<0.5 dS/cm) may indicate low fertility levels, especially of bases such as potassium, calcium or magnesium.

Pure water is a very poor conductor of electric current, whereas water containing dissolved salts ordinarily found in composts conducts current approximately in proportion to the amount of salt present. Based on this fact, the measurement of the electrical conductivity of a compost extract gives an indication of the total concentration of salts present in the matrix. Composts are usually diluted when used in a soil or growing media, reducing the soluble salts levels.

Both the pH and electrical conductivity are measured in a 1:5 slurry of compost (dry weight) and water. Deionized or distilled water is used to prepare the slurry.

Equipment: 250-mL flask, deionized or distilled water, pH meter, electrical conductivity meter.

Procedure:

1. Weigh 40.0 g dry-weight equivalent of as-received moist compost into a sample container (e.g., 250-mL screw-cap flask).
2. Bring the liquid fraction of the 1:5 solids:liquid slurry to an equivalent of 200 mL by adding deionized water to the as-received moist compost sample.
3. Place the 250-mL flask with the 1:5 slurry on a shaker for 20 min at 180 reciprocations or excursions per minute. Or, manually shake.
4. Determine the electrical conductance of the 1:5 compost/water slurry with a conductivity/resistivity meter.
5. Determine the pH of the 1:5 compost/water slurry with a pH meter.

Lab Exercise 9: Compost Bioassay

Purpose: To learn how to conduct a plant bioassay of compost. Bioassays are used to measure the impact of using composts as a plant growth media or soil. A bioassay is useful in determining if composts are unstable or if inhibitors, such as salts, fatty acids or herbicides, are present at concentrations that could adversely affect plant health. A high compost to growing media ratio of 1:1 is used to amplify the effects of potential inhibitors. **For accurate results, bioassays must be conducted with 3 or more replicates and controlled lighting, temperature, and watering**.

Equipment: Styrofoam or other pot (1 liter) without drainage holes, growing media with nutrients (e.g. ProMix), weighing scale (0-3 kg), seeds (bean, tomato or cucumber), deionized or distilled water, temperature controlled area (e.g., greenhouse) with a 12 hour light cycle.

Procedure:

1. Record sample type (e.g. finished compost, etc.) ____________
2. Determine sample moisture content ($\mathbf{MC_s}$): ____________%
3. Determine growing media moisture content ($\mathbf{MC_{gm}}$): ____________%
4. Mix the compost sample and growing media 1:1 on a dry weight basis to give ~1 liter of mix.
5. Add water to saturate the mix and allow to drain.
6. Weigh the saturated sample ($\mathbf{W_{ss}}$): ____________g
7. Calculate the weight of an 85% saturated sample ($\mathbf{CW_{ss}}$): ____________g

   ($CW_{ss} = W_{ss} * 0.85$)
8. Record the target weight of an 85% saturated sample plus pot ($\mathbf{TW_{ss}}$): __________g
9. Place 4 bean seeds in the pot at a ½ inch depth.
10. Place pot in greenhouse. Water daily to the target weight (TW_{ss}) using deionized or distilled water (not tap water).
11. Observe daily and record the number of seeds that germinate. After germination cull to one plant. Poor germination indicates that high salt concentrations or fatty acids may be present.
12. After 35 days, photograph the plants and observe the leaf and plant morphology (shape, color, etc.). Curled leaves or loss of apical dominance (central stem grows less strongly than side stems) indicates herbicide contamination, yellow leaves indicate insufficient nitrogen or water stress, and poor growth indicates nutrient immobilization.
13. After 35 days, record the number of leaves and plant height (**H**). Cut the plant at the soil surface and record the plant wet weight ($\mathbf{W_{wet}}$) and dry weight ($\mathbf{W_{dry}}$).

H: ____________cm

W_{wet}: ____________g

W_{dry}: ____________g