S2.2.1 AEROSOL PENETRATION THROUGH FABRIC MEDIA

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Clothing or garments are widely used to prevent dermal contact from particles, especially in occupational workplace. As the important parameter to quantify the fabric performance, however, the penetration study received little attention. Two ubiquitous fabrics (10 oz denim and A30) were experimentally tested in this study using benchtop and sleeve test setups. The benchtop test established the relation among face velocity, pressure drop, and penetration using small fabric samples and conventional filter test protocols. In the sleeve configuration, representing fabric on a segment of human body, aerosol penetrations through a cylindrical fabric column were measured under different elevated wind conditions in a wind-tunnel. The measurements were obtained as a function of particle size, wind-velocity, and at different locations on the fabric relative to the wind-direction. In addition to the individual fabric test, penetrations were also measured for a serial combination of two fabrics. The experimental results of fabric particle-penetrations were used to determine if inhomogeneous fibrous filtration theory could be used to predict fabric penetration performance. The theoretical model required knowledge of effective fiber parameters for the fabrics and these were obtained by optimizing theoretical predictions to match experimental benchtop particle penetrations. Using these effective parameters, fabric particle penetrations were then predicted for the sleeve model for the different tested conditions. It was found that theoretical predictions matched experimental results very well for all cases. Our study suggests that particle penetrations through fabric material on human bodies can be predicted under elevated wind conditions using filtration theory and relatively simple benchtop experiments.