A FIRE RESISTANT ROOFING LAYER CONSISTING OF SUPERABSORBENT POLYMER AND INTEGRATED SPRINKLER SYSTEM

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Objective:

The current market has room for a better roofing option to protect houses from wildfires. This project aims to design a roofing composite that surpasses the ASTM class-A fire-resistance standard by using a superabsorbent polymer layer (SAP).

Background:

- In both 2017 and 2018, California wildfires alone cost >10000 structures and >$13 billion dollars in damages each year.
- A burning roof can collapse inward and destroy the home completely
- SAPs are polymers that can absorb and trap over 400 times their weight in water and contain it as a gel [2].

Product Specifications:

Weight: 8 lb/ft^2 (soaked)
Price: $0.68/ft^2

Roof Structure (from inside to outside):

1. Roof deck
2. Waterproof Barrier
3. SAP Blanket, 1.5” Structural Grid, and Sprinkler System
4. Metal Roofing Panels

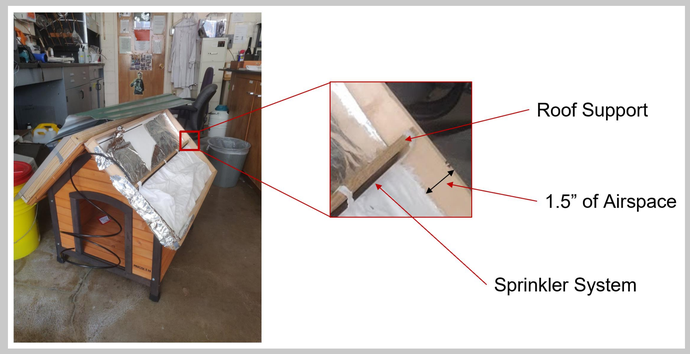

Fig 1: The current prototype of the SAP roof. The full house is shown on the left, while a closeup is shown on the right, depicting the sprinkler system and roof support

ASTM-Based Testing:

Test Purpose and Design:

- Provides direct, standardized comparison between two “Class A” roofs
- Two roofs were made:
  - Control roof with an FR-10 firesheet [1]
  - Prototype roof with SAP layer
- Roofs were burned with a standardized wooden burn box and temperatures were recorded with thermocouple

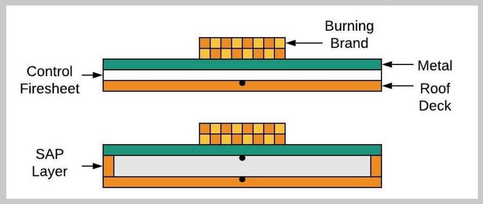

Figure 2: The control roof (above) and SAP roof (below) with thermocouple locations marked

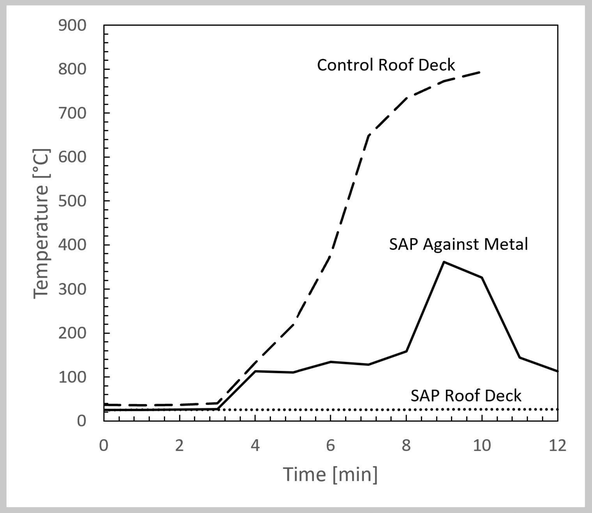

Fig 3: A graph showing the results of the burn test for three different thermocouples. All thermocouples were placed underneath the center of the burning block. Thermocouple placements found in Figure 1. Final burn pictures are depicted in Figures 4 and 5

Figure 4: The SAP blanket roof after test completion

Figure 5: The back of the control roof after test completion

Test Results:

The SAP outperformed the control roof, keeping the roof deck at 25 °C for the duration of the test, while the control roof reached over 800 °C and ignited the roof deck.

The SAP roof was kept significantly cooler at around 380 °C on the outside and 25 °C underneath, and the only noticeable damage was on the metal paneling, which was warped.

Future Work:

Continued Prototype Design

- Super Absorbent Polymer containment and expansion within roof
- SAP dehydration, rehydration, and general reuse of pouches
- Continued development of sprinkler system
- Mold testing

The Team:

Oregon State University

Citations:

[1] https://roof.atlasrwi.com/products/fr-slipsheet-inorganic-fire-retardant-underlayment/fr-10/#tap-download

[2] Sodium Polyacrylate; MSDS No. S25565 [Online] AquaPhoenix Scientific; Hanover PA, Jan 15, 2015. https://betastatic.fishersci.com/content/dam/fishersci/en_US/documents/programs/education/regulatory-documents/sds/chemicals/chemicals-s/S25565.pdf (accessed Apr 18, 2019)