THE FIRST YEAR OF THE PROJECT DIF-JACKET - DEVELOPMENT OF AN INNOVATIVE FIREFIGHTER JACKET

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Under the project DIF-Jacket [LINK 1], the multidisciplinary team (CEFT, CeNTI and CITEVE) are combining several solutions and techniques to produce an innovative thermal protective jacket for firefighters, following a procedure based on the application of numerical models to optimize the design. The CEFT team leads the tasks about the numerical simulation work, the CeNTI partner leads the tasks of selection and functionalization of the materials and the CITEVE partner leads the tasks of the prototype construction and performance evaluation tests. In this presentation, the main outcomes of the project, obtained during the first year, will be shown.

The jacket will be based on a combination of protective clothing components prepared in different layers. Among the solutions, there will be included reflecting surfaces and Phase Change Materials (PCMs). During the first year, the CEFT team numerically tested the performance of a solution based on the incorporation of PCMs into the jacket structure [1]. Different commercial PCMs were numerically tested (only considering heat transfer phenomena), and the numerical data allowed quantifying the masses and the critical properties of the PCMs to ensure protection (i.e. assessed by skin damage) during transient periods of fire exposure, post-fire exposure and resting phases. Moreover, water content is of utmost importance, and for that reason, the model was improved to consider water transport along with the jacket. The model predicted with accuracy the water content and skin temperature profiles obtained on a typical firefighter protective clothing (without PCM), initially dry, and exposed to heat. Further studies will be carried out to obtain data when the sample had high percentages of initial water. The project also intends to characterize the response of firefighter body to different scenarios considering different protective clothing. For that reason, a 65-node thermoregulation model was integrated into the simulation platform to study the performance of the new firefighter jacket in realistic fire scenarios and considering firefighter cycles (e.g. number of breaks). We expect that the generated information will contribute to improve firefighter's strategies and promote the correct use of firefighting equipment. The National School of Portuguese Firefighters (ENB) have already joined the project to support the design of studies with realistic scenarios and the first workshop of the project will be presented in ENB schools.

PCM candidates and other solutions (e.g. IR pigments) with the potential to improve the jacket thermal performance were experimentally integrated by CeNTI into textile structures, to developed new solutions with better comfort and performance. These samples have been characterized to obtain the relevant properties (e.g. surface emissivity, thermal resistance, PCM temperature of melting and enthalpy). Further experimental studies will be carried out to understand the evolution of the sample temperature and water content when exposed to different radiative heat fluxes. Through all the R&D steps, the CITEVE partner highlighted the legislation and standards requirements of the materials applicable to firefighter protective clothing. Moreover, the partner started studying the implementation of the new solution in the jacket (now at a small scale) and its feasibility, among other practical features.

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REFERENCES

[LINK 1] https://difjacketproject.fe.up.pt/

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