

Fire – Compost and Organic Matter

Fire is a serious concern at anytime and anywhere. Some fires can start in compost and may cause the loss of property or lives. Fires are more common at composting facilities than most realize.

What causes an organic matter fire?

Fire requires oxygen and fuel, which is provided by the organic materials typically composted. Compost fires can be caused by spontaneous combustion, lightning strikes, heat from equipment or vehicles, sparks from welding activities, wildfires and arson. Spontaneous combustion is the most common cause.

What is spontaneous combustion?

Spontaneous combustion occurs when materials self-heat to a temperature high enough to cause them to ignite. Typically, composting materials ignite at temperatures between 150 and 200°C.

As the temperature rises, the speed of temperature increase also rises. For example, heat is generated about 16 times faster at 100°C than at 60°C because the reaction rate approximately doubles with each 10°C rise in temperature.

In a compost pile, the organic matter and microbial activity generate heat from the biological activities; this activity causes the compost temperature to reach 70 to 80°C. At this point, the microorganisms die or become dormant, and the biological heating stops.

From that point to the temperature at which organic materials ignite (150°C and higher), heat-releasing chemical reactions take over. These actions

include chemical oxidation, slow pyrolysis (chemical decomposition brought about by heat) and condensation of gases within dry charred particles.

Fire in compost piles

What is the recipe for spontaneous combustion in compost?

Key conditions

- biological activity
 - relatively dry materials
 - dry pocket
 - large well insulated piles
 - limited air flow
 - time for temperature to build up
- Other factors*
- non-uniform mix of materials
 - poor moisture distribution
 - difficult to know temperature throughout a pile
 - lapse or oversight in monitoring

Spontaneous combustion is the most common cause of compost fires

These conditions are all more prevalent within large undisturbed piles that contain raw feedstocks, curing compost and finished compost than in an active composting system.

Biological activity generates heat within organic matter, a goal for composting. However, the temperature is controlled by heat loss through evaporation of moisture, aeration and sometimes mechanical turning. The moisture content of a pile may become too low, reducing the effectiveness of the material to cool through evaporation and thus causing the temperature to rise above desirable levels (above 60°C).

The critical moisture range that supports spontaneous combustion is roughly 20 to 45 percent, while

the optimal range for composting is typically 50 to 60 percent. Large piles may inhibit air exchange, therefore not allowing the material to cool.

The combination of organic materials with low moisture contents in a large unmonitored pile with limited air exchange is a prescription for spontaneous combustion.

Are there different types of fires?

In large piles with limited oxygen, a smoldering fire starts when materials reach their ignition temperature. This type of fire is inefficient, producing gases, smoke and heat, but no light. When more oxygen is present, a glowing fire can occur, producing smoke, more heat and higher temperatures. With abundant oxygen, a flaming fire with very high temperatures will ensue.

Warning: a large pile containing a smoldering fire could change to a flaming fire if the material is opened up, and oxygen is allowed to fuel the fire.

How can you prevent fires and be prepared for one?

- Meet with your local fire department, and discuss compost fires and guidelines to handle the fires if they begin. Explain the composting process and the organic matter that may be stored. Typically, fire departments will use water on compost fires, which may not be the best first step.
- Have an agreement with the fire department about when to call them. For example, if there is smoke, call the fire department.
- Consider how to handle all the water that will run off the site as a result of fighting a fire. The run-off will carry nutrients, compost and ash.
- Have the correct equipment on site such as water, fire hoses, related hardware, equipment for moving material and written guidelines.
- Consider equipment such as tractors and skid steers as they could be used to fight a fire. Ensure operators understand how to use this equipment safely during a fire.
- Monitor your organic material for hotspots – high temperature (76 to 80°C), vents, smoke or burnt smell.
- Ensure temperature monitoring equipment can reach the centre of the piles.
- Ensure adequate ventilation and moisture content (above 40%) of pile to release heat.
- Avoid large piles – no greater than 12 feet high.

Emergency response kit

Compost facilities should consider creating an emergency response kit as part of their overall fire prevention plan, such as the one developed by California composter Matt

Cotton of Intergrated Waste Management Consulting. Here are some of his suggestions. The kit should be designed for easy access and portability. In an emergency, the kit could be placed on a front-end loader or forklift and rushed to the fire scene. Each facility should evaluate its own emergency response needs to build their kit.

- 400 feet of fire hose (1 1/2 inch diameter)
- one 1 1/2 inch fire hose Y
- two 1 1/2 inch diameter fire hose nozzles
- one fire hydrant wrench
- two ABC 20-pound fire extinguishers
- keys for the necessary equipment
- response card with instructions for fire pump operation and an emergency call list.

Fire – how to put it out

Surface fire – from lightning strikes, sparks or heat from equipment, etc.

- The proper response and procedures for attacking surface fires are best obtained from the fire department.
- Applying water or chemicals usually works for surface fires.

Spontaneous combustion

- Do not aerate the material – added airflow feeds chemical oxidation thus fueling the fire.
- Equipment or operators should never climb on top of the material when a fire is suspected.
- Remove material from the pile until the burning sections are isolated and quenched.
 - Remove coolest material from the edges of the pile first.
 - As material is removed spread on the ground or stack in small piles to cool.
 - Apply water or chemicals to hot material.

Warning: Smothering a burning pile with soil and waiting for it to cool is not a practical strategy for an internal fire unless the pile can be allowed to sit in place for a long time, sometimes up to two years.

Information adopted from

Rynk, R. 2000. Fires at composting facilities: causes and conditions. *BioCycle Journal of Composting and Recycling*. January: 54.

Rynk, R. 2000. Fires at composting facilities: handling and extinguishing fires. *BioCycle Journal of Composting and Recycling*. February: 58.