

Testing of DefendPak and Vermiculite as Fire Suppression Media

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Background/Scope

DefendPak is an expanded post-consumer recycled glass material being marketed as “fire protection granules” for a wide range of fire classes including combustible metal and lithium-ion battery fires. Vermiculite is an expanded mica-like mineral common in insulation materials and lawn care products, as well as in some fire protection applications.

In an effort to compare DefendPak and Vermiculite as potential fire suppression media for fires involving lithium-ion batteries, Chippewa Valley Technical College’s (CVTC) Fire Safety Center (FSC) tested the two products using a standardized approach. The goal of the tests was to determine the effectiveness of the products at controlling or suppressing lithium-ion battery fires and the smoke produced from such fires.

Methods

Two identical battery packs were constructed using the following materials layered and held together with a steel hose clamp (Figure 1). Each battery pack was also fitted with two thermocouples to verify that the film heaters were functioning and to monitor the heat of the batteries during the pre-ignition phase.

- Four 7.4 Wh lithium-ion polymer (LIPO) batteries at full state of charge
- Four ABS spacers to represent a battery pack housing
- Two polyimide film heaters

Prior to each of the two tests, a volume of 1100 cubic centimeters (67.1 cubic inches) of extinguishing media was prepared. Starting with an equal amount of media for each test allowed a comparison of the effectiveness of the products at controlling the fire and smoke produced by the battery packs.

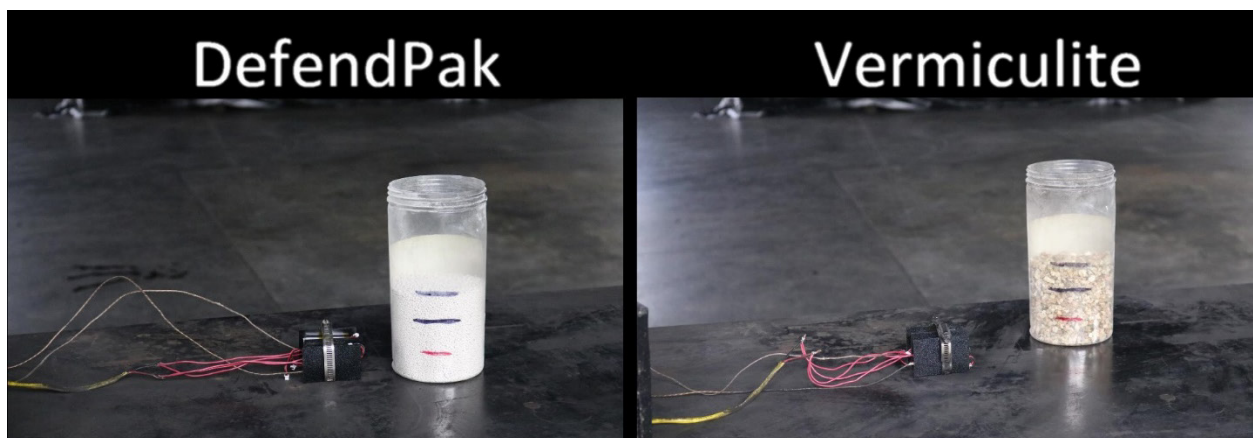


Figure 1. LIPO Battery Packs and Extinguishing Media

To heat the batteries to ignition temperature, the film heaters were connected to a power supply set to deliver 15 volts, 1.4 amps, and 23 watts. The battery packs were heated to the point of ignition and once battery ignition occurred, the power supply was turned off. In both tests, application of the extinguishing media occurred 5 seconds after the fourth and final LIPO cell ignited.

Results/Discussion

The application of DefendPak to the burning battery pack was effective at suppressing the fire and controlling the smoke that was produced. It took less than 1100 cubic centimeters of DefendPak to extinguish the fire and nearly all smoke production was contained once the full 1100 cubic centimeter was applied. The full 1100 cubic centimeters of Vermiculite, however, was unable to extinguish the fire and additional Vermiculite was needed to do so (Figure 2). Even after the application of an additional 500 cubic centimeters of Vermiculite, smoke production was still considerably more than with 1100 cubic centimeters of DefendPak (Figure 3).



Figure 2. LIPO battery pack tests after 1100 cubic centimeters of media has been applied.

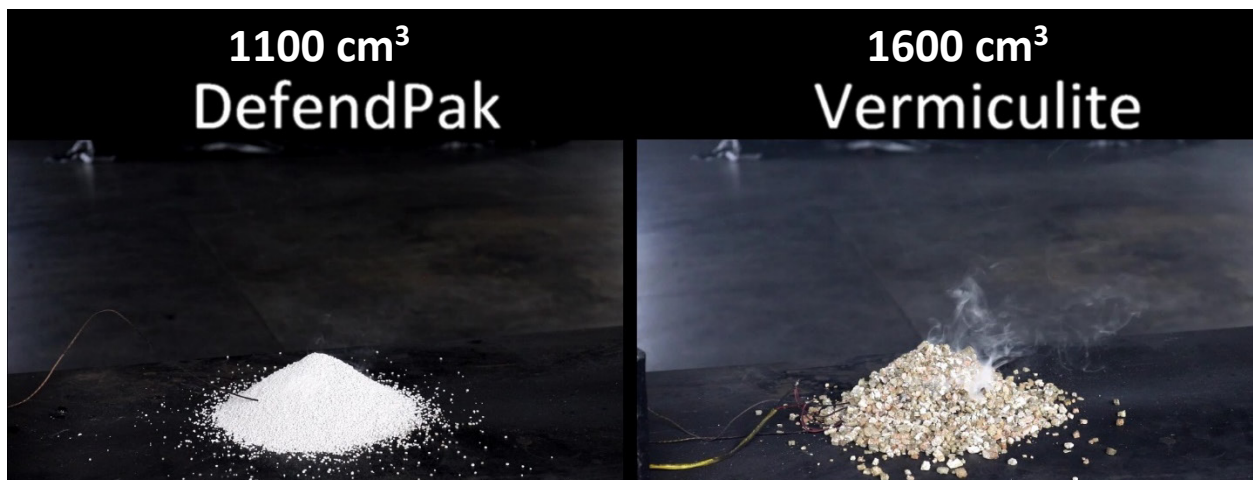


Figure 3. LIPO battery pack tests after additional Vermiculite has been applied.

A side-by-side video of the two tests was created to compare the ability of the two products to control fire and smoke. The video (available at the link below) is synced to the time of media application.

<https://youtu.be/oJRLeQorpAc>

Conclusion

Test results show that both DefendPak and Vermiculite can control and suppress lithium-ion polymer battery fires, but DefendPak was more effective at controlling the fire than Vermiculite. The volume of DefendPak required to extinguish the test fire was considerably lower than the volume of Vermiculite required. Additionally, DefendPak was much more effective at controlling smoke than Vermiculite. Smoke production was nearly 100% contained with the initial application of DefendPak, while considerable smoke remained even after additional Vermiculite was applied. While the choice of extinguishing media for lithium-ion battery fires should likely include a consideration of multiple properties, the results of this test demonstrate that DefendPak is capable of suppressing fires when used as a direct application media and is able to control the heat, smoke, and fire produced from lithium-ion battery fires.