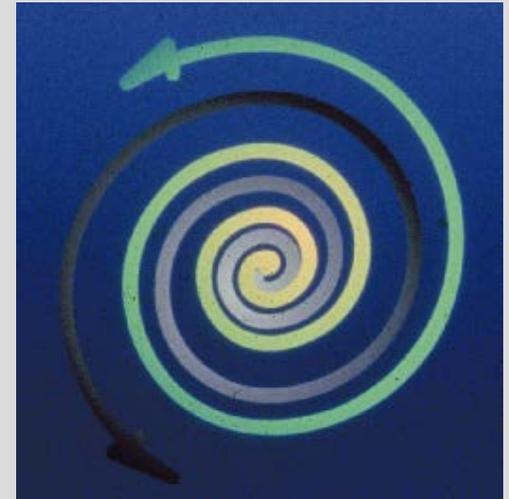


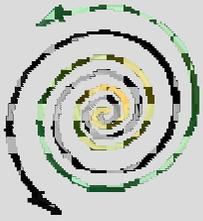
*Operations*

---

# ***Compost Operators Training Certificate Course***

**Operations**





# *Operations*

---

## ***References***

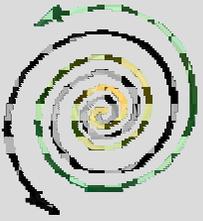
### **United States Composting Council**

*\*Recommend Commercial Composting and Compost Use 40-hour advanced course*

### **The Practical Handbook of Compost Engineering**

*Haug*

### **Michigan Compost Operator Training Guidebook**

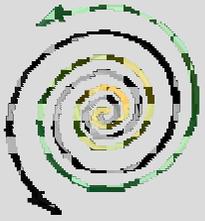


# *Operations*

---

## ***Outline***

- 1. Composting Processes**
- 2. Composting Systems and Technologies**
- 3. Process Monitoring and Control**
- 4. Health and Safety**
- 5. Equipment Selection and Maintenance**
- 6. Staffing**
- 7. Site Selection and Community Relations**



# *Operations*

---

## ***Composting Processes***



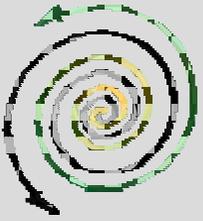
# *Operations*

---

## ***Composting Processes***

- 1. Feedstock Characterization**
- 2. Pre-Processing**
- 3. Active Composting**
- 4. Compost Curing**
- 5. Screening**
- 6. Odor Control**





# *Operations*

---

## ***Potential sources include***

- ❖ **Yard trimmings**
- ❖ **Land clearing debris**
- ❖ **Food scraps**
- ❖ **Storm debris**
- ❖ **Biosolids, sludges and greases**
- ❖ **Animal manures**
- ❖ **Animal mortalities**
- ❖ **Agricultural wastes**
- ❖ **Wood wastes (e.g., pallets)**
- ❖ **Sheetrock**

**Know your Waste!**



## Yardwaste to Compost



WeCare 





# *Operations*

---

## ***Material Acceptance***

- ❖ **Transportation/ Delivery**
  - ❖ Local (curbside)
  - ❖ Commercial (large volumes at once)
  - ❖ Container type (additional handling)
- ❖ **State of Material**
  - ❖ Volume vs. mass (packed trucks!)
  - ❖ Bags (odor and pre-processing issues)
  - ❖ Old (wet and odorous)





# *Operations*

---

## ***Feedstock Characterization***

### **❖ Quantities**

- ❖ Mass/ volume per day (solids and liquids)**

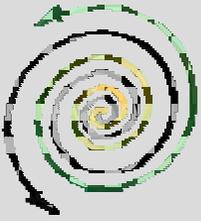
### **❖ Properties**

- ❖ Bulk density (weight per unit volume)**
- ❖ Moisture content**
- ❖ Nutrients (C&N, also P and micronutrients)**
- ❖ Contaminants**

### **❖ Develop appropriate feedstock 'recipes'**

### **❖ Seasonal Variations**

- ❖ Grass (spring) vs. leaves (fall)**



# *Operations*

---

## ***Recipe Development***

- ❖ **Characteristics of materials added to a mixture can aid or inhibit the decomposition process, aeration, microbial growth and odor production**
- ❖ **A mix of too high carbon will decompose at a slow rate and a mix high in nitrogen runs the risk of generating odors**
- ❖ **Seasonal generation patterns require that leaves be accumulated on-site in the fall for mixing**
- ❖ **Keep a careful watch on anaerobic materials and anaerobic conditions**



# *Operations*

---

## ***Design Criteria***

- ❖ **Air (oxygen, no less than 5%)**
- ❖ **Moisture (40-60%)**
- ❖ **Particle size (less than 2 inches)**
- ❖ **Porosity (free air space of >35%)**
- ❖ **C:N ratio (30:1 or less)**
- ❖ **pH between 6.5 and 8.0**
- ❖ **Temperature (70-150<sup>0</sup>F: meso to thermo)**
- ❖ **Bulk Density - lbs/cy (varies per waste)**



# *Operations*

<b>Material Composition</b>	<b>Nitrogen (dry weight) (%)</b>	<b>C:N (dry weight)</b>	<b>Moisture Content (average %)</b>	<b>Bulk Density @ Moisture Content (lbs/cy)</b>
<b>Food Waste</b>	<b>3.1%</b>	<b>15:1</b>	<b>70%</b>	<b>600 lbs/CY</b>
<b>Yard Waste</b>	<b>2.5%</b>	<b>20:1</b>	<b>10 to 50%</b>	<b>350 lbs/CY</b>
<b>Vegetable Waste</b>	<b>3.5%</b>	<b>12:1</b>	<b>70%</b>	<b>550 lbs/CY</b>
<b>Fruit Waste</b>	<b>1.4%</b>	<b>40:1</b>	<b>80%</b>	<b>800 lbs/CY</b>
<b>Coffee Grounds</b>	<b>3.0%</b>	<b>20:1</b>	<b>70%</b>	<b>600 lbs/CY</b>
<b>Tea Bags/Leaves</b>	<b>1.0%</b>	<b>70:1</b>	<b>70%</b>	<b>550 lbs/CY</b>
<b>Leaves</b>	<b>0.9%</b>	<b>60:1</b>	<b>40%</b>	<b>300 lbs/CY</b>
<b>Brush</b>	<b>2.0%</b>	<b>35:1</b>	<b>15 to 70%</b>	<b>400 lbs/CY</b>
<b>Grass</b>	<b>3.4%</b>	<b>15:1</b>	<b>80%</b>	<b>500 lbs/CY</b>
<b>Wood Chips</b>	<b>0.1%</b>	<b>600:1</b>	<b>50%</b>	<b>400 lbs/CY</b>
<b>Sawdust</b>	<b>0.2%</b>	<b>500:1</b>	<b>40%</b>	<b>400 lbs/CY</b>
<b>Soiled Paper</b>	<b>0.2%</b>	<b>150:1</b>	<b>20%</b>	<b>250 lbs/CY</b>
<b>Corrugated Cardboard</b>	<b>0.1%</b>	<b>550:1</b>	<b>8%</b>	<b>100 lbs/CY</b>



# Operations

## Recipe Example

- ❖ **Seasonal Yard Waste (brush/grass), poultry litter, clearing debris, leaves**

Seasonal YW Quantities:	12,000 "customers" x 2.6 persons/household = 31,200 persons			
	31,200 persons x 0.1 tons/person/year = 3,120 tons/year of YW			
	<u>Spring</u>	<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
Seasonal Quantity Distr.	40%	20%	30%	10%
Quantity per season (tons):	1248	624	936	312
Quantity per month (tons):	416	208	312	104
Quantity per week (tons):	104	52	78	26
Seasonal Distributions:	<u>Spring</u>	<u>Summer</u>	<u>Fall</u>	<u>Winter</u>
Grass Clippings	35%	25%	10%	0%
Brushy Yard Waste	65%	75%	40%	80%
Leaves	0%	0%	50%	20%



# Operations

MIX RATIO CALCULATIONS - Spring  
Example Weekly Recipe

## Recipe Example (Spring)

INGREDIENTS	Poultry Litter	Brushy Yard Wastes	Grass Clippings	Leaves (Freshly fallen)	Vegetative Clearing Debris	TOTAL MIX TARGET
C (% AS IS)	37.8	53.0	41.0	37.3	33.8	
N (% AS IS)	2.7	1.0	3.0	1.5	1.1	
MOISTURE%	37	42.5	80.0	54.1	57.5	
UNITS IN MIX BY WGT (T)	10	68	36	0	45	159
UNITS IN MIX BY WGT (LB)	20,000	136,000	72,000	0	90,000	318,000
UNITS IN MIX BY VOL (CY)	13	272	144	0	129	557
DENSITY (LBS/CY)	1600	500	500	200	700	
RELATIVE DENSITY	1.00	0.31	0.31	0.13	0.44	
	20000.00	136000.00	72000.00	0.00	90000.00	
POUNDS OF CARBON	7,560	72,080	29,520	0	30,420	139,580
POUNDS OF NITROGEN	540	1,360	2,160	0	990	5,050
C:N RATIO	14.00	53.00	13.67	24.87	30.73	<b>27.64</b> 20 TO 30
POUNDS OF MOISTURE	7,400	57,800	57,600	0	51,750	174,550
NUMBER OF UNITS	20,000	136,000	72,000	0	90,000	318,000
PERCENT MOISTURE						<b>54.89</b> 50 TO 65%



# Operations

MIX RATIO CALCULATIONS - Summer

Example Weekly Recipe

## Recipe Example (Summer)

INGREDIENTS	Poultry Litter	Brushy Yard Wastes	Grass Clippings	Leaves (Freshly fallen)	Vegetative Clearing Debris	TOTAL MIX TARGET
C (% AS IS)	37.8	53.0	41.0	37.3	33.8	
N (% AS IS)	2.7	1.0	3.0	1.5	1.1	
MOISTURE%	37	42.5	80.0	54.1	57.5	
UNITS IN MIX BY WGT (T)	20	39	13	0	45	117
UNITS IN MIX BY WGT (LB)	40,000	78,000	26,000	0	90,000	234,000
UNITS IN MIX BY VOL (CY)	25	156	52	0	129	362
DENSITY (LBS/CY)	1600	500	500	200	700	
RELATIVE DENSITY	1.00	0.31	0.31	0.13	0.44	
	40000.00	78000.00	26000.00	0.00	90000.00	
POUNDS OF CARBON	15,120	41,340	10,660	0	30,420	97,540
POUNDS OF NITROGEN	1,080	780	780	0	990	3,630
C:N RATIO	14.00	53.00	13.67	24.87	30.73	<b>26.87</b> 20 TO 30
POUNDS OF MOISTURE	14,800	33,150	20,800	0	51,750	120,500
NUMBER OF UNITS	40,000	78,000	26,000	0	90,000	234,000
PERCENT MOISTURE						<b>51.50</b> 50 TO 65%



# Operations

MIX RATIO CALCULATIONS - Fall

Example Weekly Recipe

## Recipe Example (Fall)

INGREDIENTS	Poultry Litter	Brushy Yard Wastes	Grass Clippings	Leaves (Freshly fallen)	Vegetative Clearing Debris	TOTAL MIX	TARGET
C (% AS IS)	37.8	53.0	41.0	37.3	33.8		
N (% AS IS)	2.7	1.0	3.0	1.5	1.1		
MOISTURE%	37	42.5	80.0	54.1	57.5		
UNITS IN MIX BY WGT (T)	20	31	8	39	45		143
UNITS IN MIX BY WGT (LB)	40,000	62,000	16,000	78,000	90,000		286,000
UNITS IN MIX BY VOL (CY)	25	124	32	390	129		700
DENSITY (LBS/CY)	1600	500	500	200	700		
RELATIVE DENSITY	1.00	0.31	0.31	0.13	0.44		
	40000.00	62000.00	16000.00	78000.00	90000.00		
POUNDS OF CARBON	15,120	32,860	6,560	29,094	30,420		114,054
POUNDS OF NITROGEN	1,080	620	480	1,170	990		4,340
C:N RATIO	14.00	53.00	13.67	24.87	30.73	<b>26.28</b>	20 TO 30
POUNDS OF MOISTURE	14,800	26,350	12,800	42,198	51,750		147,898
NUMBER OF UNITS	40,000	62,000	16,000	78,000	90,000		286,000
PERCENT MOISTURE						<b>51.71</b>	50 TO 65%



# Operations

## MIX RATIO CALCULATIONS - Winter

Example Weekly Recipe

## Recipe Example (Winter)

INGREDIENTS	Poultry Litter	Brushy Yard Wastes	Grass Clippings	Leaves (Freshly fallen)	Vegetative Clearing Debris	TOTAL MIX TARGET
C (% AS IS)	37.8	53.0	41.0	37.3	33.8	
N (% AS IS)	2.7	1.0	3.0	1.5	1.1	
MOISTURE%	37	42.5	80.0	54.1	57.5	
UNITS IN MIX BY WGT (T)	20	21	0	5	25	71
UNITS IN MIX BY WGT (LB)	40,000	42,000	0	10,000	50,000	142,000
UNITS IN MIX BY VOL (CY)	25	84	0	50	71	230
DENSITY (LBS/CY)	1600	500	500	200	700	
RELATIVE DENSITY	1.00	0.31	0.31	0.13	0.44	
	40000.00	42000.00	0.00	10000.00	50000.00	
POUNDS OF CARBON	15,120	22,260	0	3,730	16,900	58,010
POUNDS OF NITROGEN	1,080	420	0	150	550	2,200
C:N RATIO	14.00	53.00	13.67	24.87	30.73	<b>26.37</b> 20 TO 30
POUNDS OF MOISTURE	14,800	17,850	0	5,410	28,750	66,810
NUMBER OF UNITS	40,000	42,000	0	10,000	50,000	142,000
PERCENT MOISTURE						<b>47.05</b> 50 TO 65%



# *Operations*

---

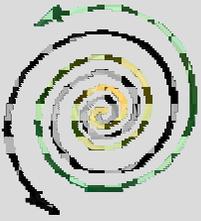
## ***Pre-Processing***

### **❖ Recovery**

- ❖ Remove physical contaminants
- ❖ Protect equipment from damage
- ❖ Easier to remove at front end

### **❖ Preparation**

- ❖ Optimize particle size for efficient composting
- ❖ Prepare for mixing
- ❖ Inoculum (compost recycle)
- ❖ Don't overgrind contaminants



# *Operations*

---

## ***Pre-Processing***

### **❖ Grinding**

- ❖ Breakdown large amendments (tree limbs)**
- ❖ Obtain desired particle size**
- ❖ Stockpile!**

### **❖ Mixing**

- ❖ Combine recipe ingredients**
- ❖ Bulking agent (wood) needed with wetter feedstocks**
- ❖ Complete and homogenous mixing is best**
- ❖ Moisten**



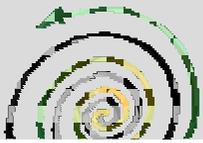
# Brush and Wood Waste Tub Grinding to Mulch





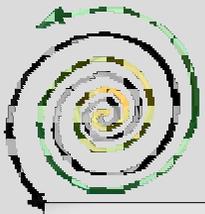
# Doppstadt Used for Yardwaste Processing *Operations*



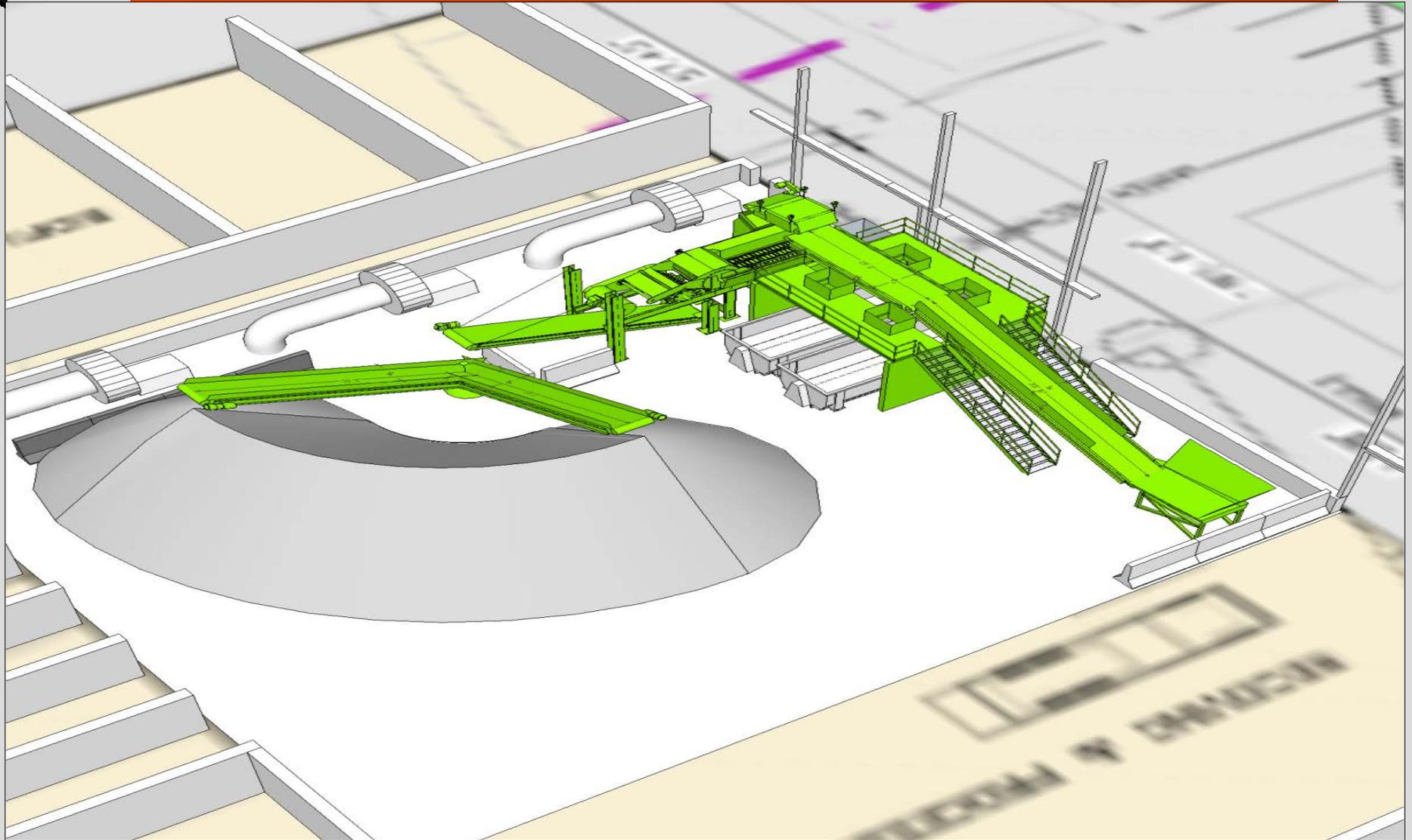


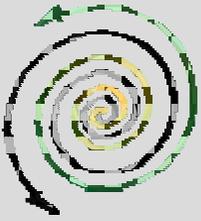
# *Operations*





# Receiving & Pre-processing Operations



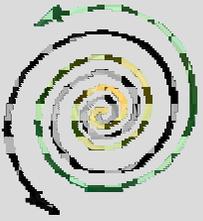


# *Operations*

---

## ***Active Composting***

- ❖ **Design criteria**
- ❖ **Biological process ~30+ days**
- ❖ **Objectives**
  - ❖ **Degradation/ stabilization of organic matter**
  - ❖ **Pathogen destruction**
  - ❖ **Seed destruction**
  - ❖ **Remove odor potential**
- ❖ **Process control**
  - ❖ **Porosity, oxygen level, moisture**
  - ❖ **Microbial diversity by temperature control**

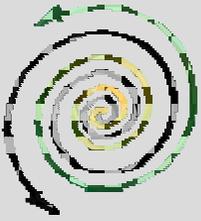


# *Operations*

---

## ***Changes in Compost Piles***

- ❖ **Mix of raw materials becomes more uniform and less bio-active**
- ❖ **Color turns brown to black**
- ❖ **Volume reduction of 25% to 50%**
- ❖ **Weight loss of 40% to 80%**
- ❖ **Some loss of N as ammonia**
- ❖ **C:N ratio declines**



# *Operations*

---

## ***Curing***

- ❖ **Once composted material is stable, but not mature**
  - ❖ **Stability = stage of decomposition**
  - ❖ **Maturity = biochemical state of the compost**
- ❖ **Maturing removes potentially phytotoxic intermediate compounds of decomposition**
- ❖ **Extent of curing defined by market**
  - ❖ **Overwintering ag fields – little curing**
  - ❖ **Horticultural uses – full curing**
- ❖ **Time: 30 – 60+ days**

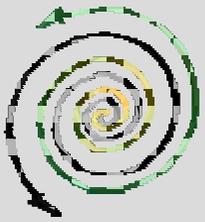


# *Operations*

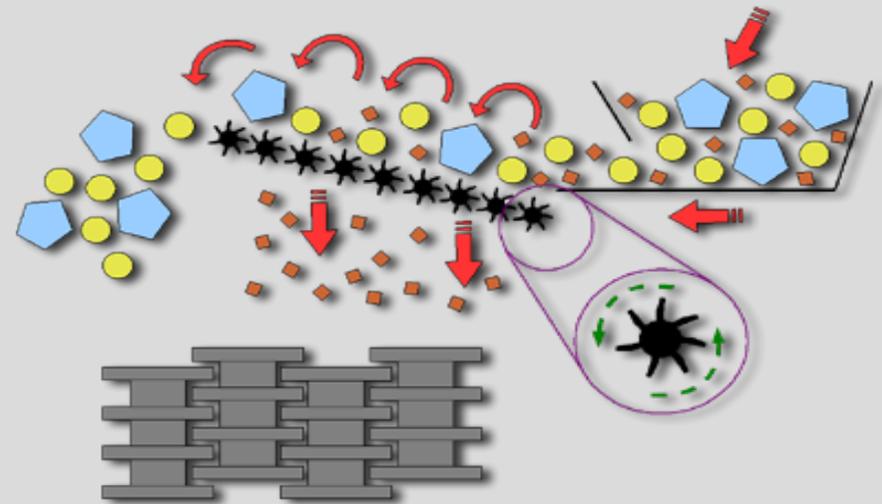
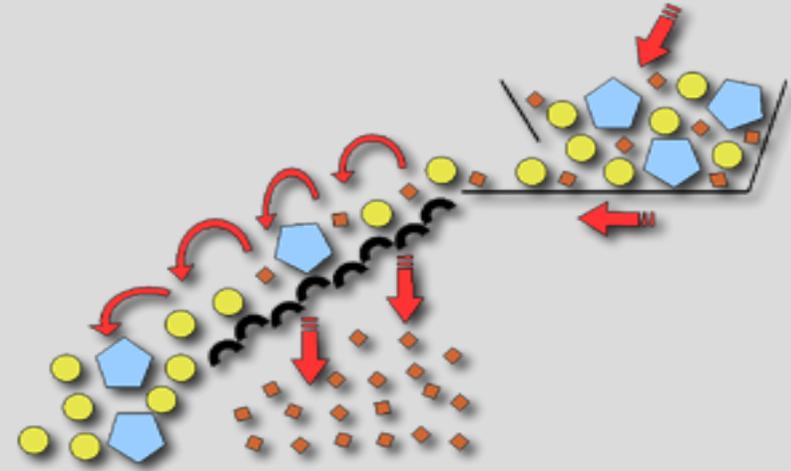
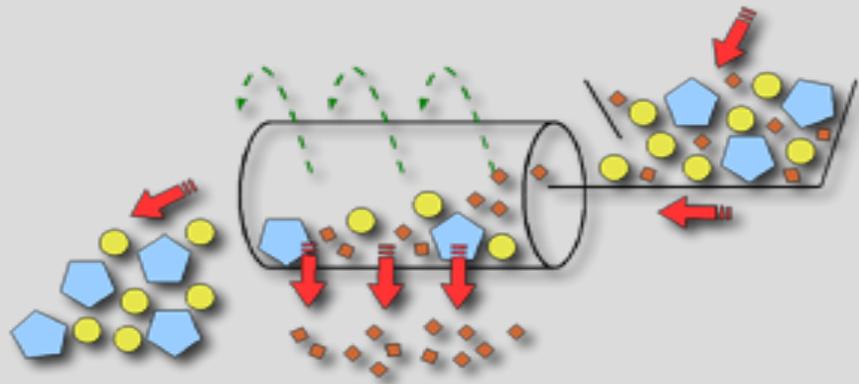
---

## ***Screening***

- ❖ **Equipment used to remove ‘large’ particles from finished compost before it is sold**
- ❖ **Screen size (e.g., 1/4”, 3/8”, 1”) vary on what the market for that material is**
  - ❖ **Golf course = smaller size**
  - ❖ **Road construction = larger size**
- ❖ **Types**
  - ❖ **Trommel Screen**
  - ❖ **Shaker deck**
  - ❖ **Star screen**



# Operations





# *Operations*

---

## ***Odor Control***

- ❖ **Chemical compounds emitted as a gas, inhaled and sensed by the human nose**
- ❖ **Odor quantification**
  - ❖ **Concentration**
  - ❖ **Intensity**
  - ❖ **Persistence**
  - ❖ **Character**
  - ❖ **Hedonic tone (pleasantness, or lack of)**
- ❖ **Determine odor concentration**

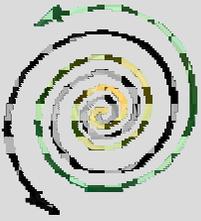


# *Operations*

---

## ***Odor Control***

- ❖ **Most released in first 14 days and after turning/ material movement**
- ❖ **Perform odor modeling for site layout/ mitigation**
- ❖ **Implement odor treatment technologies**
  - ❖ **Biofiltration**
  - ❖ **Windrow covers**
  - ❖ **Chemical scrubbers**
  - ❖ **Masking agents**
  - ❖ **“Neutralizers”/ counteractants**
  - ❖ **Electric field/ ozone generators**



# *Operations*

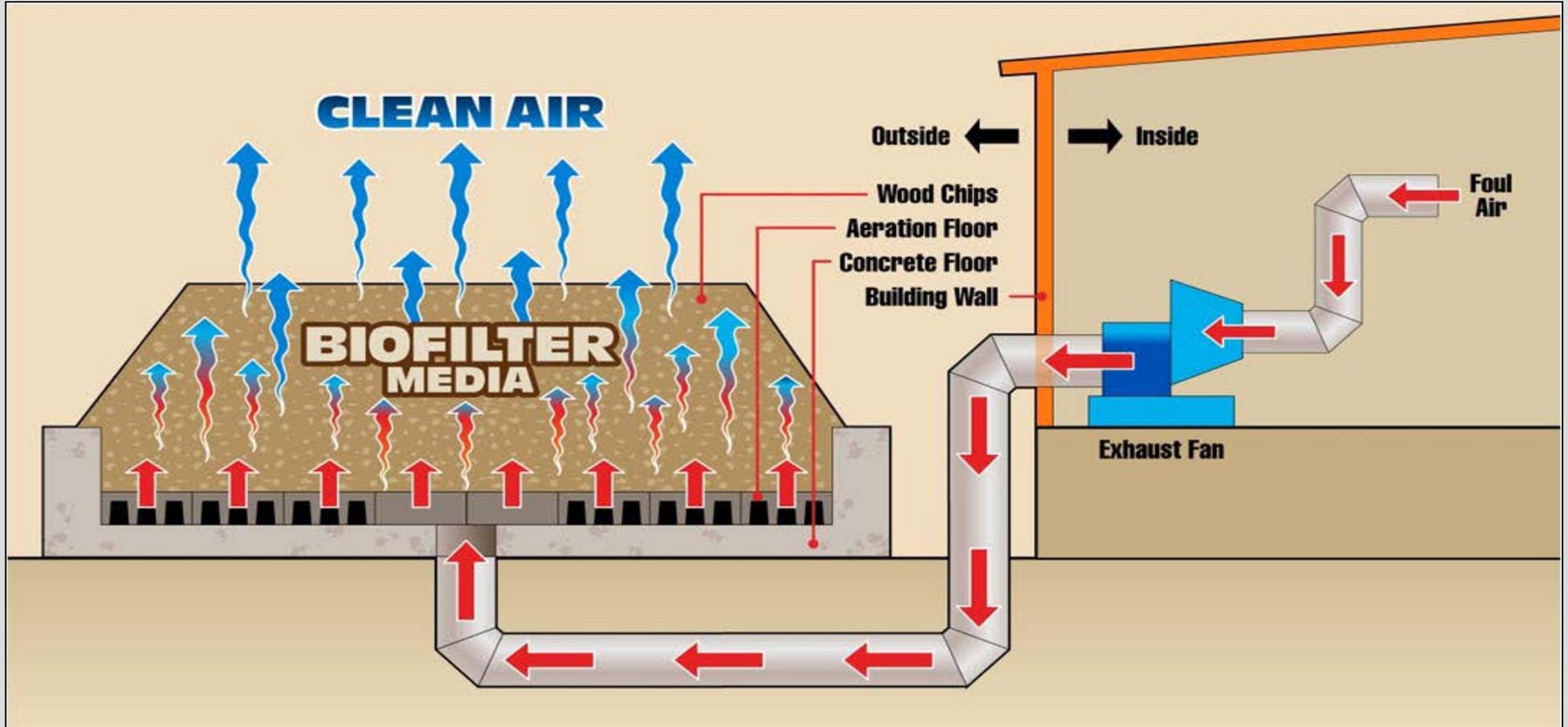
---

## ***Odor Control***

- ❖ **Common Odors and Cause**
  - ❖ Ammonia = Too much nitrogen
  - ❖ Amines (fishy) = Anaerobic conditions
  - ❖ Sulfides (rotten egg) = Anaerobic conditions
  - ❖ Volatile Fatty Acids, VFAs (gym bag) = Anaerobic conditions
- ❖ **Factors to Consider**
  - ❖ Composting rate/ size
  - ❖ Moisture
  - ❖ Aeration and turning
  - ❖ Recipe
  - ❖ Weather conditions
  - ❖ Time of day
  - ❖ Season



# Odor Control Technology Operations







*Operations*

---

# ***Composting Systems and Technologies***

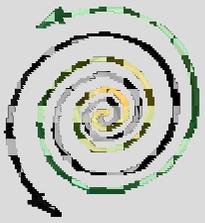


# *Operations*

---

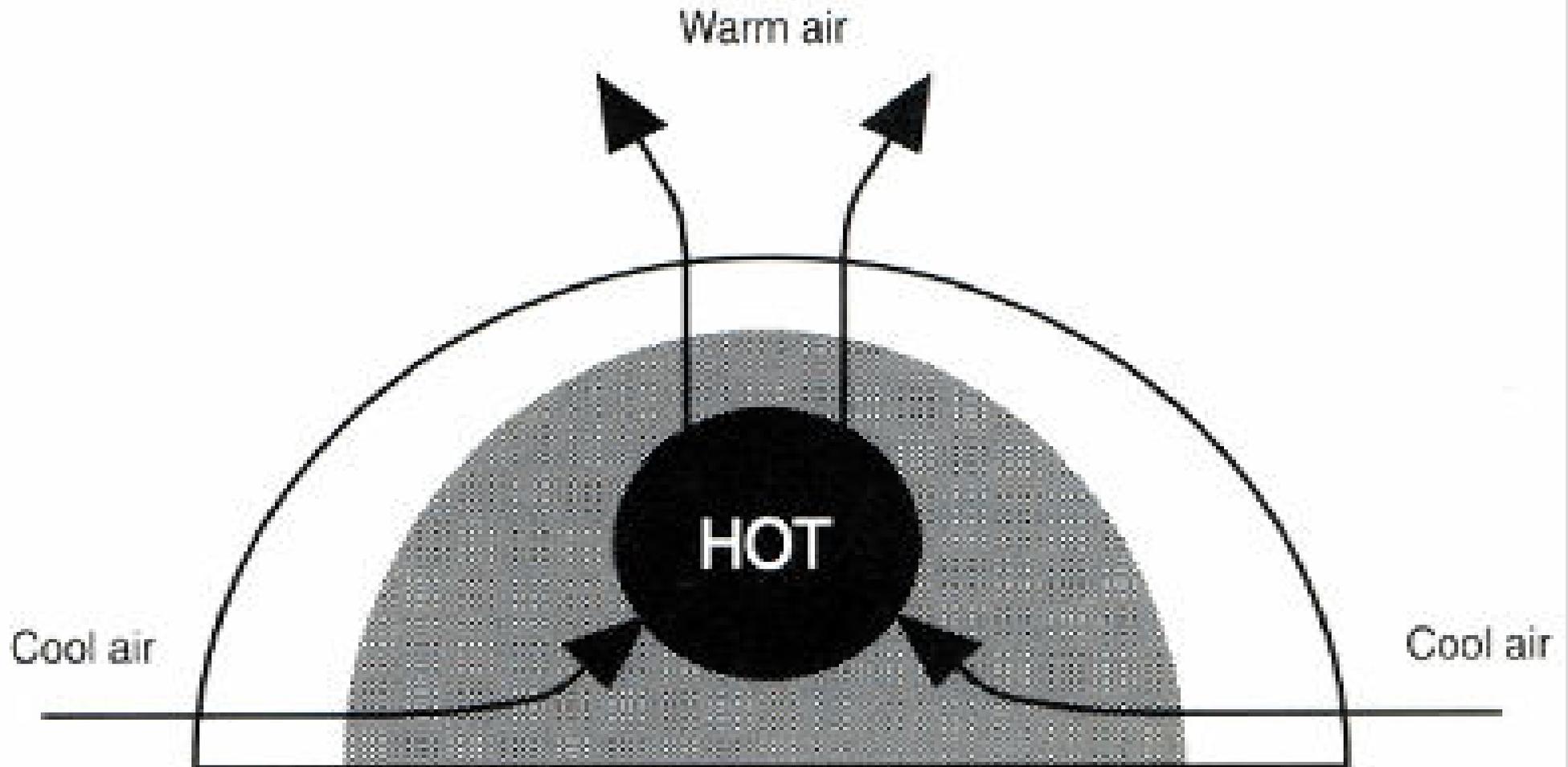
## ***Compost Methods***

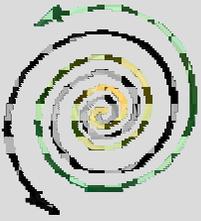
- 1. Turned Windrows**
- 2. Passive aerated windrows**
- 3. Aerated static pile**
- 4. In-vessel composting**



# *Operations*

## **'Chimney Effect'**





# *Operations*

---

## ***Turned Windrows***

- ❖ **Mixed materials placed in windrows which are agitated or turned**
  - ❖ **Various shapes**
- ❖ **Windrows aerate by passive air movement (chimney effect)**
- ❖ **Turning vital**
  - ❖ **Rebuilds porosity**
  - ❖ **Releases trapped heat, water and gases**
  - ❖ **Exchanges surface with interior materials**
- ❖ **Windrow Management**
  - ❖ **Important to maintain turning schedule (temp and odor control)**







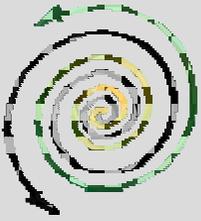
# *Operations*

---

## ***Passive Aerated Windrows***

- ❖ **Eliminates need for turning by supplying air to the materials through perforated pipes embedded in each windrow (hot gases rise upward out of the windrow)**
- ❖ **No turning or agitation of the materials occurs once the pile is formed**
- ❖ **Good for odorous feedstocks (i.e., fish waste)**





# *Operations*

---

## ***Aerated Static Pile***

- ❖ **Takes the piped aeration system a step further, using a blower to supply air to the materials**
- ❖ **No turning or agitation of the materials occurs once the pile is formed**
- ❖ **Can be positive or negative pressure air, depending on facility specifications**
- ❖ **Good for biosolids**



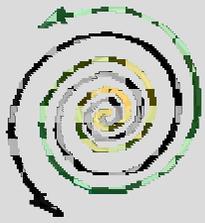


# *Operations*

---

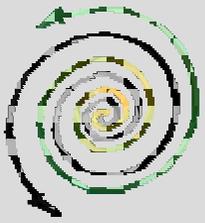
## ***In-Vessel***

- ❖ **Confine the materials within a building, container, or vessel**
- ❖ **Rely on a variety of forced aeration and mechanical turning techniques to speed up the process**
- ❖ **Bin composting, rectangular agitated beds, silos, rotating drums**



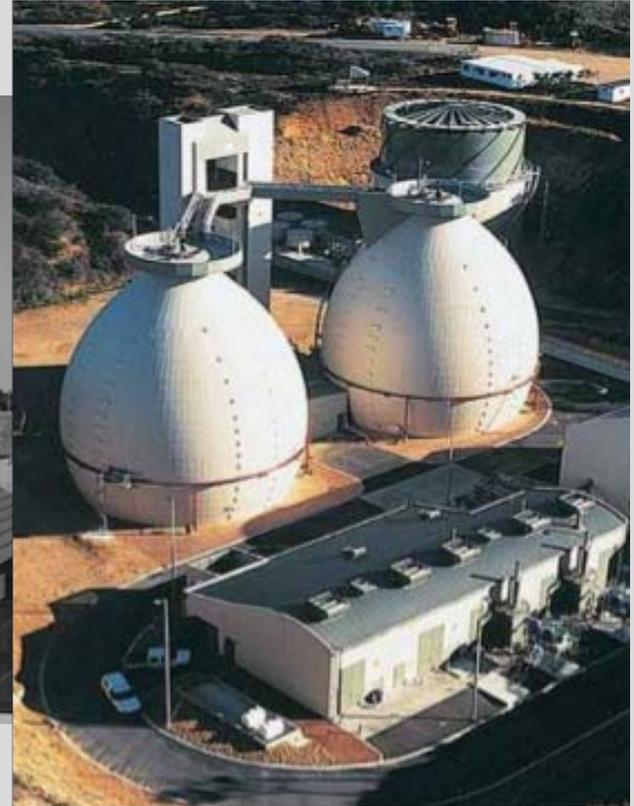
# ***BDP In-vessel Compost System Operations***





# *Operations*

## ***Anaerobic Digestion***





# Operations

Technology Type		O&M Cost (\$/ton) Low	O&M Cost (\$/ton) High	Time to Finish	Time to Finish (incl. curing)	
<b>Aerobic</b>						
Open Air	Agitated Pile (Windrow)	\$25/ton	\$52/ton	90 days	6-12 months	
	Aerated Static Pile	\$13/ton	\$25/ton	60 days	4-12 months	
Enclosed	Agitated Bed and Vessels	Horizontal Bays with top-rail agitator	\$34/ton	\$60/ton	21 days	2-4 months
		Containers (worm bins, earth tubs)	\$20/ton	\$50/ton	7 days	2-4 months
	Aerated Static Pile	Non-Rigid (Plastic or Fabric "Bags")	\$25/ton	\$50/ton	60 days	4-6 months
		Rigid (tunnel, bunker, vessel)	\$50/ton	\$150/ton	14 days	4-12 months
	Rotating Drums		\$25/ton	\$55/ton	7 days	2-4 months
<b>Anaerobic</b>						
Anaerobic Digestion (container or vessel)		\$50/ton	\$100/ton	30 days	2-3 months	
Anaerobic Digestion (silo/tank)		\$50/ton	\$150/ton	30 days	2-3 months	



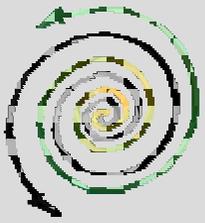
# *Operations*

---



# Operations

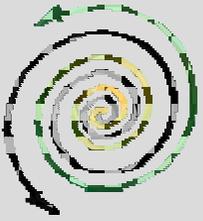
Technology Type		Minimum Volume	Maximum Volume	
<b>Aerobic</b>				
Open Air	Agitated Pile (Windrow)		10 tons/day	200 tons/day
	Aerated Static Pile		1 tons/day	20 tons/day
Enclosed	Agitated Bed and Vessels	Horizontal Bays with top-rail agitator	5 tons/day	500 tons/day
		Containers (worm bins, earth tubs)	1 lbs/day	20 lbs/day
	Aerated Static Pile	Non-Rigid (Plastic or Fabric "Bags")	0.5 tons/day	800 tons/day
		Rigid (tunnel, bunker, vessel)	2.0 tons/day	800 tons/day
	Rotating Drums		0.5 tons/day	1200 tons/day
<b>Anaerobic</b>				
Anaerobic Digestion (container or vessel)		500 gal/day	40000 gal/day	
Anaerobic Digestion (silo/tank)		40000 gal/day	250000 gal/day	



*Operations*

---

# ***Process Monitoring and Control***



# *Operations*

---

## ***Common Parameters***

### **❖ Temperature**

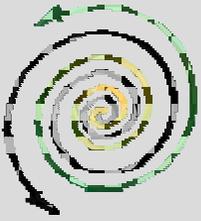
- ❖ Primary indicator of microbial activity
- ❖ Issues with  $<70^{\circ}\text{F}$  and  $>160^{\circ}\text{F}$

### **❖ Moisture**

- ❖ “Squeeze Method” – a few drops only
- ❖ Oven methods

### **❖ Oxygen**

- ❖ Similar assessment of composting rate as T



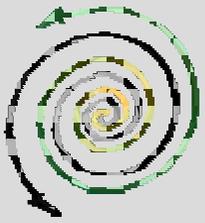
# *Operations*

---

## ***Process Monitoring and Control***

- ❖ **Implement Quality Assurance/ Quality Control standards and program**
- ❖ **Perform process monitoring to verify:**
  - ❖ **Product safety standards**
  - ❖ **Product market specs/ standards**
  - ❖ **Process control**
  - ❖ **Regulatory compliance**
- ❖ **Develop and implement site monitoring and sampling plan**
- ❖ **Field and laboratory analysis**
- ❖ **Develop a site Contingency Plan**

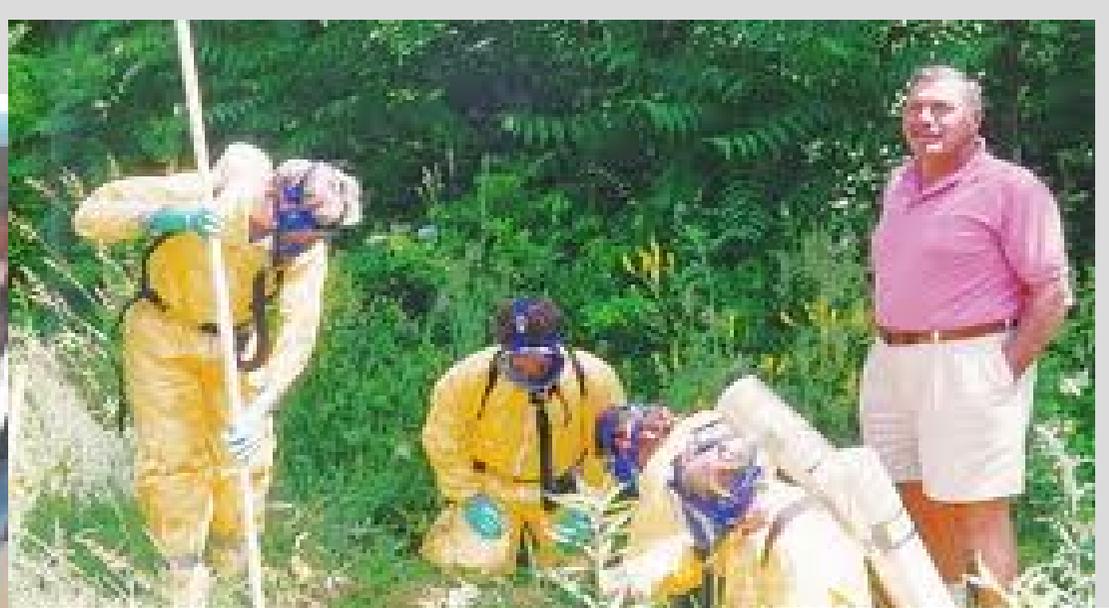
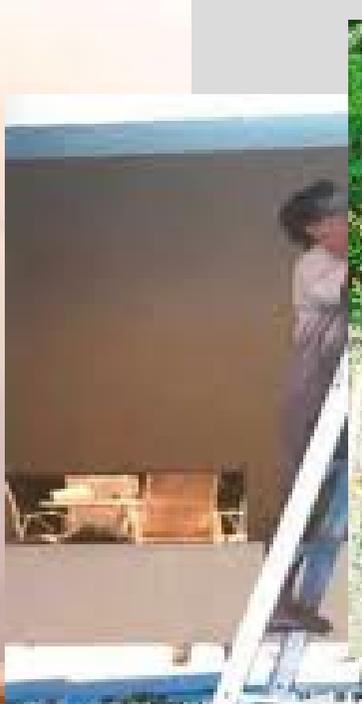


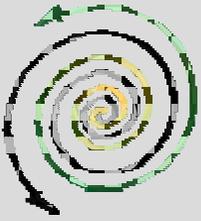


# *Operations*

---

## ***Health and Safety***





# *Operations*

---

## ***Health Concerns***

- ❖ **Dust: inhalation, eye irritants, airborne contaminants**
- ❖ **Noise: hearing loss**
- ❖ **Heavy equipment and machinery: loss of limb or life, electrocution, thrown objects**
- ❖ **Heat: exhaustion**



# *Operations*

---

## ***Safety***

- ❖ **Minimizing the risks**
  - ❖ **Pick the right site and equipment**
  - ❖ **Provide Personal Protective Equipment (PPE)**
  - ❖ **Maintain a good housekeeping program**
- ❖ **Safety in compost production**
  - ❖ **Operate equipment appropriately**
  - ❖ **Train and communicate with personnel**

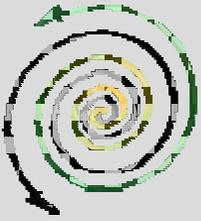


# *Operations*

---

## ***Occupational Safety & Health Administration (OSHA)***

- ❖ **www.osha.gov**
- ❖ **Compliance acceptance**
- ❖ **Laws & regulations**
- ❖ **Enforcement**
- ❖ **State programs**

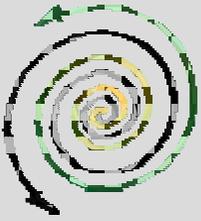


# *Operations*

---

## ***Fires***

- ❖ **Compost is readily available fuel source**
- ❖ **Typical compost materials ignite when**
  - ❖ **Moisture content <40%**
  - ❖ **Just enough oxygen present (vent holes)**
  - ❖ **Usually in large mass piles**
- ❖ **Ignition source**
  - ❖ **Mechanical (sparks, equipment, cigarette)**
  - ❖ **Biological (uncontrolled microbial activity)**
  - ❖ **Temps >158-176F spontaneous combustion occurs**
- ❖ **Develop fire prevention plan (w/ local fire department)**



# *Operations*

---

## ***Contaminants***

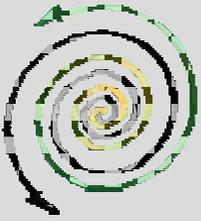
- ❖ **Develop a feedstock questionnaire**
  - ❖ **Visit feedstock generators**
  - ❖ **Pre-test feedstock sources**
- ❖ **Post signs**
- ❖ **Track all incoming feedstock by load**
- ❖ **Visually inspect loads as they are received**
- ❖ **Charge addition fees for contamination**
- ❖ **If possible, remove contaminants before processing**



*Operations*

---

***Equipment Selection and  
Maintenance***



# *Operations*

---

## ***Equipment Selection***

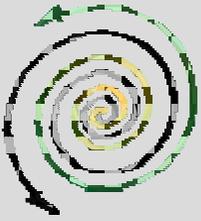
### **Considerations**

- ❖ **Production**
- ❖ **Simplicity of operation & maintenance**
- ❖ **Product support**
- ❖ **Durability**
- ❖ **Relationship with manufacturer**

### **Considerations**

- ❖ **Price**
- ❖ **Safety**
- ❖ **Reliability**
- ❖ **References**
- ❖ **Reputation**

**Know your Waste!**

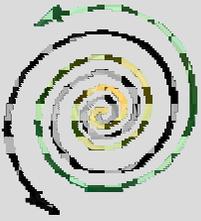


# *Operations*

---

## ***Equipment Categories***

- ❖ **Pre process equipment**
  - ❖ Weigh scales
  - ❖ Grinding equipment
  - ❖ Mixing equipment
  - ❖ Loading/ material handling equipment
- ❖ **In process equipment**
  - ❖ Compost turners/ loaders
  - ❖ Moisture management equipment
  - ❖ Aeration equipment
  - ❖ Process management equipment
- ❖ **Post process equipment**
  - ❖ Screening equipment
  - ❖ Bagging equipment



# *Operations*

---

## ***Price Variations***

- ❖ **Turning Equipment**
  - ❖ Loaders = \$50K-\$300K
  - ❖ Tractor-driven Turners = \$40K-\$200K
  - ❖ Self-propelled Turners = \$40K-\$600K
- ❖ **Grinding/Chipping**
  - ❖ Grinders = \$20K-\$700K
  - ❖ Hammer Mills = \$17K-\$400K
  - ❖ Chippers/Shredders = \$5K-\$300K
- ❖ **Mixing**
  - ❖ Pug Mills = \$20K-\$200K
  - ❖ Batch Mixers = \$10K-\$350K
- ❖ **Screening**
  - ❖ Screeners = \$50K-\$500K



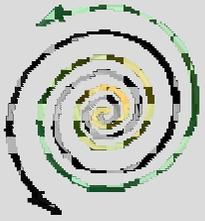
# *Operations*

---

## ***Maintenance***

- ❖ **House Keeping**
  - ❖ **Appearance of grounds and structures**
- ❖ **Equipment**
  - ❖ **Follow vendor O&Ms**
  - ❖ **Preventative maintenance schedules**
  - ❖ **Record keeping**
  - ❖ **Computerized tracking and inventory**

**CONTINGENCY!**



# *Operations*

---

## ***Staffing***

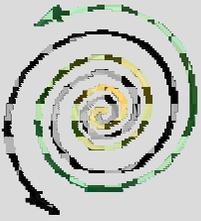


# *Operations*

---

## **Staffing**

- ❖ **Small pool of skilled *composters***
  - ❖ **Large equipment operators and farmers**
- ❖ **Need mechanical skill and high attention to detail**
- ❖ **Large expense is operations and making sure all tasks are run efficiently**
- ❖ **Need to make sure all equipment is operational with minimal downtime**
- ❖ **Mix of full- and part-time staff**
- ❖ **Training vital**



# *Operations*

---

## ***Staff Training***

- ❖ **Composting 101**
- ❖ **Let ALL employees understand importance and effect of every step!**
- ❖ **Site health and safety, and security**
- ❖ **Duty/ equipment specific**
- ❖ **Other aspects as well**
- ❖ **Operations and maintenance**
- ❖ **Proper reporting/ record keeping**

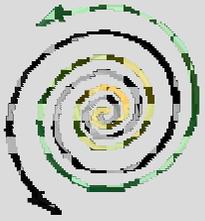


# *Operations*

---

## ***Staff Management***

- ❖ **Administer training**
  - ❖ **Initial**
  - ❖ **On-going**
- ❖ **Certification up-keep**
- ❖ **Seminars/Conferences**
- ❖ **Schedules and seasonal needs**
- ❖ **Mix roles (for covering...do not want back-up!)**
- ❖ **Lead by example**

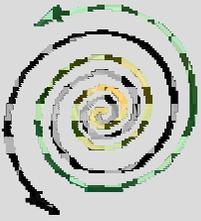


*Operations*

---

***Site Selection and Community  
Relations***



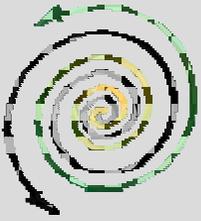


# *Operations*

---

## ***Siting***

- ❖ The most critical issue in facility development
- ❖ Need 2-5xs the land you need for facility
- ❖ Try for >1,000' to any sensitive receptors
  - ❖ Houses, churches, shopping centers, etc.
  - ❖ Surround facility with wooded buffers
- ❖ Try to be <5 miles from major arterial roads
- ❖ Acquire necessary permits (state solid waste, ag, water quality, local zoning, etc.)
- ❖ Setbacks!
  - ❖ Environmental, infrastructure (e.g., airports), etc



# *Operations*

---

## ***Site Selection***

### **❖ Site Location**

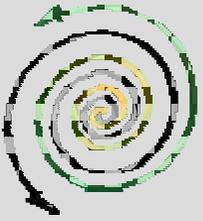
- ❖ Roads suitable for truck traffic
- ❖ Convenient to source of feedstocks
- ❖ Not in a residential area

### **❖ Sizing**

- ❖ Anticipated volume and equipment needs
- ❖ Future growth

### **❖ Site Characteristics**

- ❖ Level to slightly sloped ground
- ❖ Firm drainable soil
- ❖ Utilities convenient



# *Operations*

---

## ***Causes of Concern/ Complaints***

- ❖ **Ground and surface water pollution**
- ❖ **Property value reduction**
- ❖ **Migration of airborne fungal spores and pathogens**
- ❖ **Odor**
- ❖ **Excessive truck traffic**
- ❖ **Noise**
- ❖ **Vectors: rodents and insects**



# *Operations*

---

## ***Addressing Concerns/ Complaints***

- ❖ **Involve public in site selection and design**
- ❖ **Communication!**
  - ❖ **Hold open meetings**
  - ❖ **Send letters**
  - ❖ **Set-up a hotline and website**
- ❖ **Hold “Open House” tours**
- ❖ **Do not hide what you are doing**



# *Operations*

---

**Michael Nicholson**

**WeCare Organics, LLC**

**[mnicholson@wecareorganics.com](mailto:mnicholson@wecareorganics.com)**

**419-349-5402**