PROTECTION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL PROTECTION

Development Of Adsorbent System Against Chemical Threats

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Metal-organic framework (MOF) particles are currently being explored to become a sorbent used in the adsorbent layer of chemical biological (CB) protective textiles. MOF particles have the ability to adsorb and neutralize chemical warfare agents (CWAs) and could potentially replace or augment activated carbon as a sorbent. Currently, MOF particles are attached to nonwoven structures in a thermal based process.
The purpose of this project is to advance the current knowledge of the interactions between MOF particles and fibers in a functional nonwoven layer capable of adsorbing CWAs. This work studied how the particles and fibers interact to understand the adhesion of the MOF particles to bicomponent fibers. Bicomponent fibers are fibers consisting of two different materials and utilizes the desired properties of both materials. For this project sheath-core bicomponent fibers are used, where the center core material is for structure and stability, while the outer sheath layer is an elastomer chosen for melt point and adhesion properties. By understanding the interactions and adhesion of MOF particles and bicomponent fibers, we can optimize particle loading of the final nonwoven structure.

The current process of attaching the particles uses sheath-core fibers in a web that is co-mingled with particles and the web is subsequently heated to allow the partial melting of the sheath polymer so that the particles can adhere to the surface of the fibers. The temperature and the residence time are both important in this process. Film coupons were created and coated with MOF particles, to determine the optimal polymer for fiber and MOF particle adhesion studies. Preliminary results showed that the peak and endset melting temperatures of the polymer are ideal for this attachment process and overall particle adhesion. Currently, there are not many specific test methods out there to measure this particle adhesion. The most common test method is a tape test, which places tape on the surface of the coupon and removes the tape with force to determine if there is an adhesion failure. Using a tape test on fibers is not reliable, due to their shape and geometry. Therefore, future work will focus on a new test method to evaluate the adhesion between the MOF particles and the polymer that makes up the sheath component of the fibers.