Use of Silica Aerogel Coating and Foams for Thermal Polyolefin Based Materials to Suppress Fires in Automotive Vehicles

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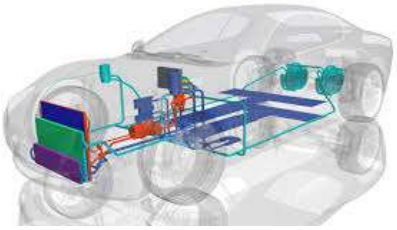
THE PROBLEM

Fire suppression systems and thermal management systems in automotive vehicles often fail. This has led to fires in electric as well as internal combustion engine vehicles. There needs to be a low-cost way to improve the fire suppression and thermal management capabiliites inside the vehicle.

THE SOLUTION

The solution is to develop an aerogel based liquid coating or foam that can be combined with thermal polyolefin to help suppress and management thermal energy throughout the vehicle. This solution applies to electric and ICE vehicles.



RESEARCH PLAN

- Understand and identify subsystems within electric and ICE vehicles that generate heat
- Understand the thermal management benefits of TPO.
- Gather information on the thermal management benefits of aerogel
- Learn about thermal system testing standards
- Do experimental test on each concept of thermal coatings and foams

A fire can happen at any time and in place within a automotive vehicle. For example, in electric vehicles the battery pack can combust from over heating and from under carriage damage. For an internal combustion engine, fires from engine over heating or loose wires are common. To date, there are a number of ways to deal with this risk. One option is to use a material like TPO that will help manage the flow and cooling of thermal systems in a vehicle.

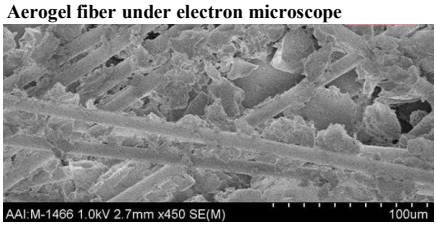
What if there was a way to increase the thermal management effectiveness of TPO. Can a coating be created that can serve as a second layer of defense for fire avoidance and over heating of internal systems? In this research, We examine the potential of using a silica aerogel-based coating and foam that can be placed on the surface of TPO materials to serve as a fire suppressant.

EXPERIMENTAL SECTION

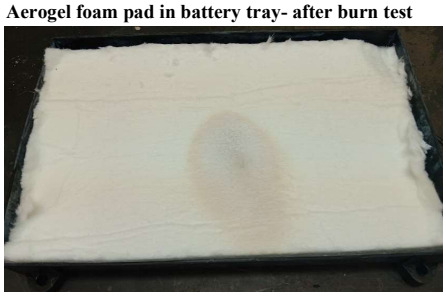
Our experiment for our research focuses on learning more about the fire suppression properties of aerogel. Through our research we learned that it is has been used in the aerospace and defense industries as a heat suppressant. The most common type of aerogel, silica aerogel, is created from a solgel reaction where liquid filled pores have been replaced with gas.

Our experiment focused on measuring the thermal penetration of aerogel as in solid form using a torch and as a liquid coating on UV paper. We placed a piece of aerogel foam in a TPO based battery pack and placed a torch over the foam for 2 minutes. We then placed 1 gram of aerogel smoke in a test tube with 10ml of water in it- 9 percent concentration. Though the aerogel demonstrated hydrophobic properties, after 24 hours, it had mixed with the water solvent. We coated the UV paper with the aerogel-water solution We placed the coated UV paper under a100 Watt UVA+UVB Full Spectrum Vapor heat lamp.

Aerogel fiber under electron microscope

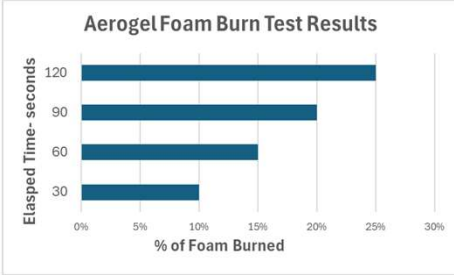


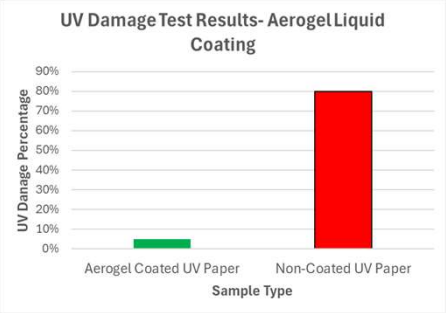
Aerogel foam pad in battery tray- after burn test



RESULTS

Our results were consistent with what our background research indicated. The aerogel has high thermal resistance. Degradation was very low for the foam. The results for the liquid coating was surprisingly in alignment with our hypothesis.





FUTURE WORK

Our research plan for future work is to continue looking at how to upgrade the liquid coating using aerogel to determine if it can have a better resistance at higher concentrations.

Conclusion: We found that aerogel has a lot of thermal management properties. We know that TPO is also good at heat diffusion. We think that concentrating our efforts on a composite material or coating for TPO in electric vehicles and ICE vehicles will give us a pathway to making a positive impact in material science.

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