



FIRE!!

A Temperature Profile Study of Mulch and Soil

**Presented by:
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MULCH FIRES ARE REALLY 2 VERY DIFFERENT ISSUES



Large Storage Piles

- More industry experience
- Better known physics
 - Ignition sources
 - Spontaneous Combustion
- Environmental consequences
 - Smoke
 - Water pollution
- Political Consequences



MULCH IN LANDSCAPES & GARDENS

- Requires An Ignition Source
 - ✓ Cigarettes in places where people and cars congregate
 - ◆ Median Strips
 - ◆ Building Entries
 - ◆ Parking lots
 - ◆ Decks & Patios
 - ✓ Electrical devices & high voltage lighting
 - ✓ Focused Reflections from garden ornaments & Low-E windows



MULCH IN LANDSCAPES & GARDENS

- Spontaneous Combustion
 - ✓ Small Piles don't spontaneously combust
 - ▶ Pallet Loads
 - ▶ Small (5-10 cu yd) piles
 - ✓ Mulch in 4" Layers
 - ✓ Anecdotally known not possible
 - ✓ Lacked empirical data as proof



Potting Soil Fires and Your Safety

Every year, the Ephrata Fire Department investigates several fires caused by potting soil. Here are some unique factors to take into consideration.

Many potting soil mixes on the market today contain as much or more organic material as inorganic material. For example, potting soil can be made of shredded wood, bark, and/or peat moss with minimal amounts of what we call real soil (dirt). Styrofoam pellets, perlite and vermiculite are some of the other items that are often added to the soil mixture for aeration and water retention. In addition, many mixtures also include different types of fertilizers. Some fertilizers are oxidizers, which will make a fire that does start, grow at an even faster rate.

Potting soil mixtures are shipped moist and in plastic bags from the manufacturer. Most people use the soil in their planters in the Spring, then they forget about them once Fall/Winter arrives. Bacterial decomposition occurs within the mix that creates heat. This is the same principle that makes compost piles or bales of hay heat up. Although this principle, which is called spontaneous combustion, is usually found more often in climates containing more moisture; because water acts as a catalyst, these types of fires can also occur here.

As evidenced this past year, fires can start when you use the old potting soil as an ashtray. You may think you are putting your cigarette out into "dirt", when in fact you are creating an opportunity for fire. Therefore, the question to ask is, "Have you taken the proper precautions with the planter pots in and around your home to keep your family and property safe?"

Helpful Hints

- Do not use old planter pots that contain potting soil as an ashtray.
- Keep an ashtray in areas where someone might be smoking around potted plants. This is a great idea for large shopping complexes or your business.
- If you have dead plants in pots in and around your home, discard them properly. Throw them out in the trash or take the soil from the pots and spread it in your yards or gardens.
- Keep your plants well watered and maintained.
- If you keep your potting soil in your garage or on your deck, do not leave it near any combustible material.



Call 509-754-4666 to request an EFD Public Educator visit your organization or civic group.
More fire & life safety information at www.ephrata.org/209.html.

We Are Under Attack

- Sporadic claims of spontaneous combustion
 - ✓ Rare default claim when no other source was identifiable
 - ✓ Many reversed when proper cause was found (insurance investigators)
- 2015 Fire Chiefs Assn made policy decision to promote spontaneous combustion campaign
 - ✓ Dozens of claims attributing fires to garden mulch spontaneous combustion
 - ✓ Harrisonburg VA flower pots
 - ✓ Numerous Northeast fire chiefs claiming mulch combustion
 - ✓ Actual fire department newsletters & TV news stories warning consumers spontaneous combustion of mulch is a danger to life and property.

WHAT IS THE DANGER?

- **Misinformation told often enough becomes truth**
- **Growing consumer fear will impact sales**
- **Becoming a “Known” or “Credible Cause” draws attention of insurance industry**
 - ✓ **Product liability**
 - ✓ **Increased cost of doing business**

Mulch & Soil Research Foundation

- 501(C)(3) research organization
- Supports MSC Programs
- Eligible for grants & Tax deductible gifts
- Board of Directors:
 - Dr. Kathryn Louis
 - Chris Littlefield
 - Anthony Brocato
 - Kent Rotert
 - Scott Salmon
 - Robert LaGasse



Sponsors of Fire Research

- **Black Gold Compost**
- **GroWell Brands**
- **Harvest Garden Pro**
- **Kellogg Garden Products**
- **Landscape Express**
- **Landscapers Pride**
- **Mountain West**
- **Northland Bark Mulch**
- **Ohio Mulch**
- **Oldcastle Lawn & Garden**
- **SunGro Horticulture**
- **Suwanee River**
- **The Mulch Center**
- **The Scotts Company**
- **Yard Works LLC**

Thank You!

MSRF Hired SwRI

- \$650 million research institute in San Antonio, TX
- Fire Research Department
 - Dr. Matthew Blaze and
 - Alexandra Joyce



SOUTHWEST RESEARCH INSTITUTE



Temperature Profile Study of Mulch & Soils in Landscape and Garden Applications

3 Phase Study

- Phase 1 – Identify
- Phase 2 – Characterize
- Phase 3 – Heat Profile Test



Phase I – Identify

- 30 mulch types
- Summarized predominant type in each region
 - South.....Shredded Cyprus Mulch
 - Southeast.....Shredded Pine Mulch
 - Northeast.....Cedar Mulch
 - Central.....Shredded Hardwood Mulch
 - West.....Shredded Lodgepole Pine Mulch

Phase I – Identify

Preliminary Screening Test

- Identify the mulch with highest risk values
 - Lowest decomposition (self-heating) temperature
 - Greatest insulation Capacity (heat holding)

Phase I – Identify

DSC/TGA

- Differential Scanning Calorimetry (DSC)
- Thermogravimetry Analysis (TGA)

A measure of the temperature at which the materials start to decompose or react and the extent of the mass change using thermogravimetry

Lower Decomposition Temperature = Greater Risk

Phase I – Identify

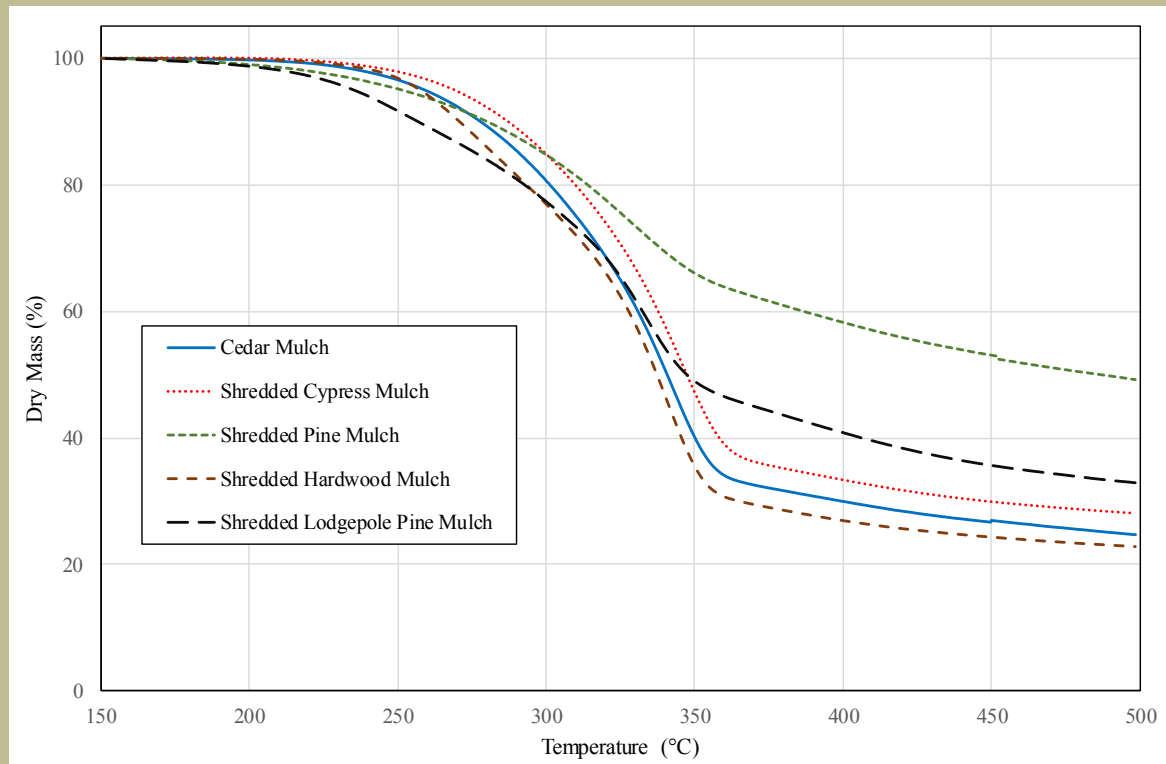


Figure 1. Average TGA Data for Five Mulch Varieties.

Phase I – Identify

Result:

1. Results were similar for all 5 mulch types.
2. Shredded Lodgepole Pine started decomp at lowest temp followed by Shredded Hardwood Mulch.
3. Shredded HW Mulch started decomp 2nd but lost more mass quickly.
4. These 2 are the most likely to self-heat

Phase I – Identify

INSULATION

- It isn't enough to self-heat, you also have to generate more heat than you release in order to combust.

ASTM C518

- Measures the steady state thermal transmission through flat slab specimens using a heat flow meter apparatus.
- 3 thicknesses: 2", 3" & 4"
- Testing performed in triplicate
- Samples of shredded Lodgepole Pine and Shredded Hardwood mulch

Phase I – Identify

RESULT:

Shredded Hardwood Mulch was a slightly better insulator which would aid in retaining heat in a pile or layer.

Phase 2 – Characterize

Physical Characteristics

- Shredded pieces $\frac{1}{2}$ - 3” long and $\frac{1}{4}$ - 1” wide and some $\frac{1}{4}$ - $\frac{1}{2}$ ” long by $<\frac{1}{8}$ ” wide
- Water content — 61%
- Fatty Acids:
 - Linoleic Acid 153 ppm
 - Linolenic Acid 13.7 ppm
 - Aracidonic Acid 3.20 ppm
- Metals: Typical

Phase 2 – Characterize

Basket Test

- U.N. Manual of Tests and Criteria, Part III, Section 33.3.1.6, Test N.4 Test Method for Self-heating Substances (UN)
- 100mm Cube
- 140°C (287°F) oven for 24 hours

Phase 2 – Characterize



Figure 3. Basket Heating Test Setup.

Phase 2 – Characterize

RESULT

- Temp rise $>60^{\circ}\text{C}$ = self-heating substance
- ***Mulch rise was 12.6°C = NOT self-heating***

Phase 2 – Characterize

Basket Heating test:

- Activation energy is the minimum amount of energy that is necessary to start a chemical reaction (e.g. combustion)
 - The higher the activation energy the harder it is initiate combustion
 - Example activation energies:
 - § Straw/Grass ~ 45-90 kJ/mol
 - § Wood pellets ~70-80 kJ/mol
- Activation energy of the Shredded Hardwood Mulch was found to be 195 kJ/mol

Phase 2 – Characterize

Crossing Point Temperature

- The point at which the temperature at the center of an object reaches or exceeds the temperature at the edges.
- Oven temperatures of 200°C (392°F) required for shredded hardwood mulch to reach crossing point

PHASE 3 - HEAT PROFILE TEST

Intermediate Test

- Actual Spontaneous Combustion Test
- Shredded Hardwood Mulch
- Wood-based Potting Mix w & w/o Fertilizer
- Peat-based Potting Mix w & w/o Fertilizer

PHASE 3 - HEAT PROFILE TEST

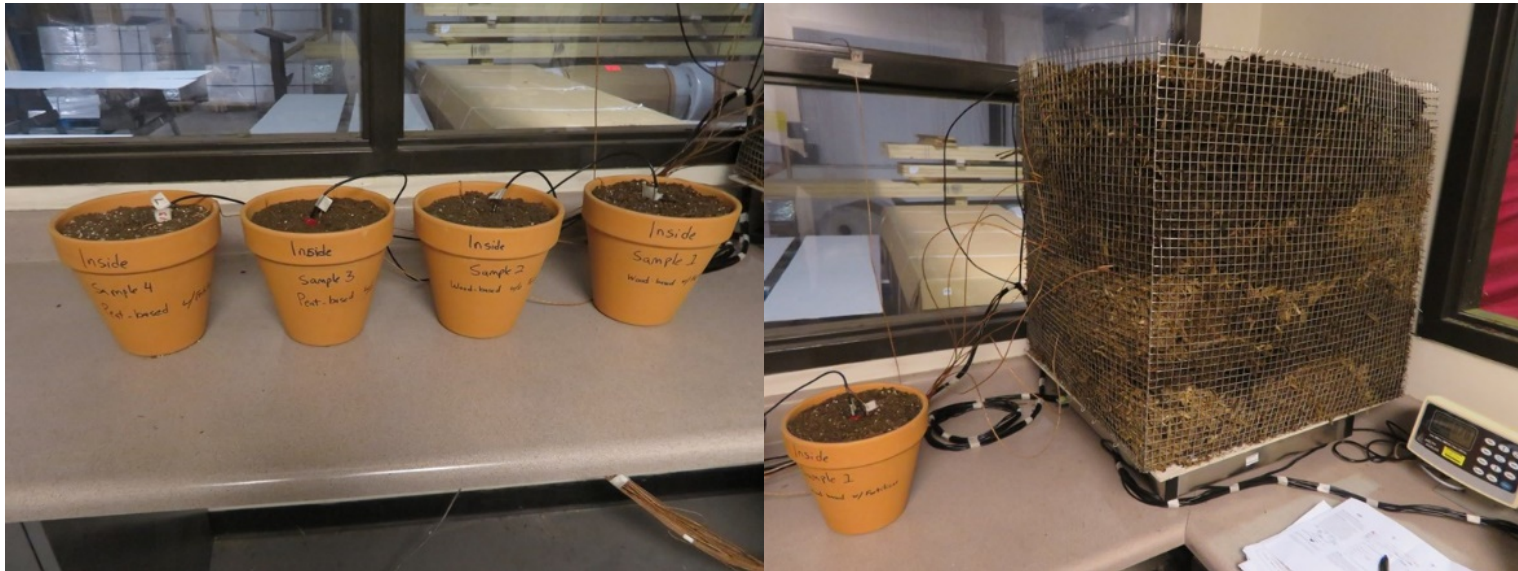


Figure 4. Intermediate-Scale Testing – Indoor Setup (Flower Pots – Left, Mulch Cube – Right).

PHASE 3 - HEAT PROFILE TEST



Figure 5. Intermediate-Scale Testing – Outdoor Setup (Ambient Sensor Locations Indicated).

PHASE 3 - HEAT PROFILE TEST

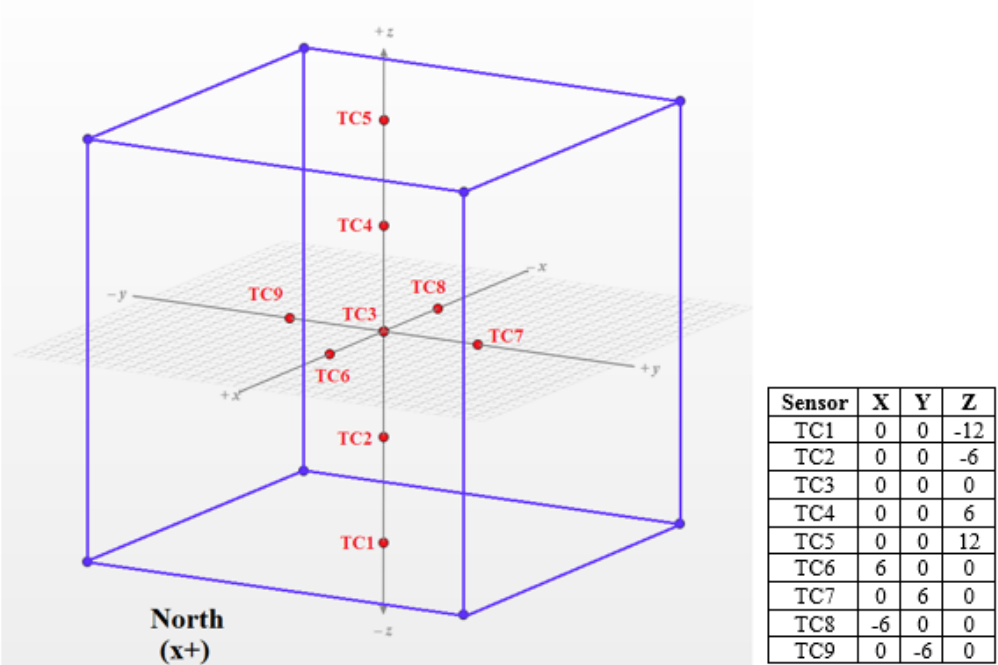


Figure 6. Indoor Mulch Cube Thermocouple Locations.

PHASE 3 - HEAT PROFILE TEST

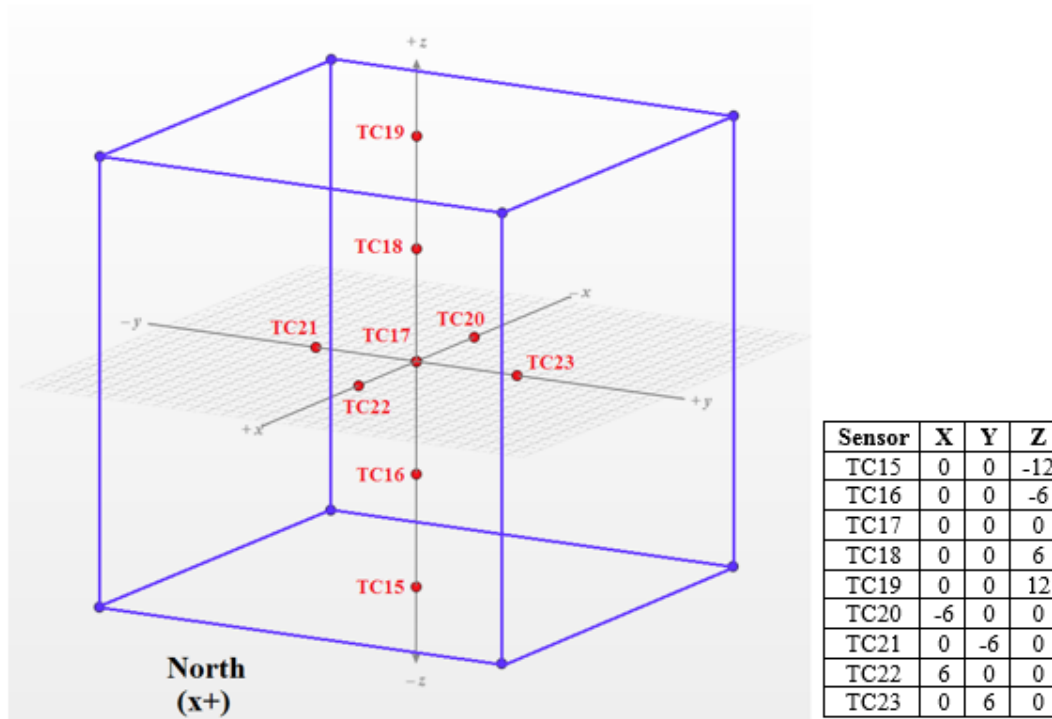
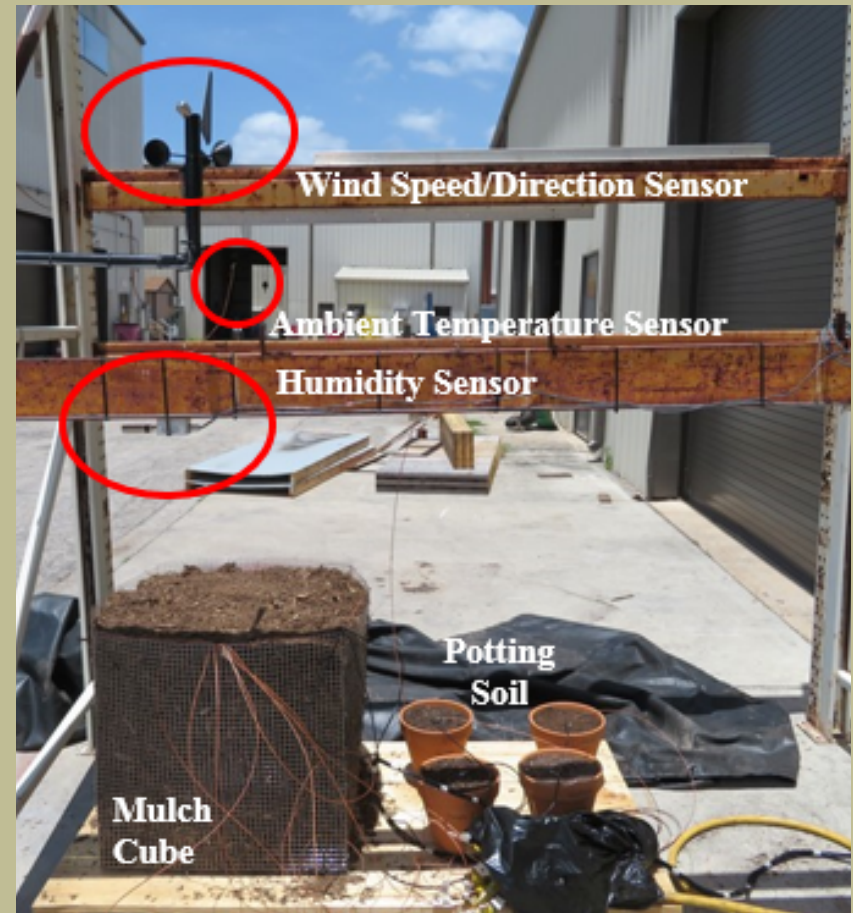


Figure 7. Outdoor Mulch Cube Thermocouple Locations.

PHASE 3 - HEAT PROFILE TEST

Measurements

- Indoor: weight, temperature, humidity
- Outdoor: weight, temperature, humidity, wind speed, wind direction
- Soils: Temperature
- Duration: 6.5 weeks during height of summer



PHASE 3 - HEAT PROFILE TEST

Results:

- Avg. outdoor high & Low:....107°F/73°F
- Outdoor Avg. Humidity:.....57%
- Avg. Indoor Temp:79°F
- Relative Humidity:.....54%

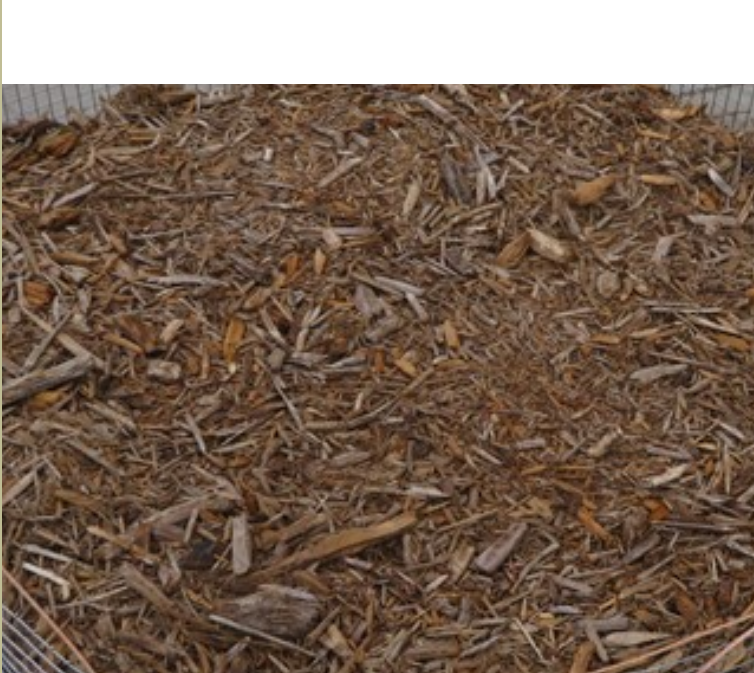


Figure 2. Shredded Hardwood Mulch.

PHASE 3 - HEAT PROFILE TEST

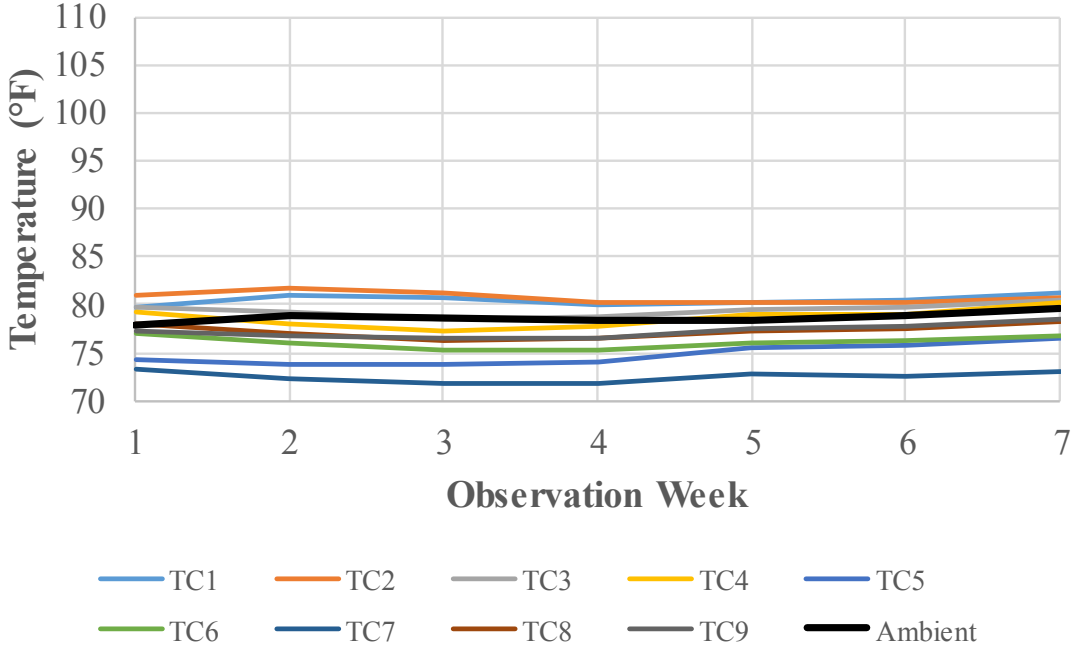


Figure 8. Indoor Mulch Cube Average Temperatures by Week.

PHASE 3 - HEAT PROFILE TEST

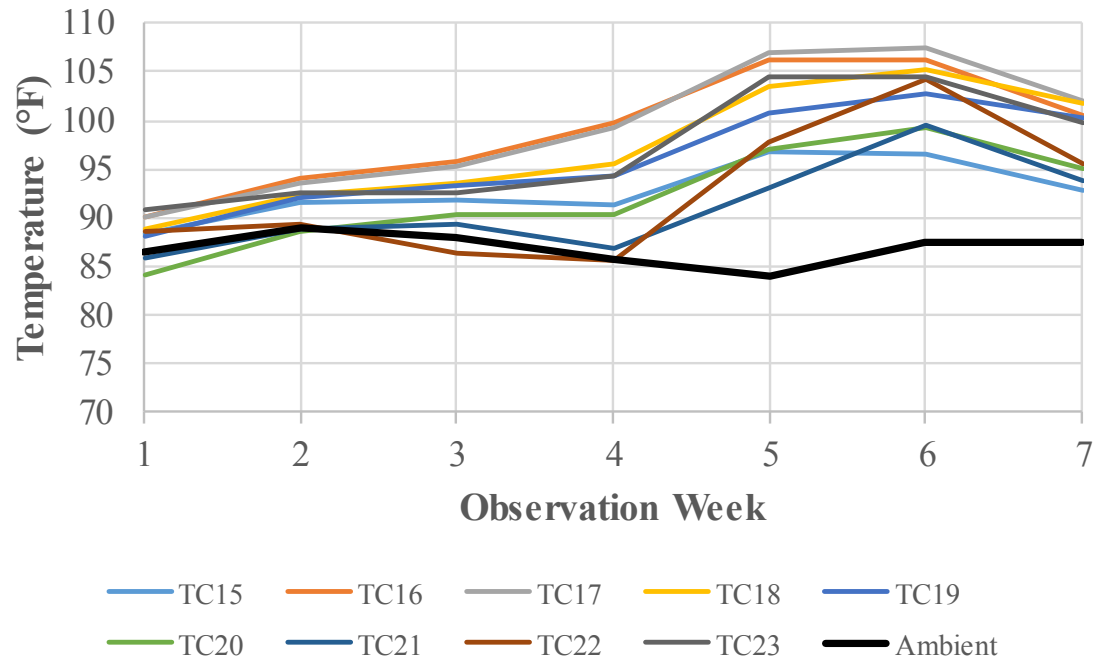


Figure 9. Outdoor Mulch Cube Average Temperatures by Week.

PHASE 3 - HEAT PROFILE TEST

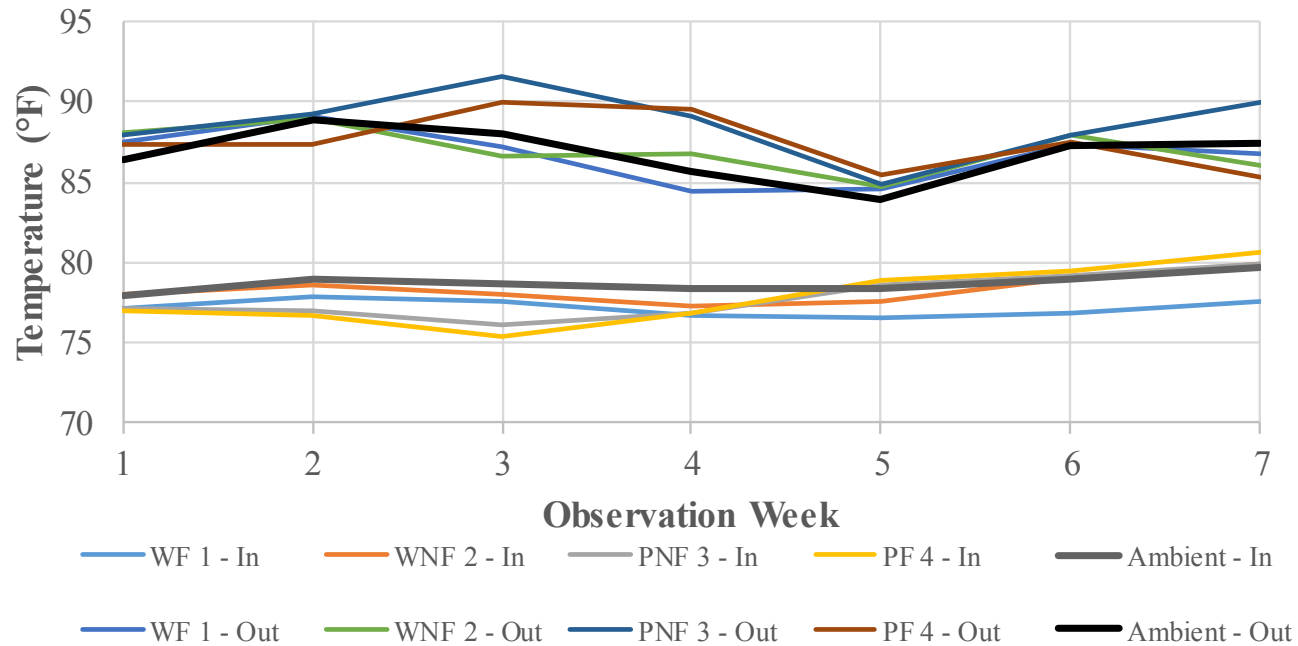


Figure 10. Potting Soil Average Temperatures (Indoor and Outdoor) by Week.

WF = Wood-based, with Fertilizer, WNF = Wood-based, No Fertilizer
 PNF = Peat-based, No Fertilizer, PF = Peat-based, with Fertilizer

CONCLUSIONS

General:

- Mulch was observed in 2' x 2' x 2' mesh cubes, both indoor and outdoor. The cube size was selected to create a pile which is much thicker than is reasonably installed in landscape applications, while allowing exposure to the ambient environment.
- Maximum depth listed on the mulch bag coverage chart is 4 inches, but the center of the mulch pile was 12 inches from any edge of the cube.
- Thinner mulch depths would be expected to pose less risk of spontaneous combustion because the pile would be less insulating.

CONCLUSIONS

Mulch:

- Ambient maximum temperatures were only slightly lower than the mulch cube internal temperatures, which indicates that the mulch is retaining heat due to its insulating properties but not self-heating.
- Based on the DSC/TGA data, the decomposition temperature for the shredded hardwood mulch was about 200°C (392° F). The maximum temperature observed in the outdoor mulch cube was (113°F) much less than the decomposition temperature.

Based on these results it is (highly/extremely) unlikely that mulch in a landscape application would pose a risk of spontaneous combustion

CONCLUSIONS

Potting Mix:

- Four 8-inch flower pots were set up alongside the mulch cubes to observe a wood-based potting soil and peat-based potting soil, with and without fertilizer.

Based on these results, it is (highly/extremely) unlikely that potting soil (wood- or peat-based, with or without fertilizer) in 8-inch flower pots would pose a risk of spontaneous combustion.

WHAT IS NEXT?

Debunk the urban myth of spontaneous combustion of mulches and soils in landscape and garden applications!

Scientific article by SwRI

Publication in major fire journals

Publication anywhere else we can find

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Questions??