18th Technical Training Series

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CalRecycle
Practical Fire Prevention and Management Tools
Fire “Triangle”

Fuel
(e.g. organic matter)

Heat

Oxygen (air)
(or any oxidation reaction)

4th Factor?
Chemical Reaction?
Fire “Tetrahedron”

- Oxygen
- Heat
- Fuel
- Chain Reaction
Sources of Fire

Surface Fires – Need a spark
- Smoldering loads
- Heat from equipment
- Stray sparks
- Arson
- Wildfire

Subsurface Fires – Don’t need a spark!
- Spontaneous Combustion
Smoldering Load

Photo Courtesy World News Network (UK)
Equipment Fires
Equipment Fires

[Image of a damaged piece of equipment]
Fires in Equipment

• Develop detailed post shut-down procedures for any large processing equipment (grinders, screens, turner, etc.). These might include:
  • Clearing all debris from any surfaces that might be hot enough to start a fire.
  • Use pressurized air to clear fine dust from engine compartment, bearings, manifolds, and other operating surfaces
  • Inspect magnetic head pulley and accumulated metal pile for smoldering or hot metal
  • Stand rear discharge conveyors to remove dust and material from grinding or screening operation.

This is a very Partial List!
Causes of Fires at Compost and Mulch Facilities

Spontaneous Combustion (SC)
- SC - Certain, 54%
- SC - Probable, 20%
- SC - Possible, 2%

Cigarette
- Certain
- Probable
- Possible

Arson
- Certain
- Probable
- Possible

Heat from Grinder

Hot in-bound load

Source: Survey of Compost and Mulch Production Facilities (Rynk & Buggeln, 2009)
Third Mulch Fire in 18 Months Ignites at Landscape Company
Spontaneous Combustion

Note what’s burning (it’s not the windrows)
Spontaneous Combustion

- Most common cause of fires at compost facilities
- No external energy/spark required
- Result of a chain reaction of several heat-generating processes
- Common in industries where organic materials are stockpiled
- Not well understood by Industry
- More common at C&G, then compost facilities; (though almost every composter is also a C&G)
Spontaneous Combustion

Temperature Change = Heat generation - Heat loss

<table>
<thead>
<tr>
<th>Smaller piles = more heat loss = lower temperatures</th>
<th>Larger piles = less heat loss = higher temperatures</th>
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<tbody>
<tr>
<td>Moist piles = more heat loss = lower temperatures</td>
<td>Dry piles = less heat loss = higher temps</td>
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Spontaneous Combustion

Heat Generation > Heat Loss

1. More heat generated than lost
2. Chain reaction of several heat-generating processes:
   - Biological self-heating (160° - 185° F)
   - Chemical reactions release heat - bridging the gap between biological heat and ignition
   - Pyrolysis, adsorption, chemical oxidation
   - Water boils away, temp. exceeds 212° F
   - Ignition happens @ 300° - 400° F
   - Limited oxygen = smoldering fire
   - With oxygen = flaming fire
How to Build a Spontaneous Combustion Pile:

1. Build a large pile of biologically active materials (13 - 15 feet or 4 meters high)

2. Use materials that are relatively dry but not too dry (20% to 40% MC)
   
   *(or allow a section of a moist pile to dry below 40%)*

3. Leave pile undisturbed for weeks

Enhancing Your Spontaneous Combustion Experience:

1. Include feedstocks that are at an early stage of decomposition (but not soaking wet)
2. Maintain the exterior in a dry well-insulating state
3. Limit aeration, or promote air channeling with pockets of dead space in between
4. Occasionally add water, but too much, and not evenly
5. Don’t touch that pile! … Leave it be
6. When good and hot – smoldering – open it up, or turn up the fans, or stir-up the wind
Minimize Fire Risk

1. Understand how and why spontaneous combustion fires occur.
2. Don’t build big piles.
3. Keep material moving (turn or move)
4. The only reliable way to reduce pile temperature is to lower it (or shrink it).
5. Be diligent (monitor temperature, moisture, odor) and react
6. Plan for a fire. How will you respond? What resources do you have?
7. Keep good records.
Fire Planning and Mitigation

Facility Design

• Make sure you have adequate space to avoid exceeding the fire-safe height of piles (especially incoming feedstock, curing, and finished compost stockpiles).
• Ensure adequate access for fire-fighting equip.
• Install a “Knox Box” so that Fire Department or other emergency responders can have 24-hour access to the facility.

Planning

• Provide adequate training, equipment, and water supply to fight a fire.
• Get to know your local fire department.
Fire Planning and Mitigation

Management

• Good composting practice = good fire prevention (adequate moisture, good feedstock mix, regular movement of materials, piles, first-in, first out inventory control)
• Understand the conditions that lead to spontaneous combustion.
• Maintain adequate moisture in piles.
• Monitor temperatures and have a threshold plan (i.e., if temps exceed 180° F, we....)
Does the Site need a Fire Prevention, Mitigation & Control Plan?

Maybe?

You will once you have a fire
Elements of a Fire Plan

• Facility Design
• Fire Prevention Procedures
• Fire Control Methods
• Fire Fighting Equipment Capabilities
• Fire Mitigation
• Approval?
• (Often required after your first fire)
What to Look For

• Understand material in and out
• Log of daily occurrences noting smokers?
• Broken equipment taking a long time – leads to bad things
• Is management in-tune with the material on-site?
• Is there an actual business plan?
What Sort of Business is This?

- Junkyard
- Chip & Grind
  Compost Manufacturing
Manage Tons in/Tons Out

Green Material In/Compost Out

- OCT
- NOV
- DEC
- JAN
- FEB
- MAR
- APR
- MAY

Tons

IN

OUT

Month
How BIG?
Summary

• Fire prevention is almost 100 percent a management issue (except for wildfire)
• Fires at chip & grind and composting sites are NOT inevitable and can be managed
• There are a number of pro-active steps facility managers can take
• Inventory management and good design are key
• LEAs can help facilitate greater understanding of the conditions that lead to fires
Thank You!

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