

# Forced Aeration with Pre-processing Animal Mortality Composting CPS 316



# Introductions

- Keith Warren, Advanced Composting Technologies, LLC or (ACT), President
- Ronnie Howard, Retired (34 years) NRCS District Conservationist, and ACT NC sales manager
- Chandler Cummins, ACT Southeastern Division Mgr.

# Today's Agenda

## #1 The Technology (15 minutes)

- History of the technology and it's relationship with NRCS
- Examine the Science and the Art of Composting Mortality
- Mechanics of Forced aeration and Pre-processing
- Examine the technology's benefits and challenges

## #2 The NRCS EQIP Connection (25 minutes)

- Ways to Incorporate the technology into EQIP
- Payment scenarios, cost estimates, design options...
- Vendor Synopsis of Advanced Composting Technologies, LLC (ACT)

## #3 Questions and Answers (30-40 minutes)

# History

- Historically NRCS depended on static pile as the standard response for composting assistance
- Only four Options:
  - Burial, Incineration, rendering, Rotary drum
- Tommy Cutts, NC's SCE recognized the limitations of those approaches and used a Conservation Innovation Grant to explore the new rotary drum option as well as a new (untested) forced aeration method of composting.

# NC Growers struggling with Static Pile

Several reasons for the struggle in 2000...and even today:

- A lack of grower focus on mortality management
- A lack of general composting knowledge
- User-Unfriendly – layering, multiple turnings, rotten, etc.
- Design Issues – wooden doors, no heavy use area, uncovered working area, no perimeter leachate control, confusion over the right recipe, etc.

# History

- In 2000, there were no commercially available forced aeration systems for mortality.
- There was one commercial composting operation in Asheville, NC that was successfully using forced aeration.
- Mr. Cutts invited and encouraged that company to participate in one of the CIGs.

Forced Aeration Technology used to compost manure and old sawdust.

Producing 1,000yds/month



Two Portable Demonstration Units were purchased with CIG \$\$ to validate the forced aeration process on poultry mortality.



Based on temperature performance, the process of forced aeration was successful.

NRCS approved 2003

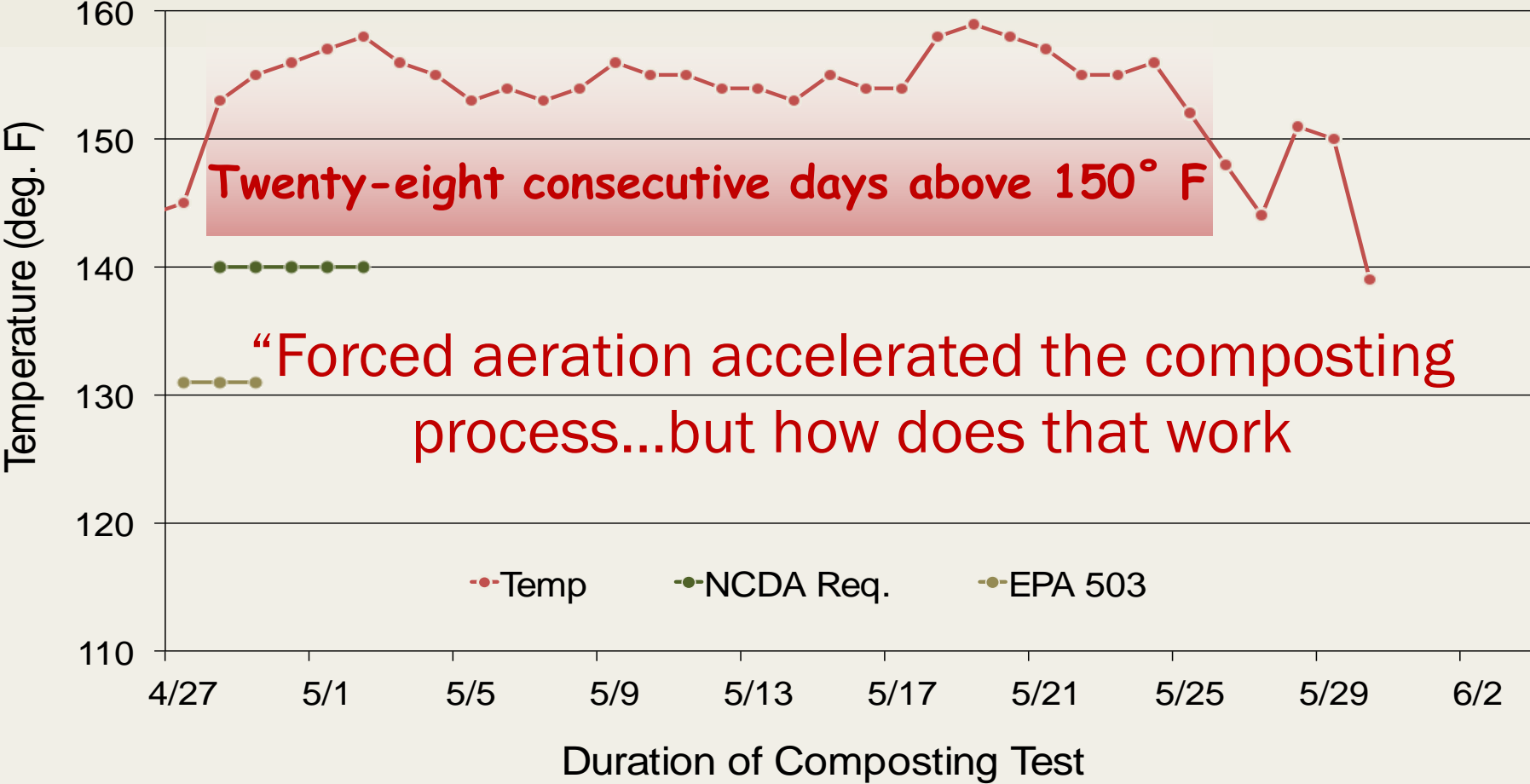
The design was a collaborative effort between NRCS and ACT to fix some of the issues with static pile.

Split-door design

Concrete bins & working pad, Heavy-duty doors, Forced Aeration, Leachate recycling



# Concrete Bin Temperature Performance



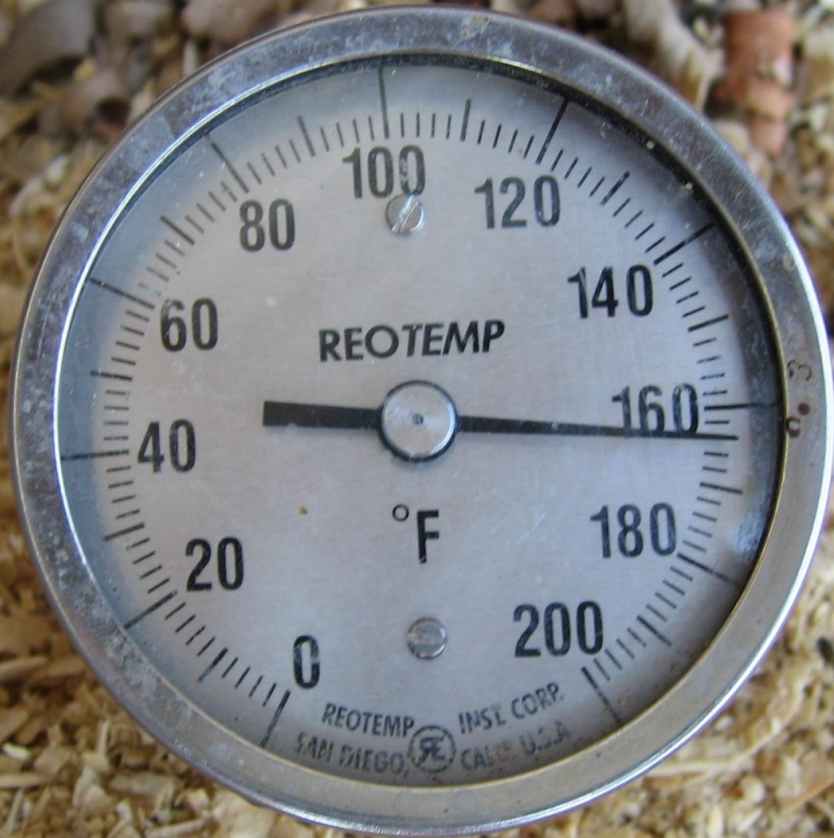
Composting is a biological process where microbes do all the work. **Figure out and deliver what the microbes need to thrive.**

Composting is an **aerobic** process (meaning that it requires the presence of air, more specifically **oxygen**) to support the microbial activity.

Those microbes that are doing all the work need 4 things to survive:

- Oxygen – fresh air
- Moisture – leachate
- Carbon – Food, Energy
- Nitrogen – Energy, critical to their biology.

**“So what’s temperature got to do with this?”**



- Temperature is the indicator of how well those four key elements are being delivered to the microbes.
- Temperature measures how fast the microbes are breaking down the organic matter
- Temperature performance = biosecurity

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F13346-6012  
ACCOUNT NUMBER  
61021

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QUALITY ANALYSES FOR INFORMED DECISIONS

FOR: MORTALITY COMPOST

TO: ADVANCED COMPOSTING  
1528 SMOKY HILL HIGHWAY  
PO BOX 2440  
CANDLER, NC 28715-2440

ATTN: KEITH WARREN

LAB NUMBER: 69716

SAMPLE ID: 1 DAVID GOODEN SWINE

DATE SAMPLED: 12/10/2013

DATE RECEIVED: 12/12/2013

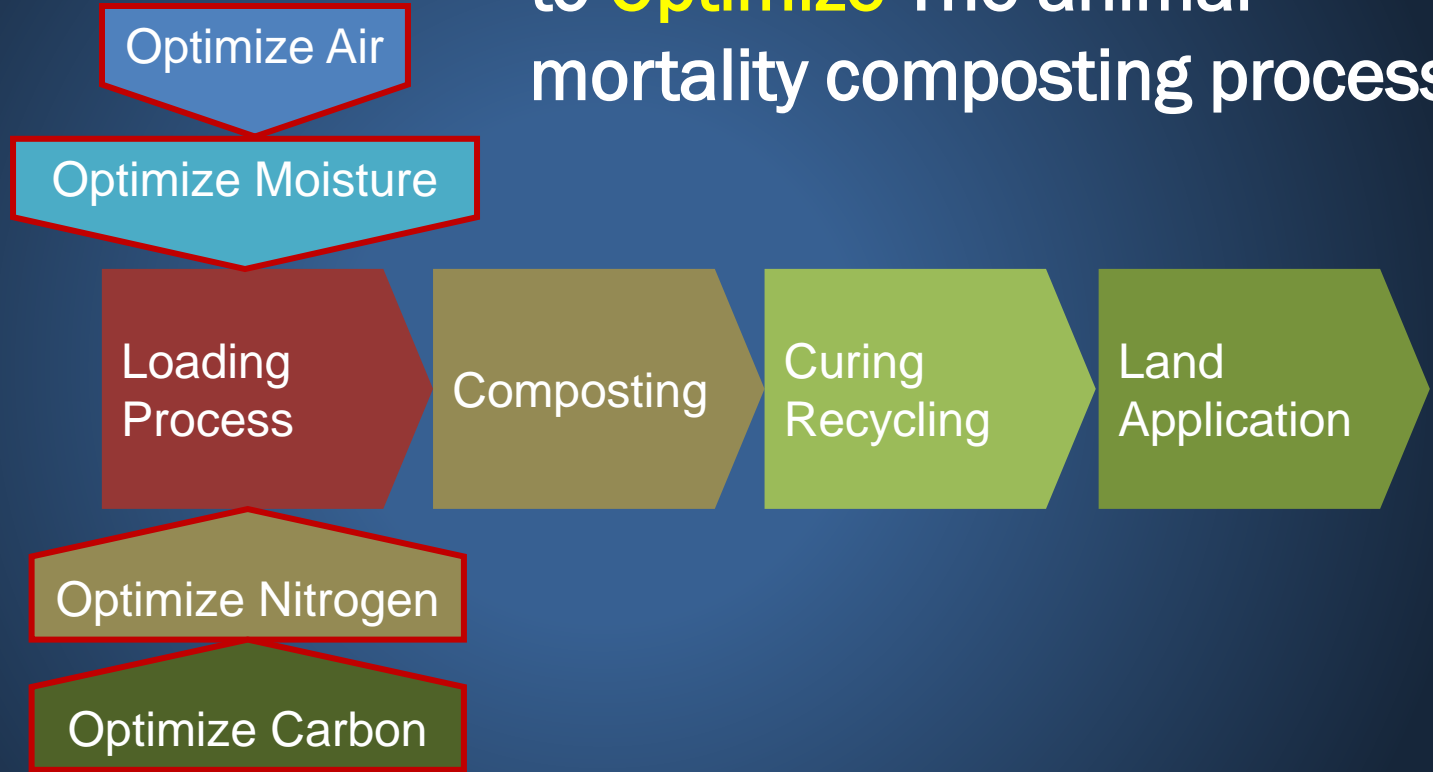
DATE REPORTED: 12/18/2013 PAGE: 2

## COMPOST ANALYSIS REPORT

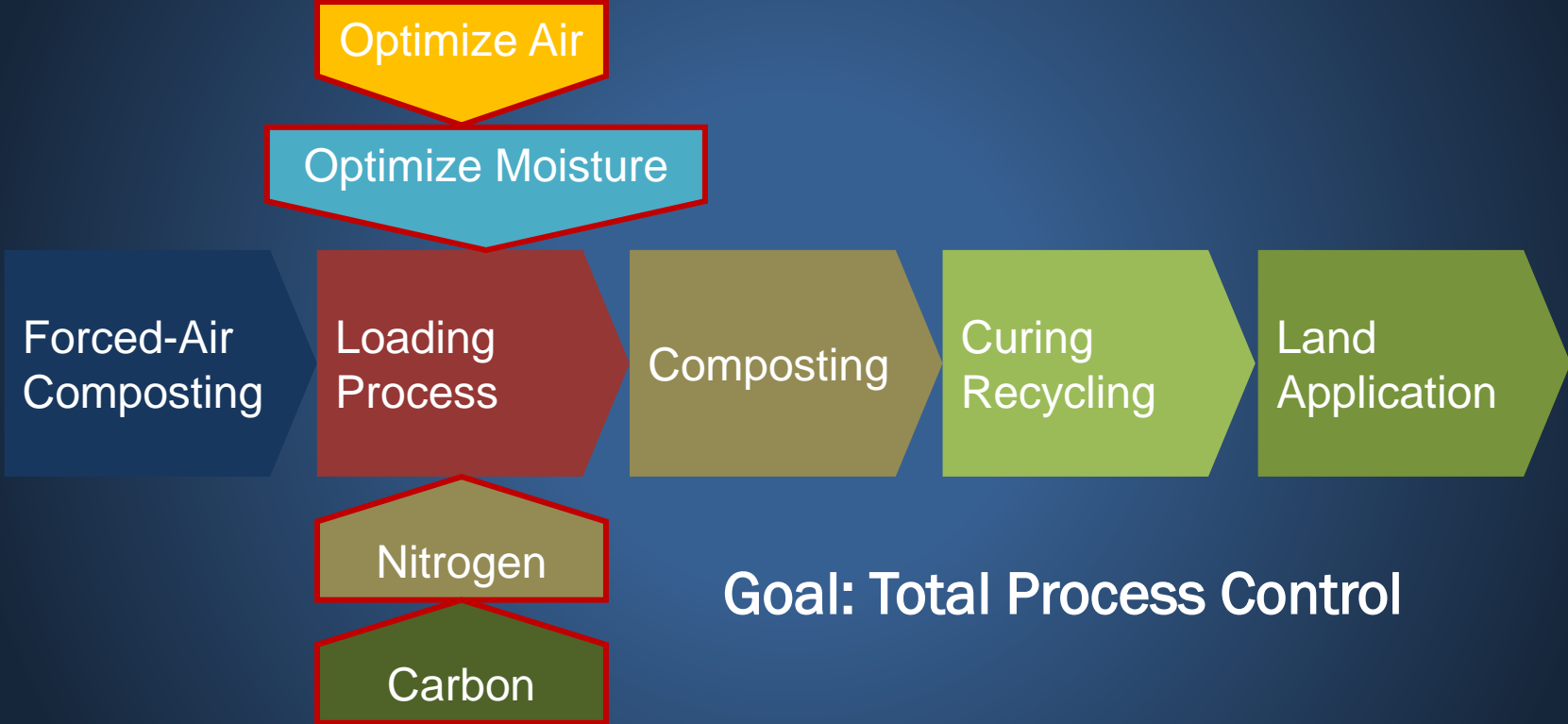
PARAMETER	UNIT	ANALYSIS RESULT	DRY BASIS RESULT	ANALYSIS METHOD
Copper (Cu)	mg/kg	75	145	TMECC 04.05-CU
Manganese (Mn)	mg/kg	93	180	TMECC 04.05-MN
Zinc (Zn)	mg/kg	108	211	TMECC 04.05-ZN
pH	-	7.8		TMECC 04.11-A
Soluble Salts	dS/m	9.59		TMECC 04.10-A
Fecal Coliform/MPN	MPN/g dry		0	SM(20th)-9221E TMECC
Pathogen Reduction - PASS/FAIL	pass/fail		PASS	40 CFR 503 Class A
Ash @ 550 C	%	6.14	11.94	TMECC 03.02-B
Organic Matter by LOI @ 550C	%	45.30	88.06	TMECC 05.07-A
Organic Carbon by LOI @ 550C	%	22.65	44.03	Estimated
Carbon:Nitrogen Ratio (C:N)	-	20.7:1	20.7:1	TMECC 05.02-A

**Not just Pathogen Reduction,  
but Pathogen Kill**

# There are four opportunities to **Optimize** The animal mortality composting process



# Forced Aeration Composting Process

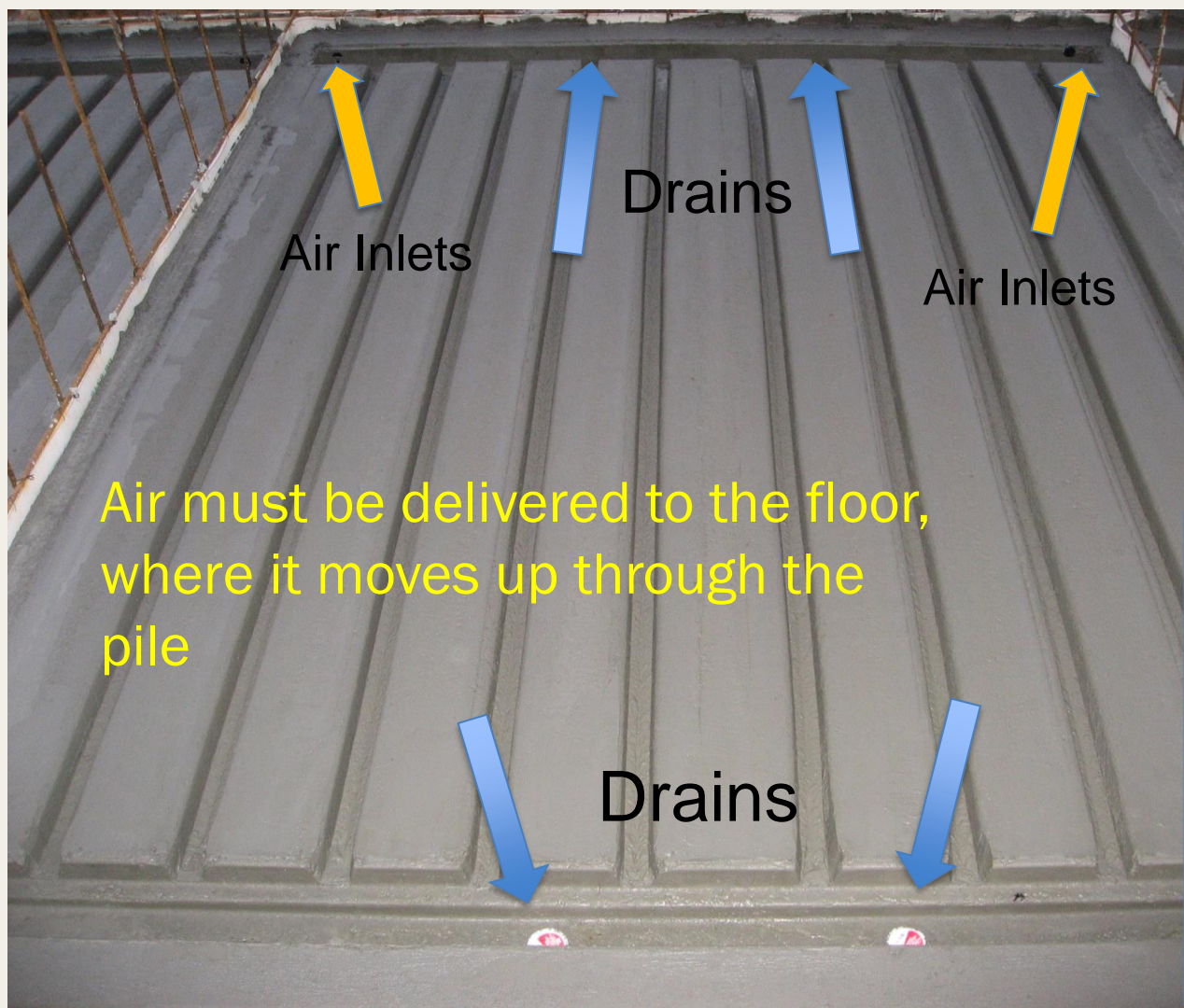




Every facility start-up was an opportunity for NRCS and NCDA and the growers to share their suggestions, criticisms, and their ideas to improve the process...

We need travel to the farm to see how forced aeration is incorporated into the structural design of the facility.

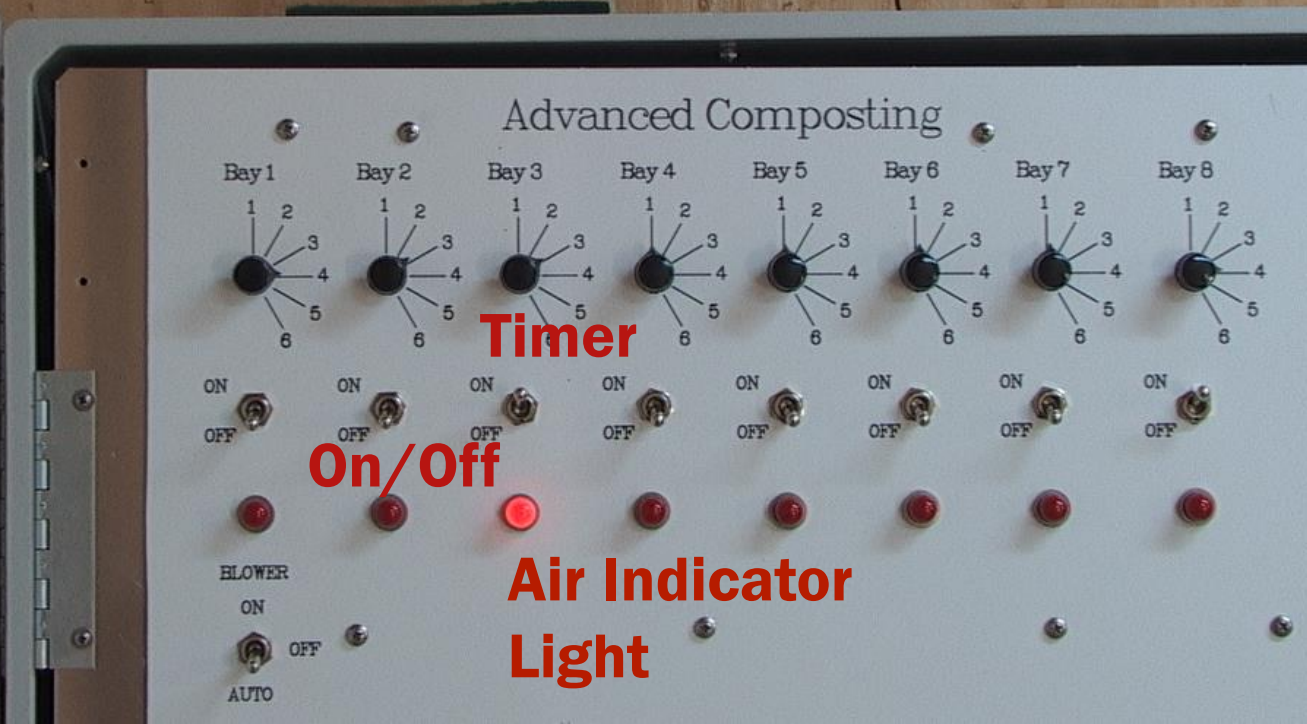
# Poured-in-Place Trenched Floors





**Air pressure gauge**

Great Process Control...  
One blower, multiple valves, from bin to bin, precise control.  
“Intuitively, it was impressive



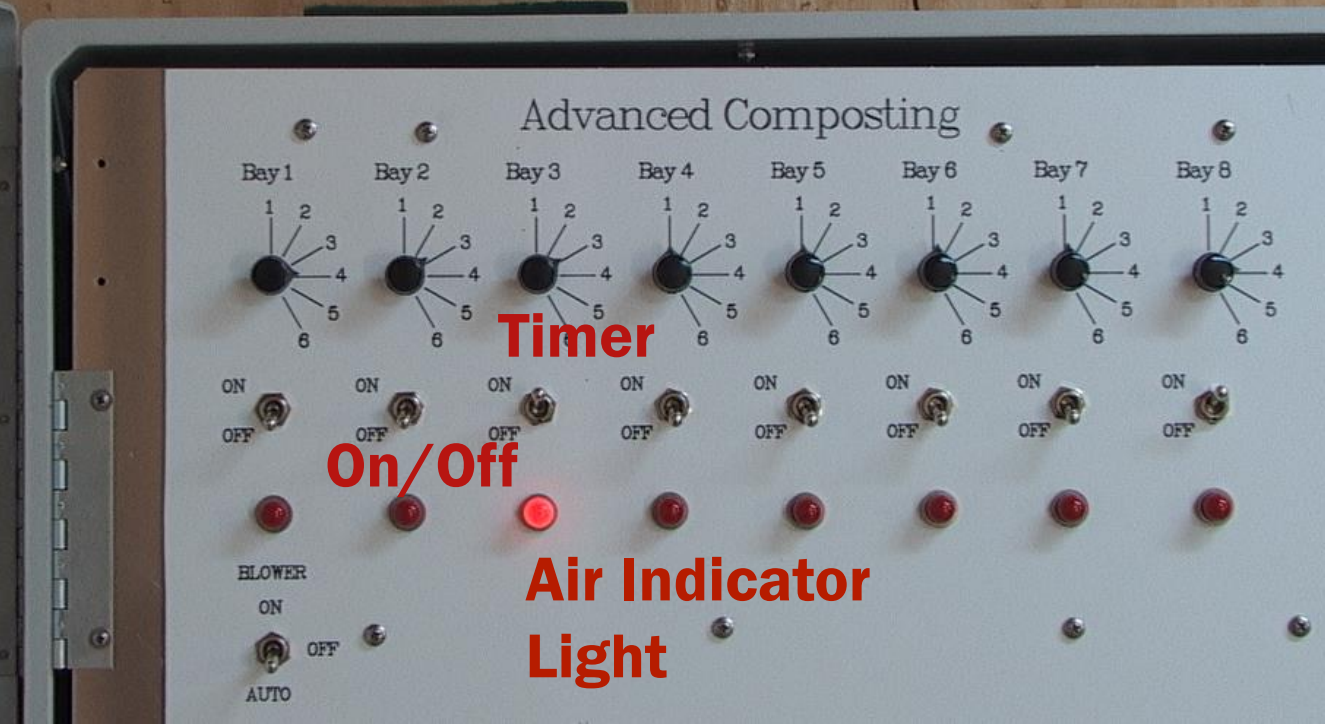
**Timer**

**On/Off**

**Air Indicator Light**



**Air pressure gauge**



**Timer**

**On/Off**

**Air Indicator Light**

But...  
The growers set it and forgot it.  
Stopping and starting the blower 8,760 times/year.  
If that single motor fails, system down...  
So instead of running 100cfm for 6mins...

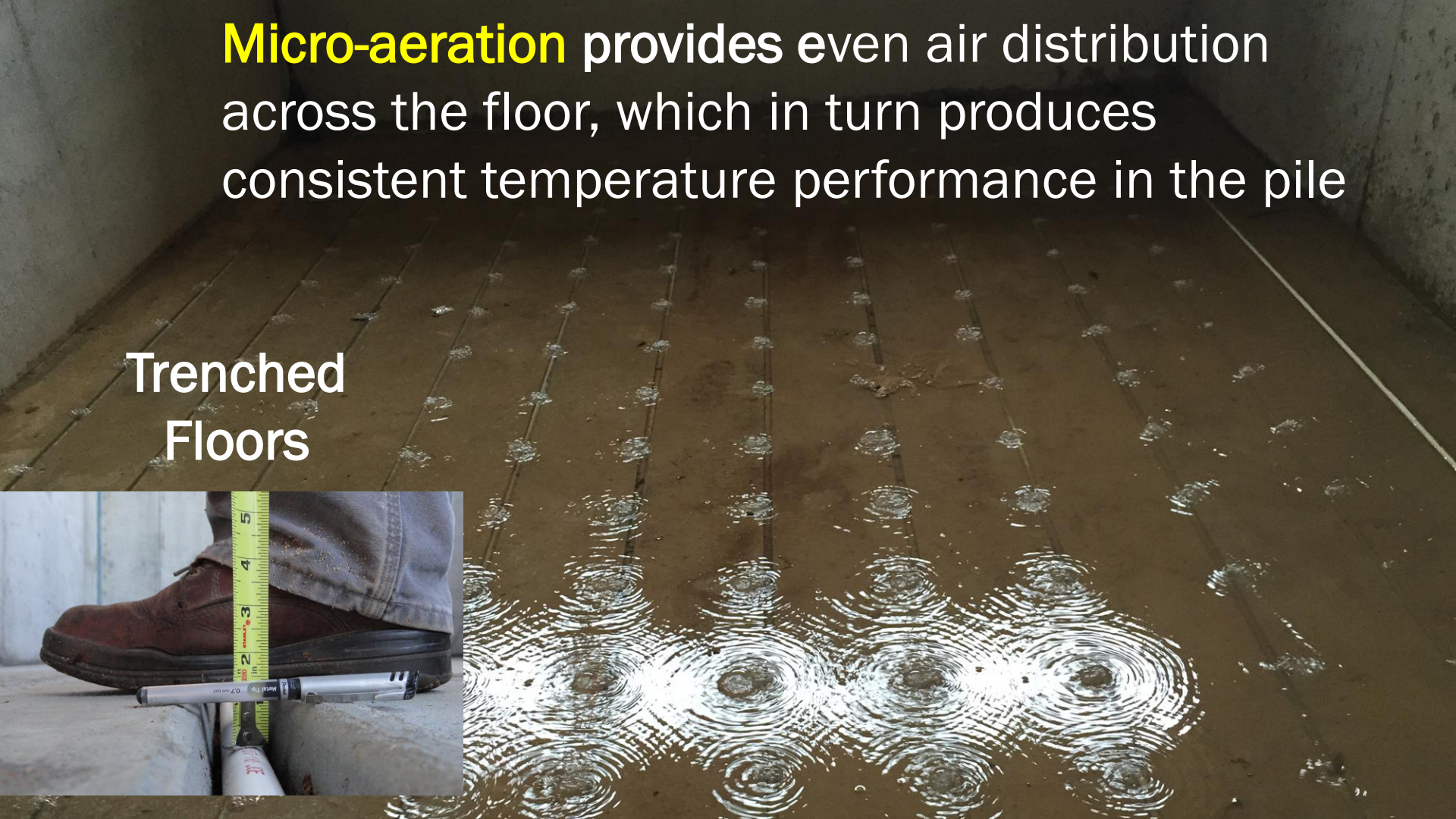
# Pressure Guages - Process Control



10 cfm for 60 min. or Micro-aeration:  
Individual Compressors  
Continuous aeration  
Smaller aeration holes

**Micro-aeration** provides even air distribution across the floor, which in turn produces consistent temperature performance in the pile

Trenched  
Floors



Optimize Air

Optimize Moisture

Forced-Air  
Composting

Loading  
Process

Composting

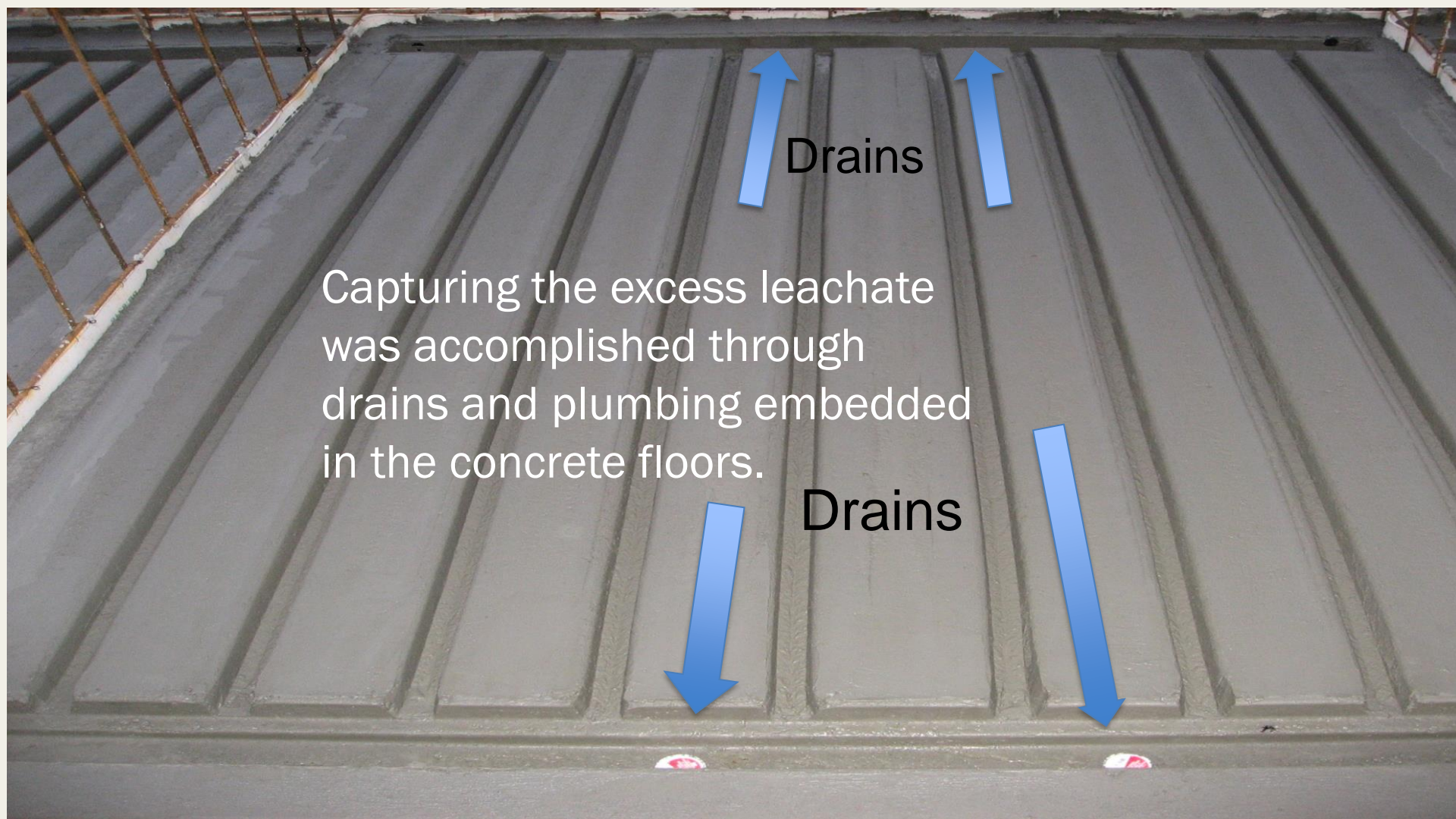
Curing  
Recycling

Land  
Application

Nitrogen

Carbon

**Goal is to provide  
Total Process Control**



Drains

Capturing the excess leachate was accomplished through drains and plumbing embedded in the concrete floors.

Drains



We collected and treated the leachate below ground in concrete storage tanks, and then we pumped that liquid back to bins to add moisture to the piles






- Moisture is critical; microbes thrive in the moisture
- The treated leachate becomes an inoculate

But there were issues:

- grower involvement,
- tanks running over,
- grease, fats, and oils building up in the tanks,
- clogged pumps, etc.



- Moisture is critical but the growers hated the leachate process...and we hated trying to fix it...



In 2014, an integrator challenged us... **“if you can eliminate the leachate tanks and the large residual bones,** then we have multiple operations in Oklahoma that need your systems.

Greg Sconyers - HanorUSA



The typical vertical feed mixer offered a means to reduce the carcass particle size and hopefully the large bones.

It worked well...not perfect but good enough to prove the concept. Great mixing, adequate bone reduction and good leachate capture. Now we needed a stationary unit, specifically designed for animal mortality.



# Modifications to the TMR Mixer

- Tub Design
- Knives
- Planetary Gear
- Stainless Steel Liner
- VFD Control Panel
- Stand-alone Conveyor

# Preprocessing:

Became a Huge “Game Changer”  
for mortality composting.



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## Bones and Leachate...

The vertical feed mixer reduced  
particle size of the carcass and the  
**bone**, but we discovered that it did a  
lot more than grind and chop.

## #1 The Bones

The mixer grinder chopped, broke, cut and reduced the bones to a manageable size, exposing them to the composting process from the very start.



## #2 The Leachate

The mixer grinder also forced all the moisture within the carcasses into the carbon during the same time that it was chopping up the bones eliminating the need for secondary leachate control.



### #3 The Loading Process

Pre-processing produces a homogenous mix before the composting process is even started. No more layering, no more placement of animals off the walls, no more managing the traditional first stage of static pile composting.



## #4 Optimizing Nitrogen

Pre-processing also forces the feathers to absorb the moisture contained in the birds, accelerating their breakdown as well. No need to add water to the whole birds to help the feathers breakdown and then adding litter to help absorb the excess.



## #4 Optimizing Nitrogen

Pre-processing exposes all of the nitrogen contained in the carcass to air, moisture, and carbon so that additional **nitrogen (LITTER)** is no longer needed, again no more managing the traditional first stage of static pile composting.



## #5 Optimizing the Carbon

Pre-processing forces the available carbon to absorb the moisture and exposes all of the carbon to readily available nitrogen and air, reducing the volume and quality of fresh carbon required by almost half. This allows more “hot” compost to be recycled into the mix.



#5 Optimizing the Carbon  
Example of ...”reducing  
the volume and quality of  
fresh carbon required by  
almost half...

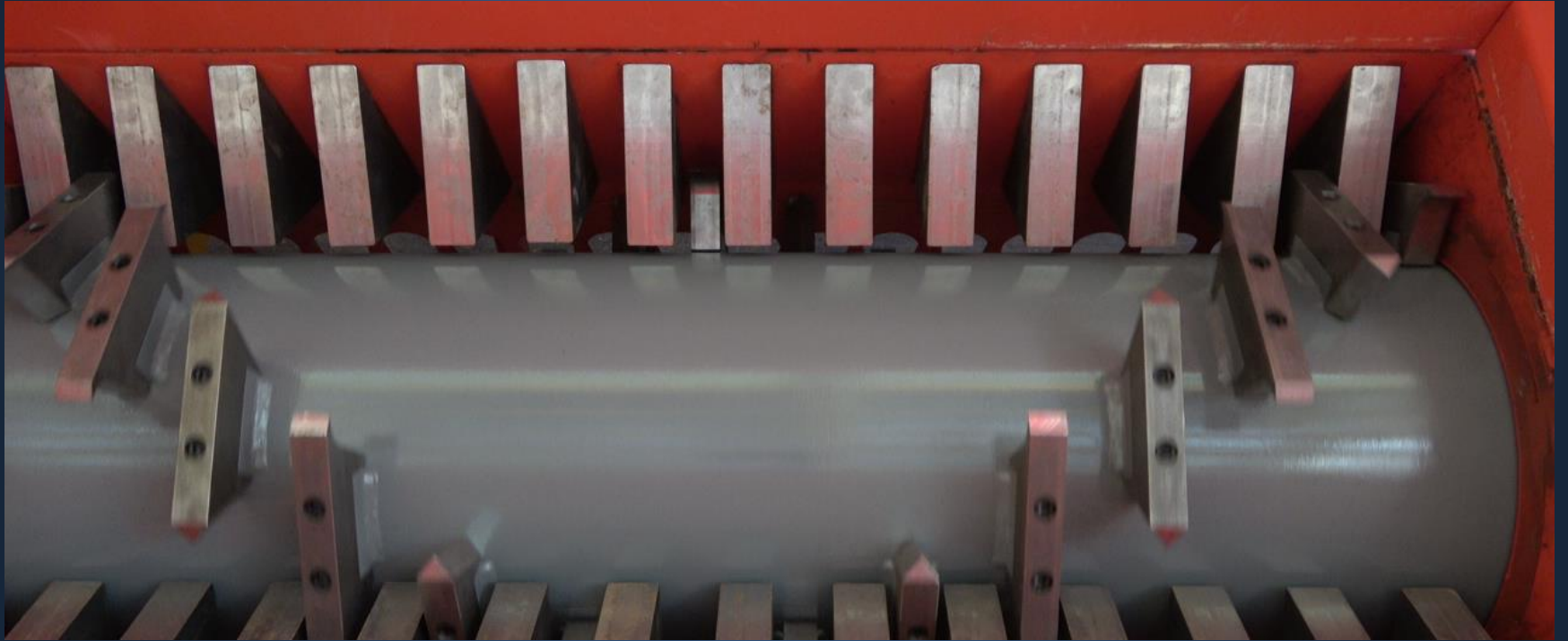


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And we're Continuing to R&D new more cost-effective approaches to Pre-processing





# Loading the mixer is Simple

- **Turn the mixer on**
- Turn the scales on
- Add 1,000lbs Fresh Carbon, based on the scales



## Loading the mixer is Simple

- ...then Add **1,500lbs Fresh Carcasses**
- and 500lbs of “hot compost”,
- mix 25 minutes

# Unloading the mixer

- Start conveyor, then open the exit door 1/3 open
- Video of unloading Sow's, Piglet's & Afterbirth after **25 Minutes** of Mixing
- Reduced the sow (nitrogen & liquids) down to small pieces, bones and all
- And the liquids (moisture) forced into the sawdust (carbon)



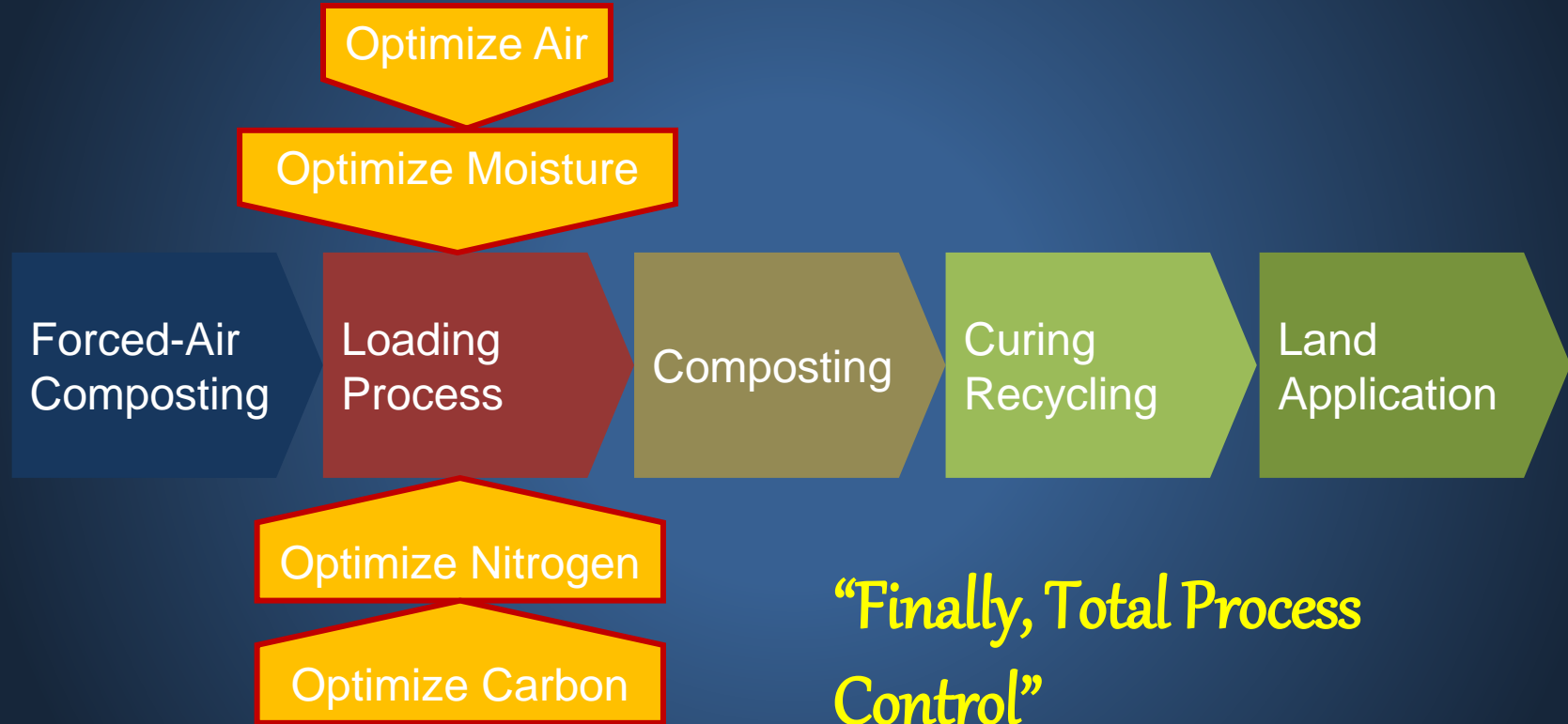


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11

12

# Forced Aeration with Preprocessing:



Finished Compost is now an asset to the farm  
Pathogen Free, so it's safe to land apply  
Fertilizer – Nutrient Value –  
Offset Carbon Costs



**Sustainable Solution to mortality management**

## Pieces come together:

- Optimum Temperature Performance
- Translates into pathogen kill.
- Minimum Bones (fragments)
- No more Leachate
- User-friendly process
- Simple operation “off the seat of the tractor”
- Preprocessing accomplishes everything that’s required in 1st stage of static pile composting
- Valuable Useable End Product that’s bio-secure



# Benefits of Forced Aeration with Preprocessing

- ✓ Eliminates excess Leachate
- ✓ Eliminates the medium and large bones
- ✓ Eliminates inefficient use of carbon
- ✓ Eliminates multiple turnings
- ✓ Eliminates the arduous task of loading a static bin
- ✓ Eliminates the rotten odor issues
- ✓ Eliminates traditional 1<sup>st</sup> stage composting

# Independent Verification by NCSU

- North Carolina State University verified the performance of ACT's Forced Aeration with preprocessing in the fall of 2018
- Documented **both swine and poultry** mortality composting performance with trials conducted on site, temperature data, sampling, testing, and reporting.
- The East National Technology Support Center (ENTSC) for the USDA NRCS is located in Greensboro, NC and rendered the short NRCS technology review.
- They concluded that the process exceeded the state and national standards for animal mortality composting based on Temperature performance, and **Pathogen kill**

# Independent Verification by NCSU and NC NRCS Approval Standards

<b>Advanced Composting Technologies, LLC</b>						
<b>NRCS NC Approval Rates</b>						
<b>Forced Aeration with Preprocessing</b>						
<b>Typical Bin Size: 10' x 15' x 6'</b>						
	<b>Poultry</b>	<b>Turkey</b>	<b>Turkey</b>	<b>Swine</b>	<b>Swine</b>	<b>Swine</b>
	<b>Broiler</b>	<b>Tom</b>	<b>Hen</b>	<b>Nursery</b>	<b>Finishing</b>	<b>Sow</b>
<b>Loading Rate (pounds)</b>	<b>12,000</b>	<b>12,000</b>	<b>12,000</b>	<b>12,000</b>	<b>12,000</b>	<b>12,000</b>
<b># of Days primary w/ Air</b>	<b>11</b>	<b>17</b>	<b>14</b>	<b>11</b>	<b>14</b>	<b>17</b>
<b># of Days Secondary w/o Air</b>	<b>11</b>	<b>16</b>	<b>14</b>	<b>10</b>	<b>14</b>	<b>16</b>

How does this new technology stack up against the other options for composting mortality?

Animal Mortality Management Comparison Chart											
		Strengths				Low	Low				
Process Description		Water	Air	Bio-	Spikes	Invest	Run	Sustain-	Leach	Bone	Finish
		Quality	Quality	Secure		Costs	Costs	able	Control	Redu	Product
<b>Burial</b>											
<b>Rendering</b>											
<b>Incineration</b>											
<b>Composting:</b>											
<b>Static Pile</b>											
<b>Rotary Drum</b>											
<b>Forced aeration with Preprocessing</b>											



  
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Preprocessing of  
the mortality  
combined with  
forced aeration  
of the mixed  
material is  
**ABSOLUTELY A  
GAME CHANGER**

## Back to the Host

How does static pile composting compare to forced aeration with preprocessing from an NRCS design perspective.?”

# Designing/Sizing a Composting Facility

Two basic Process Parameters:

1. Loading Rate
2. Cycle time

\*Typical bin is 10ft wide, 15ft long, 6ft tall without a door.

Composting Method	Static Pile	Preprocessing w/ Air
Number of houses	8.0	8.0
Hogs per house	1,100	1,100
Total hogs per cycle	8,800	8,800
Days per turn	133	133
Turns per year	2.0	2.0
Total hogs per year	17,600	17,600
Percent Mortality	3.50%	3.50%
Mortality per year	616	616
Average Wt. of hog	150	150
Lbs. of Mortality/year	92,400	92,400
<b>Average Payment lbs. / day</b>	<b>253.15</b>	<b>253.15</b>

Composting Method	Static Pile	Preprocessing w/ Air
Payment lbs. / day	253.15	253.15
Avg days to fill a bin	24	48
Rated lbs. per bin	6,000	12,000
1 <sup>st</sup> Stage cycle time	60	14
Days in 1 <sup>st</sup> Stage	84	62
Days in 2 <sup>nd</sup> & 3 <sup>rd</sup> Stage	60	14
Lbs. per bin per year	15,240	54,905
Safety Factor (loading)	35%	35%
Calculated Bins Req'd	8.19	2.27
<b>Construction Bins Req'd</b>	<b>9</b>	<b>3</b>

# Static Pile Composting

Three Parameters: Swine (Sows)

- Loading Rate: 6,000lbs
- Cycle time:
  - 1<sup>st</sup> 60days, 2<sup>nd</sup> 60days, 3<sup>rd</sup> 60days
- Temperature Performance Goal
  - 3 days above 131°F

# Static Pile vs Forced Aeration/Mixer

- How does that translate into facility size
- Example: 4,000 Sows (330,000lbs+/year)
  - Static pile: 21 bins (180days)
  - FA with Mixer: 3 + 2 bins ( 33days)



# The Open floor Layout with Pre-processing and Forced Aeration

- An innovative Mortality composting solution that combines state of the art composting technology with a cost-effective building design.
- 11” knee-wall around the perimeter that captures any leachate, and provides a bucket push wall at the bottom and cost-effective wood walls above. Can significantly reduce the building cost.
- Forced aeration keeps the piles hot, even in the colder climates of the upper Midwest without needing concrete to insulate the piles.
- Is this approach covered under the national scenario?





1

2



# The Open floor Layout with Pre-processing and Forced Aeration

- This approach was most recently reviewed by NCDA&CS and NC's NRCS and both agencies approved the design for all animal types without exception.
- Temperature performance was inline with the NCSU review and Operators appreciate the absence of internal walls that make tractor movement difficult at times.
- This approach is the only design used in North Carolina today for all NRCS forced aeration with preprocessing systems.



## Midwestern Challenges:

- Cold weather processing... forced aeration is sustainable even in cold weather.
- Multiple feedstocks, better evaluation of each type.
- Eichelberger example:
  - 0°F Ambient, 160°F Pile
- Communication with NRCS District Conservationist and the Growers, like today.

# Who is Advanced Composting Technologies

- A North Carolina based business that develops, designs, and builds animal mortality composting systems
- Primarily in the Southeast and now in the Midwest.
- Started building mortality composting systems for the NRCS in North Carolina in 2003
- Built more than 300 facilities with NRCS
- Offering Forced Aeration with Pre-processing
- Recognized by APHIS as Subject Matter Experts in Catastrophic Animal Mortality Events - Composting

# ACT - Turn-key Provider to NRCS

- ✓ Facility sizing, design, layout
- ✓ Engineering of the structure
- ✓ Permitting, if required
- ✓ Manage the whole Construction Process including stamped engineering drawings and as-builts
- ✓ Start-up training and follow-up, warranty
- ✓ O&M operational manual
- ✓ Troubleshooting, carbon evaluation

# Activities that must be done locally

- ✓ Facility sizing, design, layout (locally with central review)
- ✓ **local vendors for grading, electrical, etc.)**
- ✓ Manage the **Construction** Process including stamped engineering drawings and as-builts (local)
- ✓ Start-up and follow-up, (local) warranty (national)
- ✓ O&M operational manual, (locally)
- ✓ Troubleshooting, carbon evals (locally & central)

# Centralized Activities

- ✓ Engineered structure with a structural engineer (centralized with local stamp)
- ✓ Permitting, if required (centralized)
- ✓ Actual On-site Construction (centralized with local vendors)

# ACT – NRCS moving forward

- ✓ Can DCs contact ACT directly to have sizing done for an interested grower if the grower's name is never communicated?
- ✓ Can DCs refer growers to ACT to obtain a current price for the facility, even before they are approved?
- ✓ ACT to assist growers with FSA and EQIP applications?
- ✓ ACT to share with individual states that are interested in utilizing the technology for their growers either in-person or via Zoom, Teams, etc.

# ACT – NRCS moving forward

If a state is interested, ACT will need to know certain state specific information like:

- ✓ engineering design criteria,
- ✓ engineering review contact information
- ✓ permitting agency, requirements, and contact
- ✓ open-floor concept review and approval
- ✓ opportunities to share with district conservationists via field days, in-person meetings, digital platforms, etc.



We're excited about this national opportunity and look forward to working with you in the weeks and months ahead. Contact us anytime.



Thank  
You !!!

Questions  
and Answers

Now the  
work begins.

Give us a call, we're here  
to help.