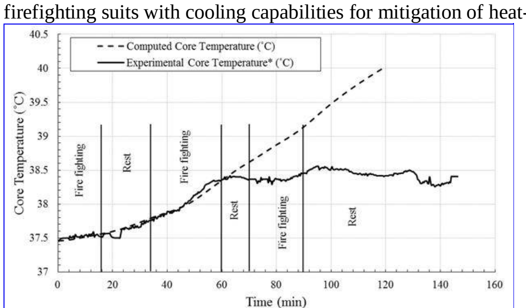
Print this Page

7th World Congress of Biomechanics
July 6-11, 2014
John B. Hynes Veterans Memorial Convention Center
900 Boylston Street | Boston, Massachusetts 02215

Presentation Abstract

Session:	15-11-Human Whole Body Thermal Modeling
Presentation:	Predicting thermophysiological response and safe duration of exposure during firefighting activities: Validation and application of whole body model.
Location:	305
Presentation Time:	Thursday, Jul 10, 2014, 8:54 AM - 9:12 AM
Author(s):	**A. K. Paul**, S. A. Zachariah, R. K. Banerjee; University of Cincinnati, Cincinnati, OH.

Abstract: *Introduction:* Regulation of heat-induced stress in firefighters is of ever increasing importance. During prolonged periods of firefighting activity there is a significant rise in the heat levels of the human body due to an increase in metabolism and the high temperature environment. The inability of firefighters to dissipate bodily heat during live-burn activities would lead to adverse physiological consequences, including unconsciousness and cardiac arrest. Thus, there is a need to ascertain the safe working duration for firefighting activities and to develop mechanisms to limit the increase in core body temperature (Tc) for individual firefighters. In this study we utilize a computational Whole Body Model [1] to predict the time taken for Tc to reach the critical value of 40 °C during firefighting activities. This model has been used previously to compute Tc and Tblood in cooling applications, cold water immersion and exercise scenarios. *Method:* The method utilizes two equations simultaneously: a) the Pennes bioheat equation in the whole body, and b) an energy balance equation to determine the change in blood temperature (Tblood) in relation to body temperature during firefighting activity. The computational model was evaluated for firefighting activities in a simulated environment and the thermal response of the firefighter was analyzed. The two major inputs to the computational model are the heart rate corresponding to the simulated activities and physiological details of the individual firefighters. The results were validated with the variation in Tc measured during live-burn activities. *Results:* The Tc measured during experimental live-burn activity shows that Tc reaches a steady state value of about 38.5 °C after 60 minutes when the firefighting suit is removed during the rest periods. However, the Tc computed by the model under the same conditions, but with the firefighting suit worn continuously, reaches the critical value in 2 hours. *Conclusion:* The computational Whole Body Model was used successfully to predict the safe duration of exposure to firefighting activities when continuously wearing the firefighting suit. With the help of this predictive model, it will be possible to accurately calibrate new generation firefighting suits with cooling capabilities for mitigation of heat-induced stress in individual firefighters.



* Firefighting suit is taken off during rest periods in the experiment

For technical inquiries, click here to contact OASIS Helpdesk or call 217-398-1792.