The Best Compost Maturity Test Ever!

Compost Matters in Atlantic Canada
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Definitions (Ontario Compost Quality Standards, 2012)

- Maturity

"A condition of compost that results from the thorough decomposition of the feedstock materials, and as a result exhibits very limited biological activity, which enables the compost to be stored and handled without adverse effect, including offensive odours, and used without risk to plants from residual phytotoxic compounds."

- Stability (is dangerous)

"The term 'stability' is sometimes used interchangeably with 'maturity'. However in it's generally accepted meaning, 'stability' refers only to reduced biological activity. It is a subset of maturity. Compost could appear stable as a result of a nutrient imbalance or lack of moisture, and not extensive decomposition, and could become 'unstable' if any of the limiting conditions are removed. All mature compost is stable, but not all stable compost is mature."

Why Maturity is Important

- One of four necessary tests (maturity, metals, pathogens, foreign matter)
- Immature compost like untreated wastewater
- Used to measure overall process performance (product)
- Used to measure internal process performance (samples @ stages).

The Challenges

- No such thing as maturity meter
- No absolute reference
- All tests are indirect.

Compost Maturity Criteria (NSDOE, 1998)

One of the following sets of criteria must be met to qualify as mature compost:

Set 1*	- C:N Ratio ≤ 25:1 - An oxygen uptake rate of <150 mg O_2 /kg organic matter-hr - Cress and radish germination shall be >90% of the control sample and plant growth shall be ≥ 50% of the control sample
Set 2	- Compost must be cured for ≥ 21 days - Compost will not reheat to >20^{o}C above ambient temperature
Set 3	- Compost must be cured for ≥ 21 days - Organic matter reduction > 60% by weight
Set 4	- Compost cured (post-thermophilic stage) for six months in aerobic environment

* Two of three required

The Catalyst…….

CERTIFICATE OF ANALYSIS

PROJECT NO:
PO#:
LAB NUMBER: 184725
SAMPLE ID: HR10-21C

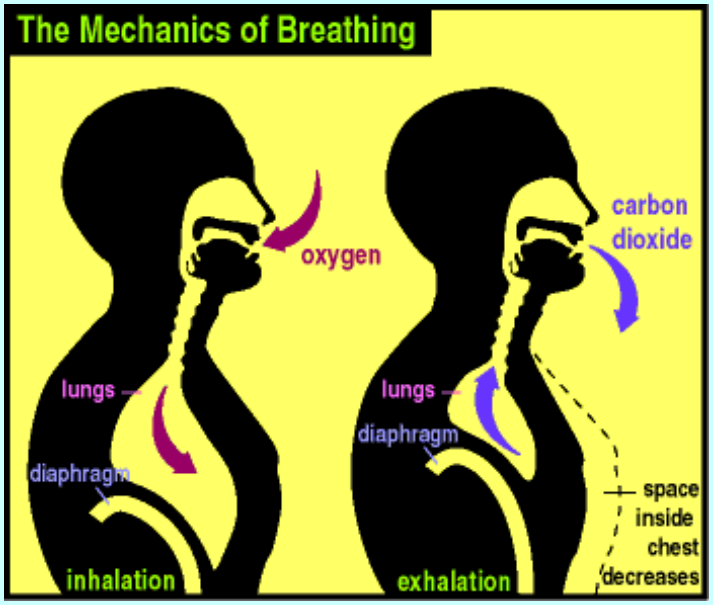
SAMPLE MATRIX:COMPOST
DATE RECEIVED:07/27/2008
DATE REPORTED:07/14/2008
PAGE:1

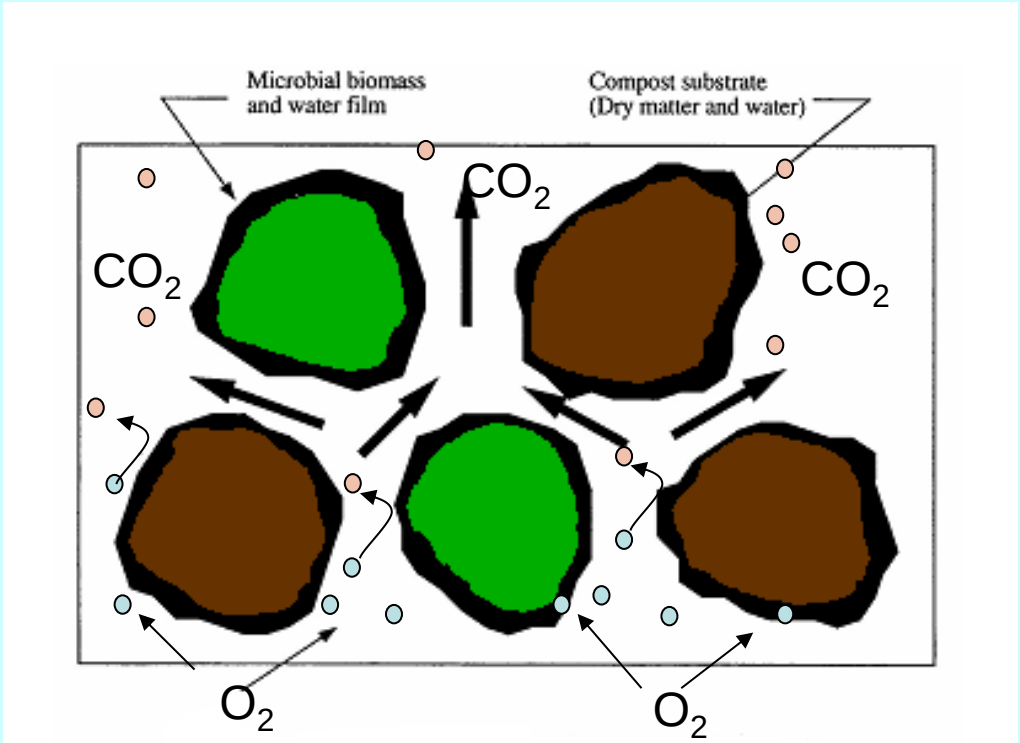
PARAMETER	RESULT	UNIT	DETECTION LIMIT	METHOD REFERENCE
Compost Stability Index	8	---		TMECC.05.08-B
Respiration-CO2-C/g OM/day	BDL*	mgCO2	0.01	TMECC.05.08-B
Respiration - CO2-C/g TS/day	BDL*	mgCO2	0.01	TMECC.05.08-B

*Below Detectable Limit

Why Oxygen Uptake (Respiration) Is Best

- Most accurate (if done correctly)
- Most quantitative
- Includes CO_2 production
- Beware of false passes & microbial health.





Respiration Rate Comparisons (mg oxygen/kg organic matter/h)

ID	Ontario MOE	Certified Lab	CRIQ
1	24	nd	200
2	23	nd	180
3	120	756	1370
4	15	289	320
5	690	756	3780
6	460	533	3580
7	1020	956	810
8	124	611	998
9	8	78	166
10	26	133	236

Modified BOD Respiration Test

Materials & Equipment:

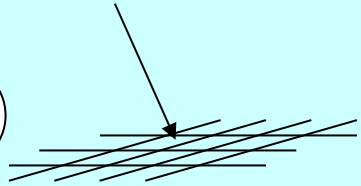
- ≈50 g screened compost (3/8”)
- Appropriate container
- Tap water
- Optical dissolved oxygen (ODO) meter with data logger
- Stir plate & magnet
- Fish tank pump, hose, air sparger & timer

Procedure

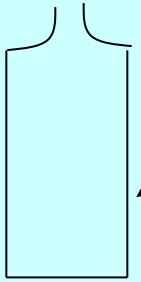
- Weigh ≈15 g of screened compost, then dry (to obtain moisture %), then ash (to obtain organic matter %)
- Weigh ≈10-20 g of screened compost, add to container
- Add known volume of tap water to container
- Place container on stir plate, add magnet and stir continuously
- Insert air hose and ODO probe, initiate ODO readings, program timer to aerate bottle intermittently
- After 2-3 days, remove air supply and ODO probe, empty and wash container
- Download ODO data to obtain average slopes (mg/L/h) over test period, divide by kg organic matter and multiply by water volume to obtain respiration rates over test period, take average of 6 maximum rates.

50 g Compost (mass, H_2O%, OM% known)

1



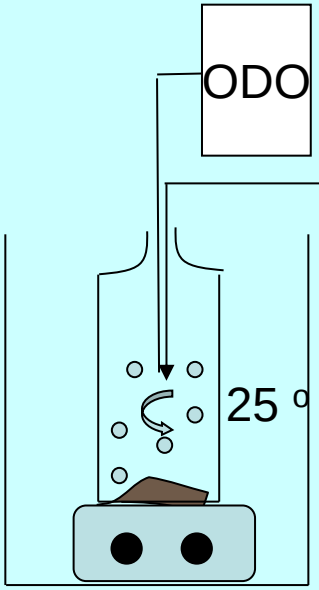
3/8” screen



Water (known volume)

Preparation

2



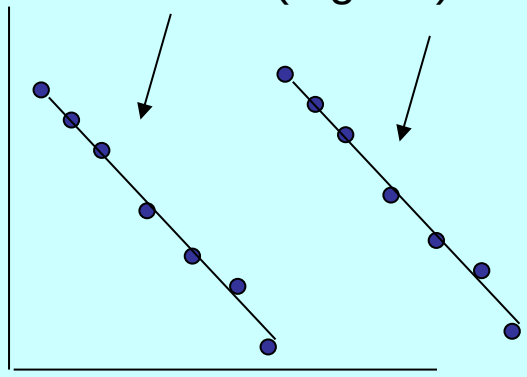
Data Collection

Time	DO
0	6.8
1	6.5
2	6.2
.	.
.	.

Continuous DO readings in incubator for 2-3 days on stir plate

3

Slope=Oxygen Consumption Rate (mg/L/h)



Data Plotted

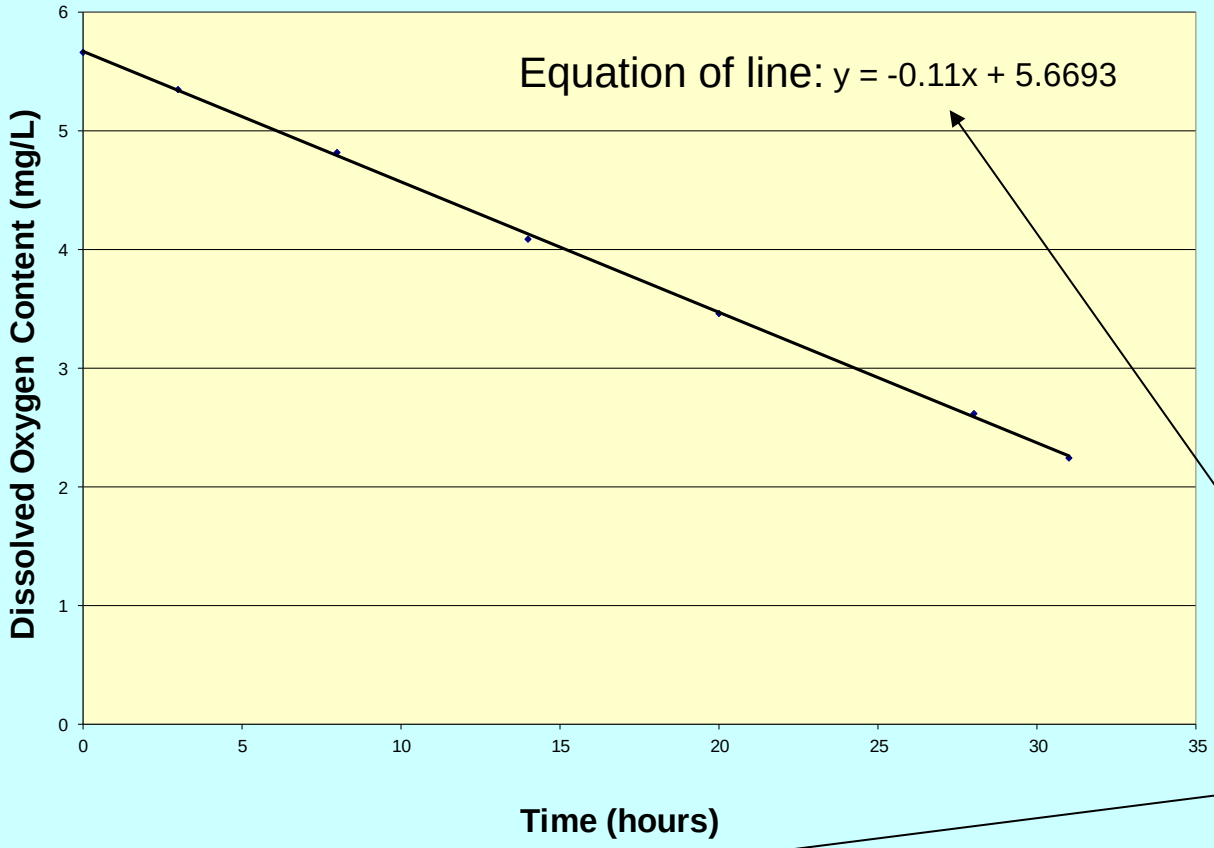
4

Multiply slope by original water volume, divide by organic matter to find oxygen uptake rate

Rate Determined

Typical Oxygen Consumption Rate

(0.050 kg wet compost, 55% water, 50% ash, DO test in 19 L water)



Slope

O_2 uptake (mg O_2/kg VS/h)=$\frac{0.11 \text{ mg/L/h} * 19 \text{ L}}{0.050 \text{ kg} * (1-0.55) * 0.5}$ = 186 mg O_2/kg VS/h

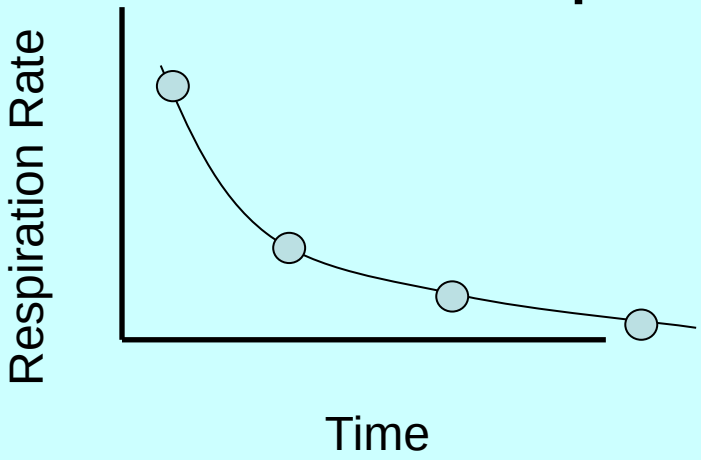
mass (kg) moisture % organic matter % water volume (L)

Respiration Comparisons (mg oxygen/kg organic matter/h)

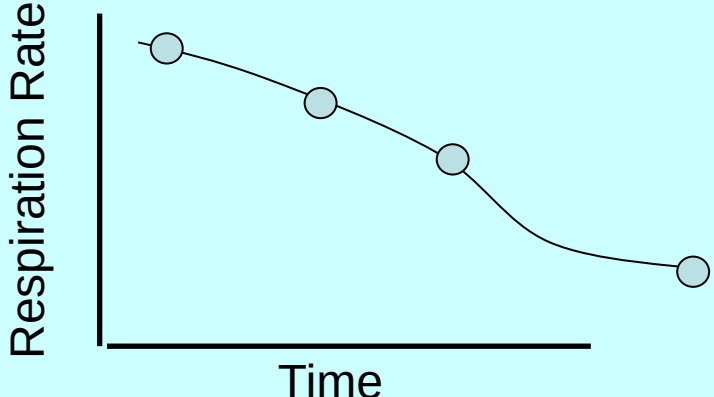
ID	Ontario MOE	Certified Lab	CRIQ	**Modified BOD**
1	24	nd	200	271
2	23	nd	180	186
3	120	756	1370	604
4	15	289	320	334
5	690	756	3780	5154
6	460	533	3580	4158
7	1020	956	810	1242
8	124	611	998	1187
9	8	78	166	232
10	26	133	236	266

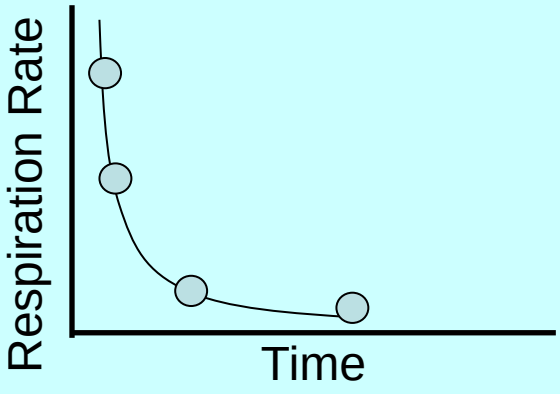
Test Use for Process Performance

- Test at multiple points in process



- Can show differences in process performance





Financial Bits

- Meter & Probe $2400
- Stir Plate $250
- Pump, hose, timer, carboy/beaker $75

  Total: $2725

  Lab test cost: $130/test

  Payback: 21 tests

Today's Research Results

	Respiration Rate (mg oxygen/kg organic matter/hour)
• Sample 1	287
• Sample 1	367
• Sample 2	2025
• Sample 2	3151

Summary

- Respiration tests are the most effective means of measuring compost maturity & evaluating composting process efficacy
- The on-site respiration test is relatively inexpensive and provides operators with accurate information on product quality and process performance.

Acknowledgements

- Sylvain Allard (BNQ)
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