Testing of the Absorbency of DefendPak

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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.

In an effort to test DefendPak as a potential packing material for the shipment of end-of-life or damaged lithium-ion batteries which may leak electrolytes, the absorbency of the product was tested. In the absence of any recognized national or international performance standards that focus on sorbents, Chippewa Valley Technical College’s (CVTC) Fire Safety Center (FSC) developed a pair of standardized tests with which to test the absorbency of the product. These tests included:

1 Short Term Uptake Capacity; and
2 Long Term Uptake Capacity.

For the purposes of this test, no distinction was made between absorption (the process by which a liquid product is assimilated into the interior of another product) and adsorption (which is the process by which a liquid adheres to the surface of another product). The term “absorption” in this report is therefore used to collectively represent both absorption and adsorption.

Methods

Short Term Uptake Capacity

In order to determine the ability of DefendPak to take up spilled material in a short period of time, the test product was exposed to water following the steps below. Each test was performed in triplicate to ensure consistency among the results. If any single test result fell outside the normal range of results, it was to be repeated; however this was not necessary. Figure 1 provides an overview of the uptake capacity test setup.

1. Place 25 grams of product in a weighted mesh bag.
2. Determine the pre-test weight of the bag, product, and weight combined.
3. Submerge the bag in the water for 5 minutes.
4. Remove the bag and allow sufficient drip time to ensure that the water which is loosely held by the product is lost due to gravitational pull.
5. After the drip time had elapsed, the sample was weighed again and the uptake capacity (also referred to as the sorbency ratio) was calculated as the mass of liquid uptaken per mass of product.

Long Term Uptake Capacity

In order to determine the total uptake capacity or sorbency ratio of DefendPak, the above steps were repeated but the exposure time was increased to 20 hours. This ensured that the product had reached saturation point. The total uptake capacity was again calculated as the mass of liquid uptaken per mass of product.

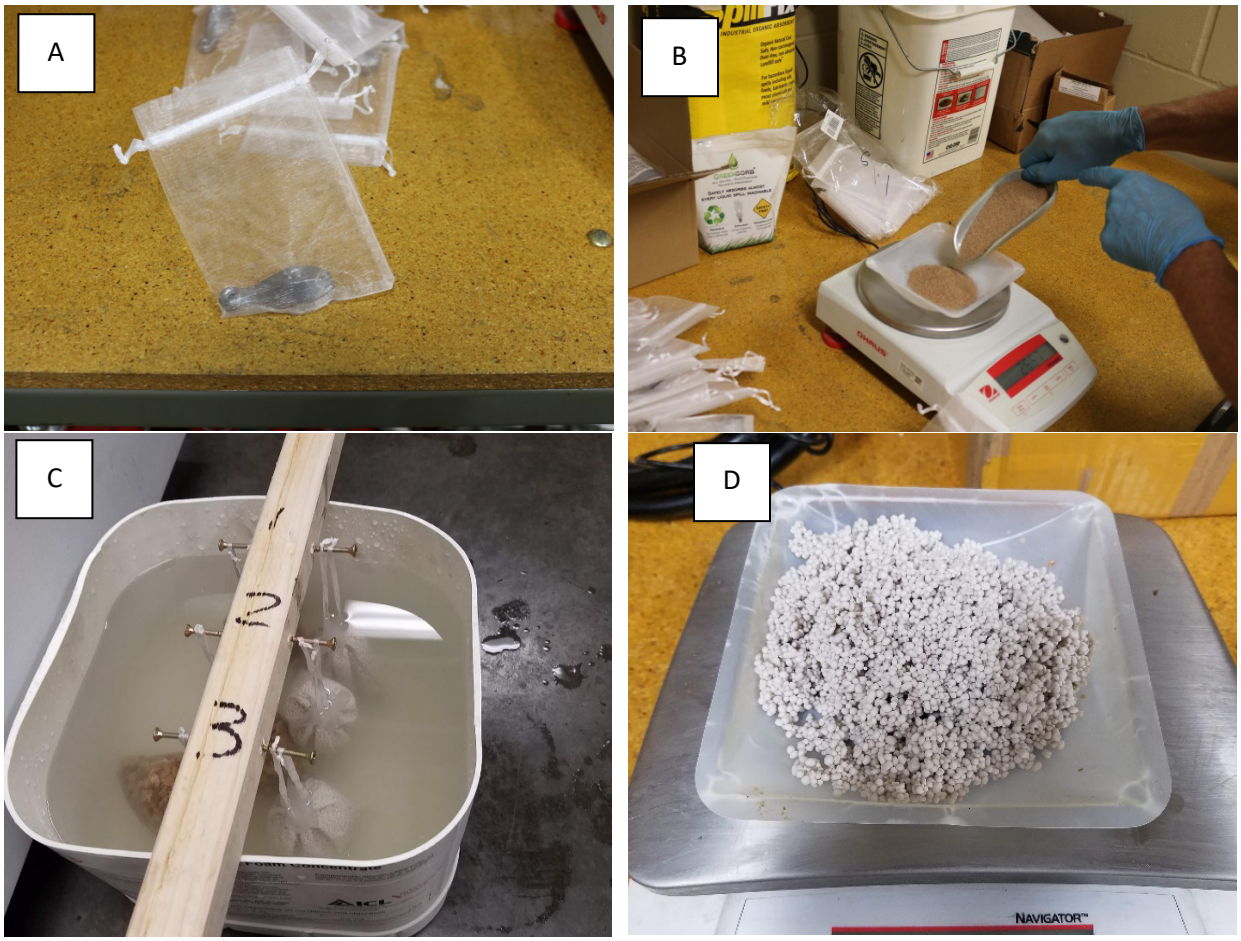

Figure 1. Test Setup for Measuring Short and Long Term Uptake Capacity. A) weighted mesh bag; B) weighing of product; C) submerged bags of products during test; D) example of DefendPak after long-term absorbency test.

Results/Discussion

Uptake Capacity

Short term (5 minute) uptake capacity of DefendPak averaged 63% of its starting weight, and long term (20 hour) uptake capacity averaged 80% of its starting weight. Table 1 displays the starting weights, ending weights, and calculated uptake capacities across the three replicates tested for the product.

Table 1. Results of Short Term and Long Term Uptake Capacity Tests

Uptake Rates					UPTAKE RATES			
					Short-term Amount Absorbed		Long-term Amount Absorbed	
Bag #	Rep #	Product	Fluid	Weight of Product (g)	Grams	Percent	Grams	Percent
1	1	DefendPak	Water	25	38.0	52%	43.7	75%
2	2	DefendPak	Water	25	42.1	68%	45.7	83%
3	3	DefendPak	Water	25	42.2	69%	45.7	83%
				Average	40.8	63%	45.0	80%

Conclusion

Test results show that DefendPak is capable or absorbing up to 80% of its original weight which makes it a potentially viable packaging material for batteries with the potential to leak fluids. It should be noted that these tests were performed with water only and no other tests liquids. The absorption/adsorption qualities of these products may vary when exposed to battery electrolytes or other liquids.