Disposal of Large Animal Carcasses

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Penn State is committed to affirmative action, equal opportunity and diversity of its workforce.

Animal Agriculture Dilemma

- Disposal of animal carcasses
  - Economics
  - Availability
  - Environmental stewardship
  - Pathogen control
- Large scale or mass disposal
- Biosecurity
  - High concern animal or poultry agents
  - Zoonotic agents

Carcass Disposal

- Pa regs-need to remove carcass within 48 hours
- Do this in a manner that is safe and environmentally acceptable
- Change in regulations for downer cows
  - Need to remove all Specified Risk Materials
- Unwanted horses
- Concern by neighbors at rural/suburban interface

Means of Disposal

- Licensed landfills
  - Make arrangements with owner ahead of time-must be a licensed and lined facility
  - Transportation
  - Safety issues in transportation
  - Rapid burial upon arrival
  - Decontamination of trucks and equipment

Means of Disposal

- Incineration
  - Some large poultry and swine operations have units
  - Animal Diagnostic Lab at Penn State
  - State Veterinary Lab at Harrisburg
  - Expensive to run ~ $0.86/lb
  - Effective but can handle limited quantities
- Tissue digestor being installed at New Bolton Center
  - Extreme alkaline process destroys carcass and prions
  - Up-front cost for equipment and building very high
  - Very effective and relatively cheap once installed

Means of Disposal

- Burial
  - Regs-100 yr. flood plain, wells, property lines
  - 200 feet from water sources & 100 ft. property
  - 6 feet down and 2 feet above bed rock
  - Not near any sink holes or wet areas
  - Do not use lime if covering over soon
- Cheap
  - Not very practical for large numbers
  - Hard to find a truly suitable location

Rendering

- Change to eliminate SRM's by April 2009
  - Need to get all SRM's out of feed chain
  - Valley Protein stopping pick-up 3/1/09
- Not for infectious or contaminated carcasses
- Acceptable and safe means of disposing many large animals
  - Portions of animals from pork and packing plants are recycled into useable products
- Carcass pick up is ~ 10% of gross

What is composting?

"A biological process that transforms raw organic materials into a nutrient rich, biologically-stable soil additive suitable for plant and crop use".

Volume reduces carcass

Drives complex compounds back towards more basic elements

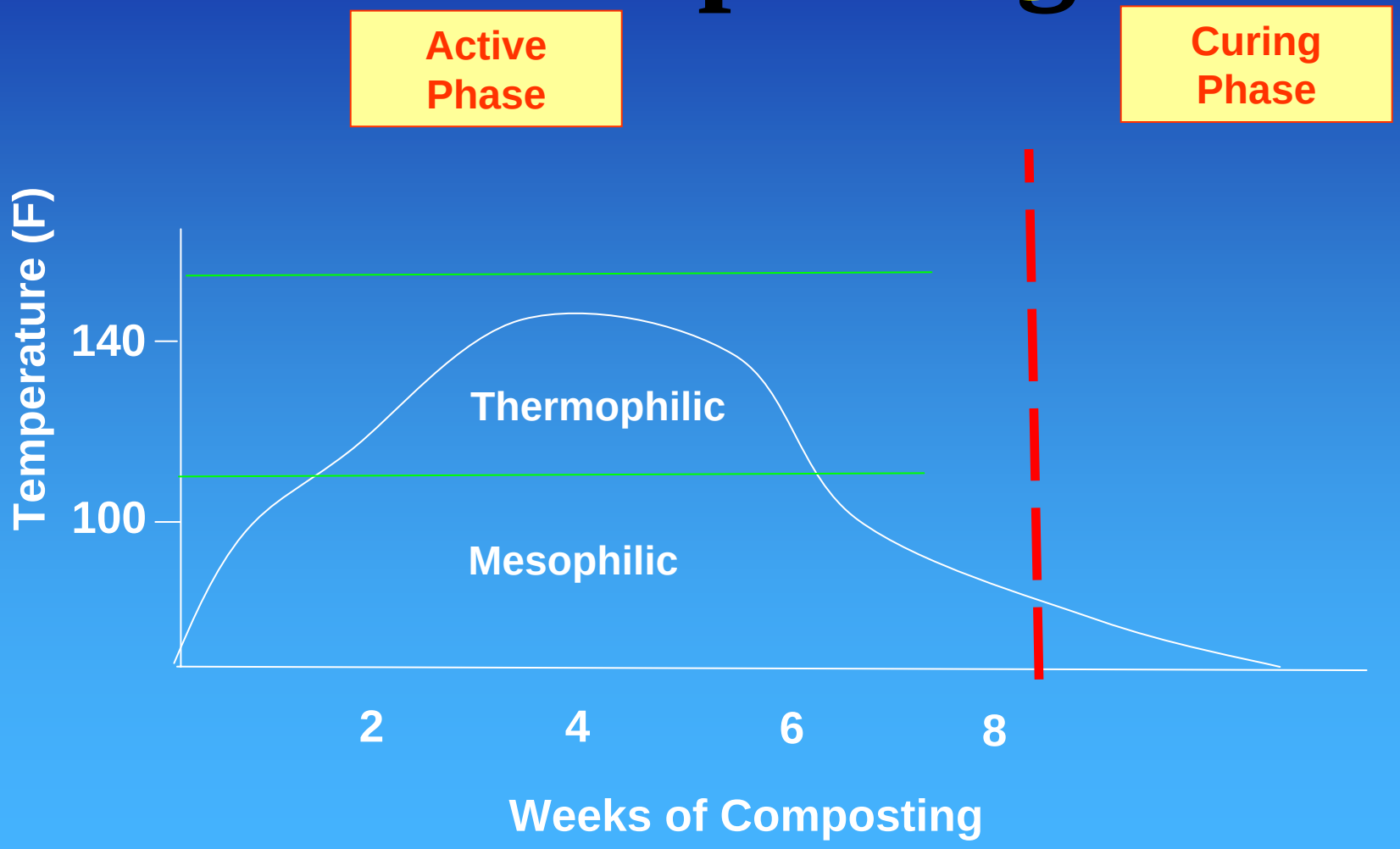
Factors Directly Impacting Microbial Activity

- C:N ratio
- Oxygen Content (Porosity)
- Moisture Content
- Temperature
- pH
- Particle Size

Temperature

- Higher temperatures result in faster breakdown of organic materials
- Temperatures above 160 º F will kill-off microbes and halt decomposition
- Temperatures below 50 º F indicates retarded microbial activity and will result in slow decomposition rates

Phases of *Aerobic* Composting



Aerobic composting and temperature

- Active composting occurs in the temperature range of 50ºF to 160ºF
- Pile temperature may increase above 140ºF but this is too hot for most bacteria and decomposition will slow until temperature decreases again.

Remember, Compost pile heat is the direct result of microbial metabolism!!!

Composting parameters

- Mesophilic bacteria: 25-55° C range
  - Normal and continuous decay
  - Over time help to break down bones
- Thermophilic bacteria:40-66 ° C range
  - Destroy most weed seeds, parasites and pathogens
  - May not destroy spores
  - Do not inactivate prions

Oxygen Content

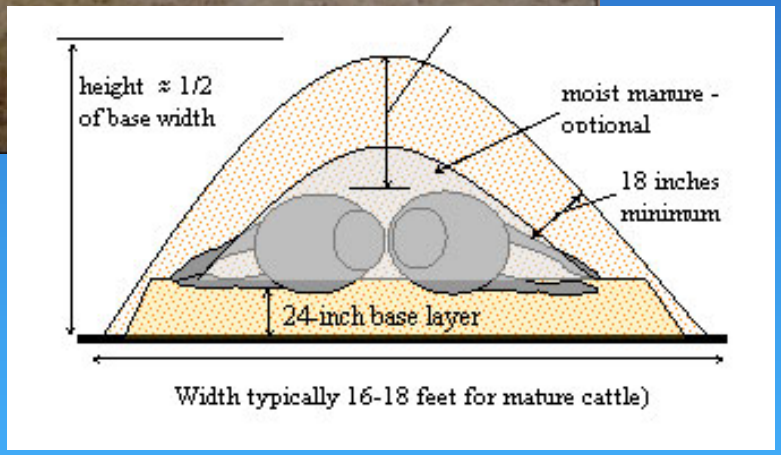
- Need Oxygen for most efficient process
- 21% oxygen in air
- 5%-10% is optimal for compost process
  - <5% process slows remarkably
- As pile heats more oxygen will be consumed by microbes

Fine Particle Size

Course Particle Size

Mixed Particle Size


Moisture Distribution vs. Air Flow Through Compost Pile



Graphic-Iowa State University

www3.abe.iastate.edu/cattlecoposting/guidelines

How to make a compost pile

- Relatively level site
- Easy access
- Solid ground
- 100-200’ from water depending on PDA or DNR references (go with 200’)
- Bacteria need, moisture, warmth, oxygen, nitrogen and carbohydrate source

How to make a compost pile

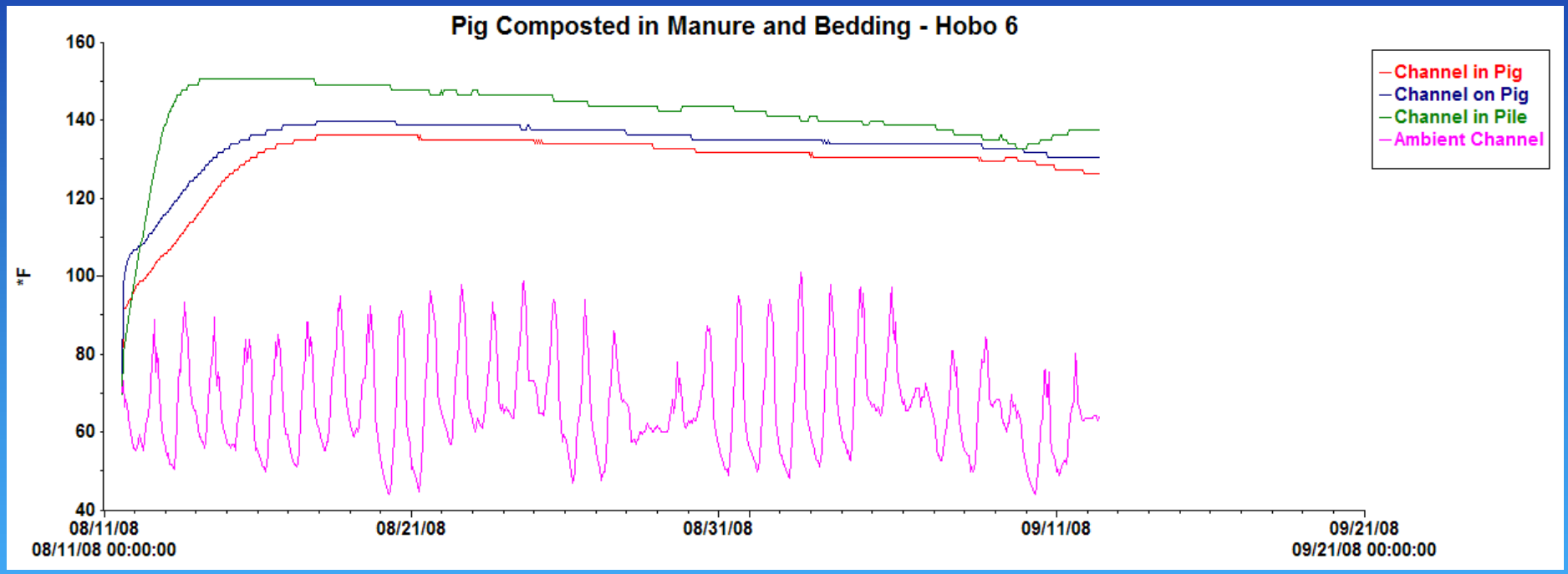
- Good material
  - Material that has texture and substance
  - Moist and will ferment
- 2 foot base of material
- Animal in middle (double width of animal with covering substrate)
- Minimum cover - 2 feet of material all around
- Re-cover anything that collapses in the next 2 weeks

How to make a compost pile

- Moisture: in range 40-60%
- Carbon to nitrogen ratio: in range~ 25-40 : 1
  - Crude protein level ~ 14-25% (TMR refusals)
- Source of fermentable energy
  - Sugar, pectins, or starches in grains or forages
  - Plant material we don't normally use for feed
- If pile doesn't ferment well it will still breakdown over time (high moisture and protein-rot)

How to make a compost pile

- Substrate choices
- Space for air passage
  - Corn silage
  - Sawdust, green wood shavings or chopped branches
  - Rotten silage along top or side of bunks
  - Feed weigh backs
  - Straw or old hay can be slow to start fermenting (chop if possible-wet down pile)
  - Pack manure if it has lots of bedding
  - Tan bark or well mixed municipal yard waste


Pig Composted in Manure and Bedding - Hobo 6
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Channel in Pig
Channel on Pig
Channel in Pile
Ambient Channel

Good vs. Bad piles

Multiple Animal Piles

- Basics still apply
- Need 25-30 carbon : 1 nitrogen
- 50-60% moisture
- >10% oxygen
- No need to lance rumen or body if >18” moist cover
- ~ 6 “ organic material between layers
- Organic particle size 0.25-2 “

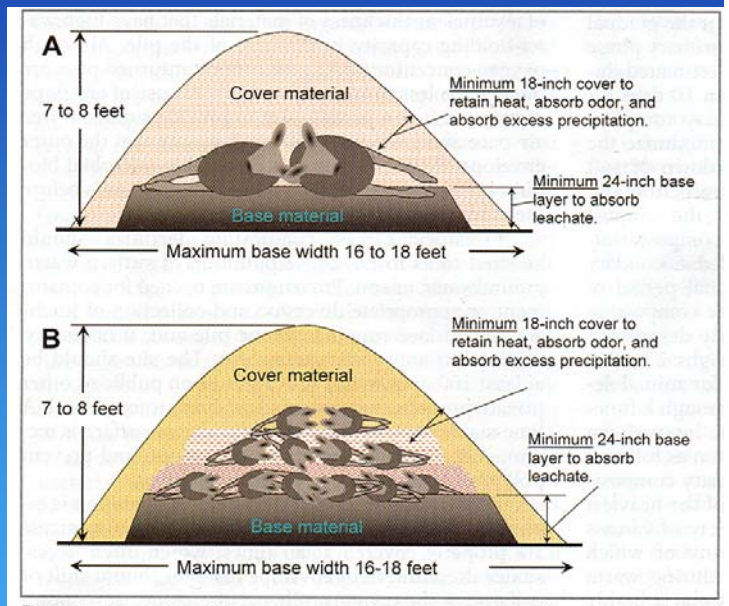
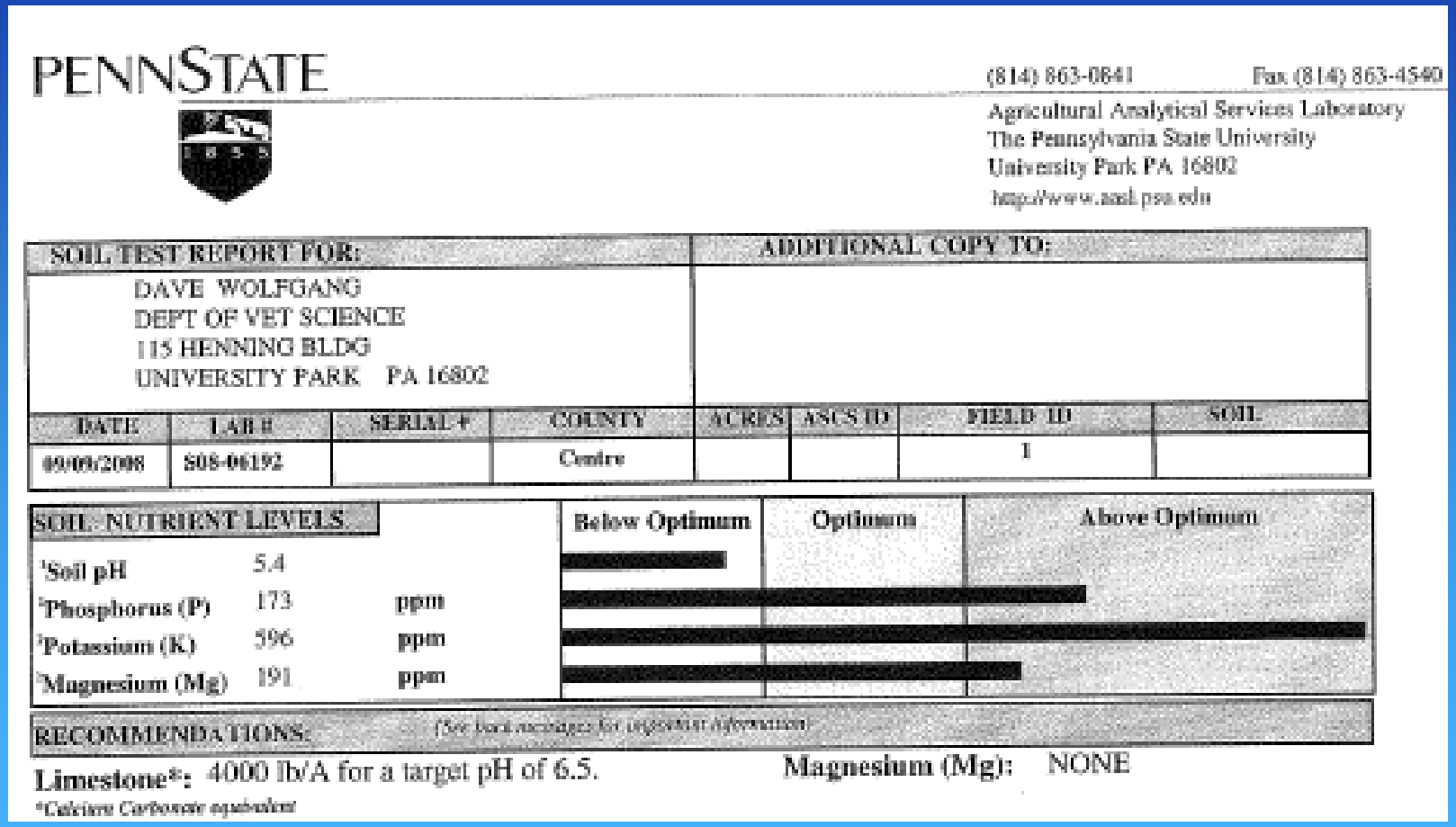


Figure 1—Illustration of the placement of large carcasses (cattle and horses; A) and small carcasses (swine, sheep, calves, or poultry; B) and in a static pile composting system.

JAVMA, Vol 234, No. 1, January 1, 2009

Glanville, JAVMA, ‘09

Soil 2-4” at edge of pile



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The Pennsylvania State University
University Park PA 16802
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SOIL TEST REPORT FOR:	ADDITIONAL COPY TO:
DAVE WOLFGANG DEPT OF VET SCIENCE 115 HENNING BLDG UNIVERSITY PARK PA 16802	

DATE	LAB #	SERIAL #	COUNTY	ACRES	ASCS ID	FIELD ID	SOIL
09/08/2008	S08-06192		Centre			1	

SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
[1]Soil pH	5.4				
[2]Phosphorus (P)	173	ppm			
[2]Potassium (K)	596	ppm			
[2]Magnesium (Mg)	191	ppm			

RECOMMENDATIONS: (See back page for important information)

Limestone*: 4000 lb/A for a target pH of 6.5. **Magnesium (Mg):** NONE

*Calcium Carbonate equivalent

Nitrate N 184 ppm

Soil 6-9” edge of pile

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DATE	LAB #	SERIAL #	COUNTY	ACRES	ASCS ID	FIELD ID	SOIL
09/09/2008	508-06193		Centre			2	

SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
[1]Soil pH	5.2				
[2]Phosphorus (P)	98	ppm			
[2]Potassium (K)	212	ppm			
[2]Magnesium (Mg)	135	ppm			

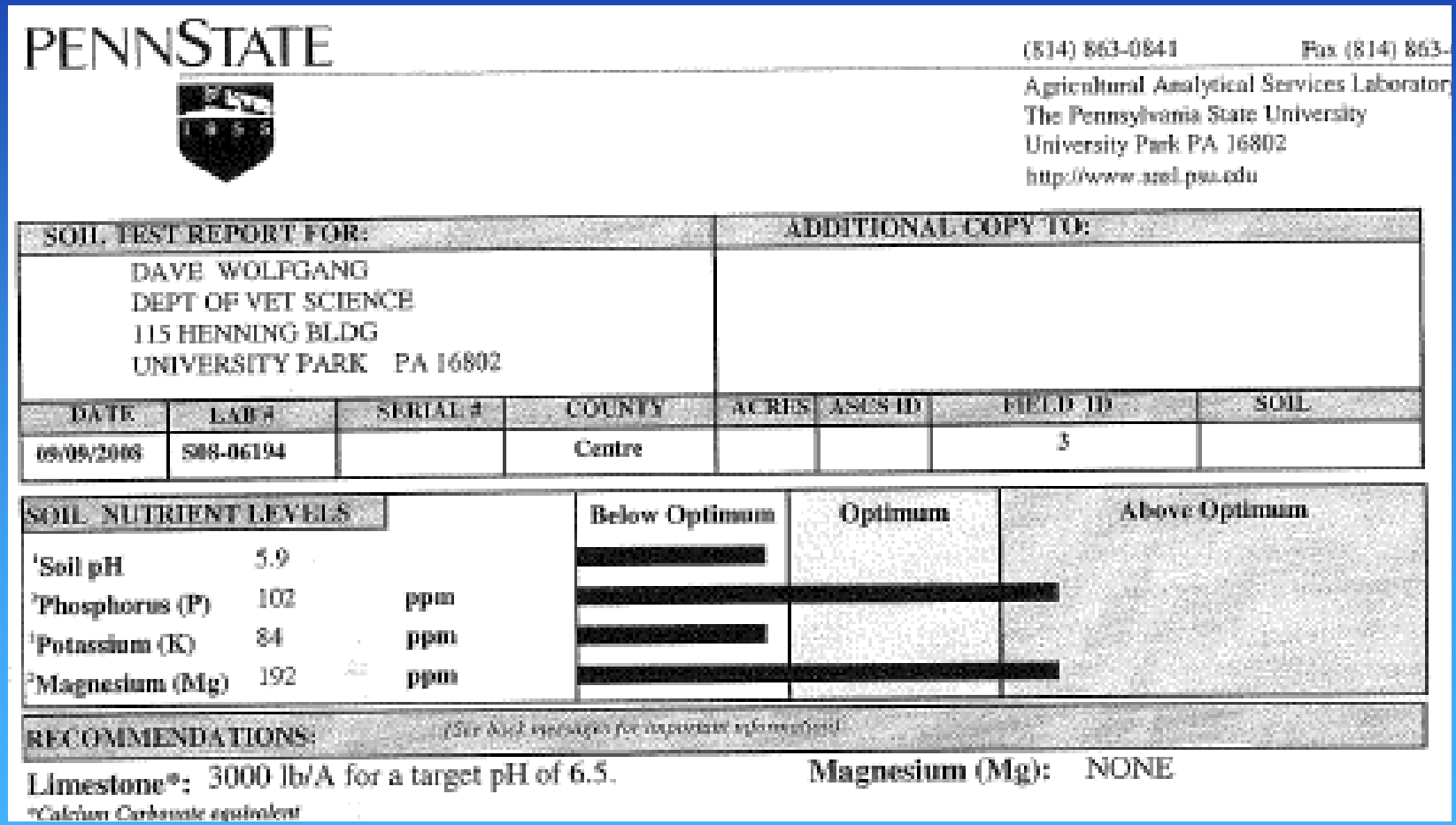
RECOMMENDATIONS: *(See back pages for explanation)*

Limestone*: 5000 lb/A for a target pH of 6.5. Magnesium (Mg): NONE

*Calcium Carbonate equivalent

Nitrate N 59.4 ppm

Control Soil 2-4”



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DAVE WOLFGANG DEPT OF VET SCIENCE 115 HENNING BLDG UNIVERSITY PARK PA 16802	

DATE	LAB #	SERIAL #	COUNTY	ACRES	ASUS ID	FIELD ID	SOIL
09/09/2008	S08-06194		Centre			3	

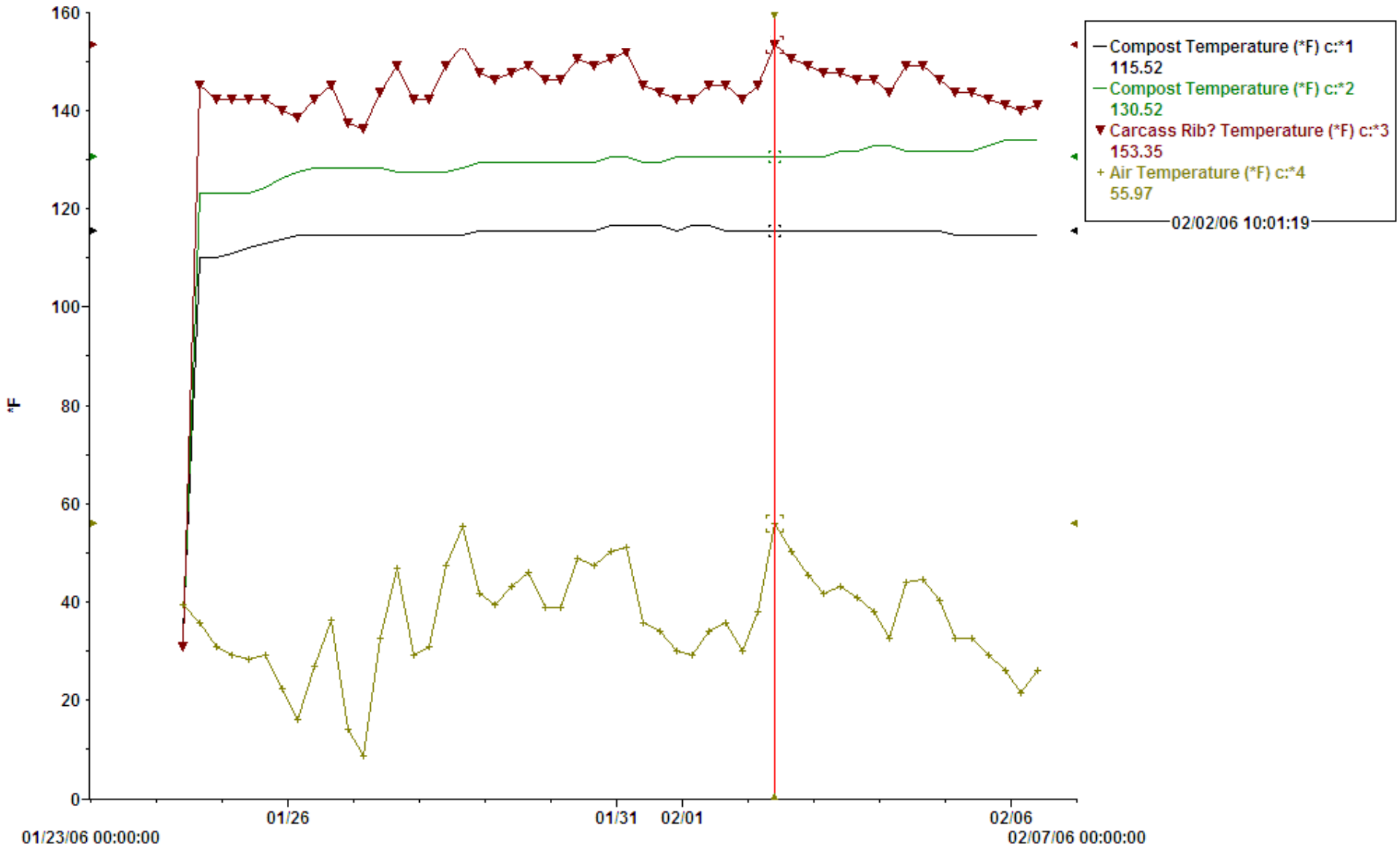
SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
[1]Soil pH	5.9				
[2]Phosphorus (P)	102	ppm			
[1]Potassium (K)	84	ppm			
[2]Magnesium (Mg)	192	ppm			

RECOMMENDATIONS: *(See back messages for important information)*

Limestone*: 3000 lb/A for a target pH of 6.5. Magnesium (Mg): NONE

*Calcium Carbonate equivalent

Nitrate N 3.4 ppm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Compost Temperature (°F) c:*1
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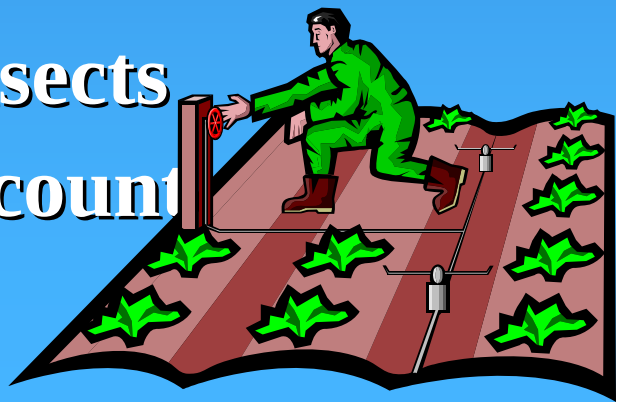
Compost Temperature (°F) c:*2
130.52
Carcass Rib? Temperature (°F) c:*3
153.35
Air Temperature (°F) c:*4
55.97
02/02/06 10:01:19


Compost has value as a soil amendment
Builds Soil Structure

Benefits of compost

- Add organic matter to soil
- Increase water holding capacity
- Increase infiltration
- Reduce erosion
- Enhance microbial activity
- Soil compaction
- Resistance to disease and insects
- Revolving nutrient bank account



Field Application

Aerated Stacked Piles

- Biosolids 7-9 feet in height
- 60 days to finish product
- Temperature 55° C or slightly higher for 3 days to eliminate pathogens
- Slightly acidic conditions

NARES, 1992

USEPA, 1999

Pathogens in Piles

Pathogen Reduction

log counts for E coli
plaque forming units/ml for viruses X 10^3

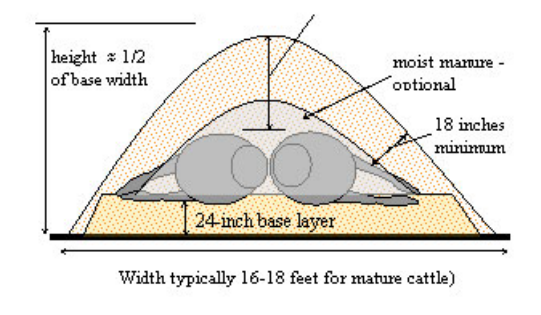
Days	E coli 101	IBR	BVD	TGE
0	12424 ± .8	110.2 ± .3	462.8 ± .4	83.3 ± .1
3	750 ± .1	0	0	0.09
7	7.1 ± 2.2	0	0	0
14	128 ± 1.9	0	0	0
30	1.6 ± .1	0	0	0
60	0	0	0	0
180	2.4 ±	0	0	0
240	0	0	0	0

Unpublished data ’07-’08

Summary of Data-for 30 days

Average daily temperature	**12°C**
Average temperature at surface	**58°C**
Average temperature in abdomen	**48°C**
Average temperature in thorax	**43°C**

Iowa State



- Painted carcass with Newcastle virus
- Stationed birds in cages near compost piles
- Birds tested negative for virus titers

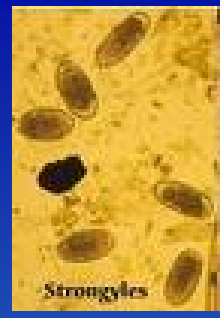
- New Hampshire
  - Virus in dialysis cassettes
  - No virus found alive after 3 days

New York data

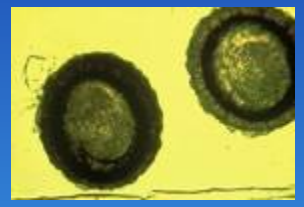
Pathogen	Reduction 30 days	End point
Salmonella	90%	180 days
Mycobacterium	75%	240 days
Campylobacter	100%	30 days
E coli	90%	180 days
Yersinia	100%	30 days

J. Bonotal-Cornell Compost Center

Special concerns



- Ascaris eggs (round worms) ~ 9 days active compost (temperature and pH)
  - 7 years mixed with manure in soil



- Taenia (tape worms) ~ 4 days active compost
  - 1-2 years in soil with organic material

- Protozoa ~ 1-2 days in active compost
  - Cryptosporidium up to 8 months in protected soil

Is this safe for environment and disease control?

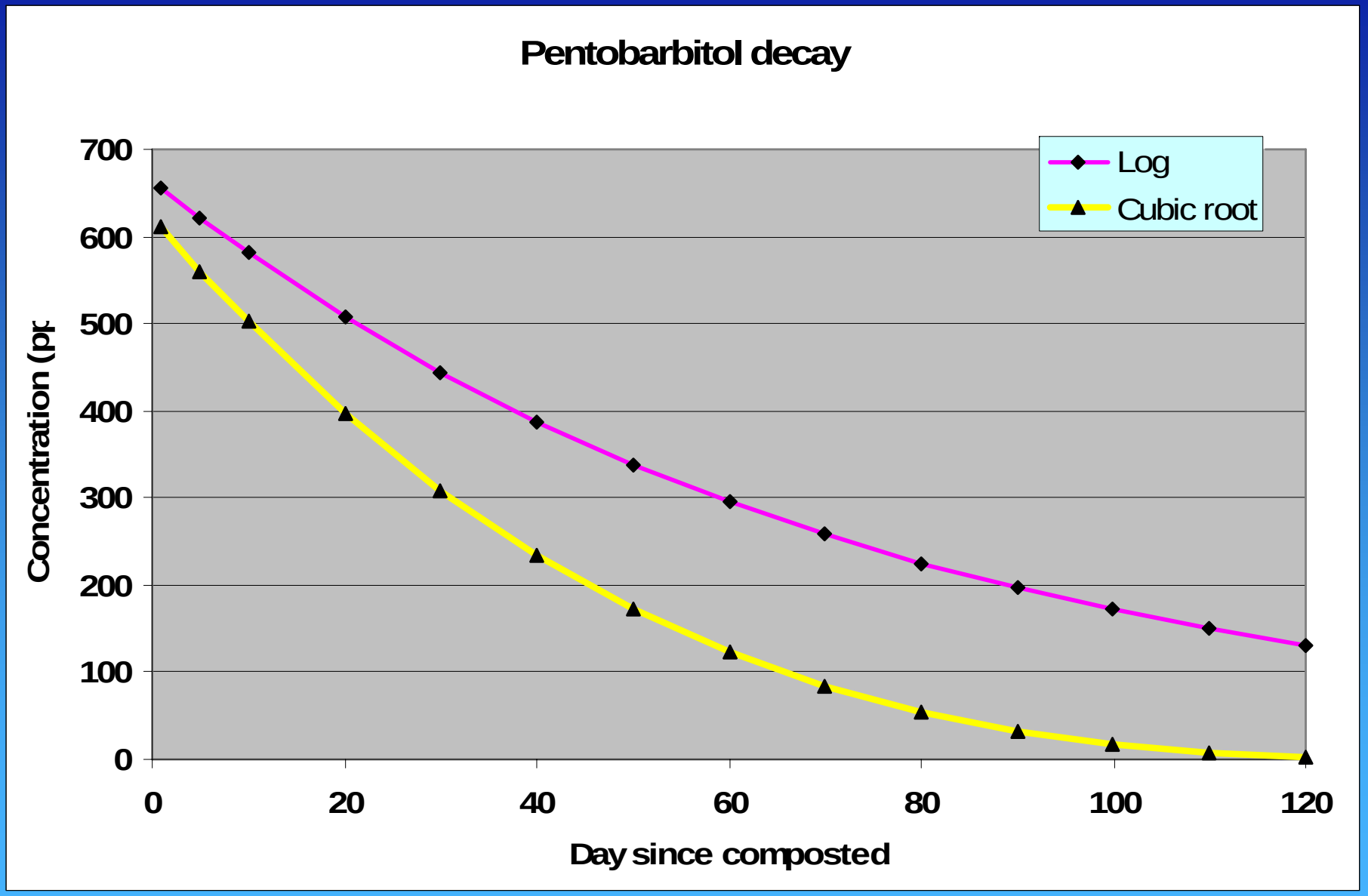
- With good base, nitrogen penetrates into soil about 2-3 feet, doesn't run away
- Potassium may be elevated slightly in soil
- Good composting
  - Need to reach ~ 140 to max 160° F
  - With good composting no odor
  - With good composting no flies
  - With good composting no pathogens
- All but largest bones gone in ~ 6 months
- Process can be speeded up with turning after ~ 6 weeks
- Will not be unsightly for passersby's

Barbiturates

- Typically broken down by oxidative pathways in liver
- Has been found in river sludge near cities in Germany
- Has been found in water samples in the US
- In Texas - recently identified after 90 days at sites where horses were composted
- Replaced in large part by newer therapeutics
  - Pentobarbital still used widely for euthanasia
  - ~10 mg/4.5Kg PO BID vs. ~350mg/4.5kg IV 1X

Is euthanasia solution a potential environmental risk?

- Mass disaster or commercial composting facility
  - Could accumulate many animals each with 30-40 grams of barbiturate in carcass
  - Suspected prolonged half life in environment
  - Highly water soluble
- Some data on finding barbiturates in environment, little if any data on how or if it breaks down

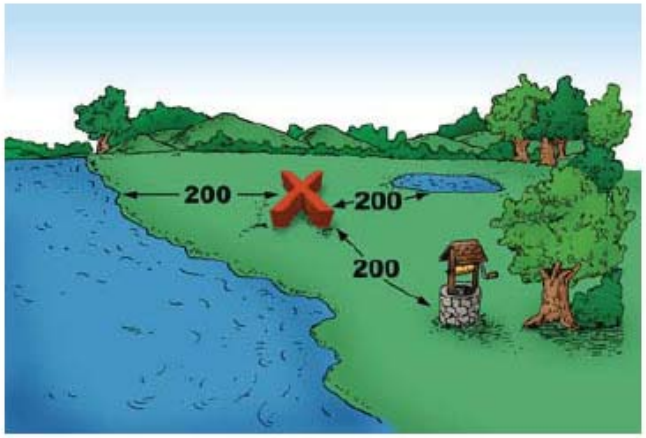


Wolfgang, unpublished '09

Pentobarbital Decay

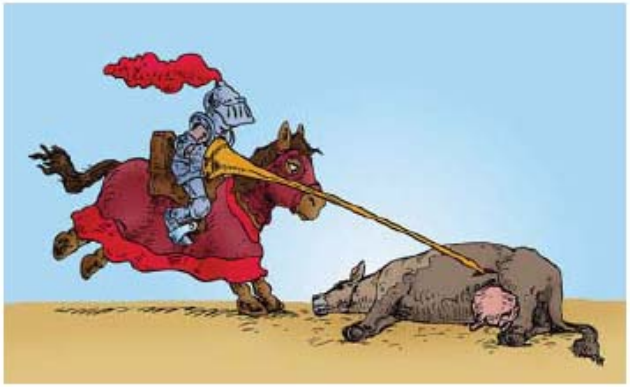
- In a well made pile with plenty of activity
  - Probably safe to predict exponential decay
  - Half life ~ 60 days
- Values in liver from euthanized animals typically range from 250-600 ppm
- Potential to find some compound left in localized areas of compost for at least one year
- We isolated 38 ppm of pentobarbital in adjacent compost after 80 days

Key Points of Static Pile Carcass Composting



- Select site that is well drained, at least 200 feet from water courses, sinkholes, seasonal seeps or other landscape features that indicate the area is hydrologically sensitive.

- Lay 24-inch bed of bulky, absorbent organic material containing sizeable pieces 4-6 inches long. Utility and municipal wood chips work well. Ensure the base is large enough to allow for 2-foot clearance around the carcass.



- Lay animal in the center of the bed. Lance the rumen to avoid bloating and possible explosion. Explosive release of gases can result in odor problems and it will blow the cover material off the composting carcass.

Cornell Waste Management Institute

http://cwmi.css.cornell.edu/

Summary

- Good location ~ level, 200’ from wet areas
- Minimum base and coverage of 2 feet of material
- Use substrate that supports good composting
  - Stir in 6 weeks if temperatures <135°F
- Temperature inside carcass is consistently less than composting substrate
  - Usually in the range of 5-10 °C
- Spread on crop ground-remove and recycle large bones

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