The Study of Adverse Weather Conditions on Soldiers Wearing Personal Body Armor in Combat and the Introduction of Mitigating Factors Through the Use of Integrated Microclimate Systems

Weather conditions are the main controlling factors that decrease combat effectiveness for the military. Weather, in particular heat, influences training schedules, soldiers' preparations for upcoming missions and combat effectiveness. This research presents a design to help soldiers decrease the chances of heat injury by modifying the personal body armor worn. By using phase change material integrated into the armor, the soldier would experience an isothermal effect ultimately prolonging the soldier's ability to work in hot environments. In order to appropriately design a model the modified armor, a one-dimensional heat flow, implicit finite difference method was used to test the effects of an unmodified and modified armored vest. Human testing was also used to measure the heat flow characteristics of the body while wearing the typical combat load. This was compared to and used as a basis for computing the heat flow by hand and seeing the effects of the phase change material. The phase change material characteristics were obtained from First Line Technologies who gave us proprietary information for two different types of phase change material. After implementing the phase change material, it is found that it does not benefit the soldier sufficiently to be commercially manufactured. However, the modeling showed potential for using a different phase change material with thermal properties optimized for the application. There are other methods to help keep the user's skin temperature constant, but none that offer the unique advantages of phase change materials. Other research may include microclimate systems consisting of conformal batteries, solar power, and Peltier coolers, as power sources and temperature controllers, respectively, which can be integrated with the phase change material to produce the proper cooling effect.

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