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DIF-JACKET: a Thermal Protective Jacket for Firefighters

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Abstract : Every year, an unacceptable number of firefighters are seriously burned during firefighting operations, with some of them eventually losing their life. Although thermal protective clothing research and development has been searching solutions to minimize firefighters heat load and skin burns, currently commercially available solutions focus in solving isolated problems, for example, radiant heat or water-vapor resistance. Therefore, episodes of severe burns and heat strokes are still frequent. Taking this into account, a consortium composed by Portuguese entities has joined synergies to develop an innovative protective clothing system by following a procedure based on the application of numerical models to optimize the design and using a combinationof protective clothing components disposed in different layers. Recently, it has been shown that Phase Change Materials (PCMs) can contribute to the reduction of potential heat hazards in fire extinguish operations, and consequently, their incorporation into firefighting protective clothing has advantages. The greatest challenge is to integrate these materials without compromising garments ergonomics and, at the same time, accomplishing the International Standard of protective clothing for firefighters – laboratory test methods and performance requirements for wildland firefighting clothing. The incorporation of PCMs into the firefighter's protective jacket will result in the absorption of heat from the fire and consequently increase the time that the firefighter can be exposed to it. According to the project studies and developments, to favor a higher use of the PCM storage capacityand to take advantage of its high thermal inertia more efficiently, the PCM layer should be closer to the external heat source. Therefore, in this stage, to integrate PCMs in firefighting clothing, a mock-up of a vest specially designed to protect the torso (back, chest and abdomen) and to be worn over a fire-resistant jacketwas envisaged. Different configurations of PCMs, as well as multilayer approaches, were studied using suitable joining technologies such as bonding, ultrasound, and radiofrequency. Concerning firefighter’s protective clothing, it is important to balance heat protection and flame resistance with comfort parameters, namely, thermaland water-vapor resistances. The impact of the most promising solutions regarding thermal comfort was evaluated to refine the performance of the global solutions. Results obtained with experimental bench scale model and numerical simulation regarding the integration of PCMs in a vest designed as protective clothing for firefighters will be presented.

Keywords : firefighters, multilayer system, phase change material, thermal protective clothing
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