Effect of Repellent Coatings, Aerosol Protective Liners, and Lamination on the Properties of Chemical/Biological Protective Textiles

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Abstract : The primary research question to be answered for Chemical/Biological (CB) protective clothing, is how to protect wearers from a range of chemical and biological threats in liquid, vapor, and aerosol form, while reducing the thermal burden. Currently, CB protective garments are hot, heavy, and wearers are limited by short work times in order to prevent heat injury. This study demonstrates how to incorporate different levels of protection on a material level and modify fabric composites such that the thermal burden is reduced to such an extent it approaches that of a standard duty uniform with no CB protection. CB protective materials are usually comprised of several fabric layers: a cover fabric with a liquid repellent coating, a protective layer which is comprised of a carbon-based sorptive material or semi-permeable membrane, and a comfort next-to-skin liner. In order to reduce thermal burden, all of these layers were laminated together to form one fabric composite which had no insulative air gap in between layers. However, the elimination of the air gap also reduced the CB protection of the fabric composite. In order to increase protection in the laminated composite, different nonwoven aerosol protective liners were added, and a super repellent coating was applied to the cover fabric, prior to lamination. Different adhesive patterns were investigated to determine the durability of the laminate with the super repellent coating, and the effect on air permeation. After evaluating the thermal properties, textile properties and protective properties of the iterations of these fabric composites, it was found that the thermal burden of these materials was greatly reduced by decreasing the thermal resistance with the elimination of the air gap between layers. While the level of protection was reduced in laminate composites, the addition of a super repellent coating increased protection towards low volatility agents without impacting thermal burden. Similarly, the addition of aerosol protective liner increased protection without reducing water vapor transport, depending on the nonwoven used, however, the air permeability was significantly decreased. The balance of all these properties and exploration of the trade space between thermal burden and protection will be discussed.

Keywords : aerosol protection, CBRNe protection, lamination, nonwovens, repellent coatings, thermal burden
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