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Dr. Uth has more than 15 years of experience in the fields of Mechanical and Power engineering, which he studied in Universities of Brunswick, Hamburg and Valencia. After that, he was deeply involved in the research of numerical modeling of thermal fluid flow in complex geometries in the Institute of Thermo-Fluid Dynamics in Hamburg. Since 2015 Dr. Uth works as Research Engineer and as an Expert on Thermoregulation at Dräger.

Abstract:

Core temperature sensing: New Technologies to accurately measure an essential parameter to improve Safety of Mines Rescuers

Underground extreme environmental conditions with temperatures well above 30°C and nearly fully saturated air lead to high physiological strain since the human mechanism to release heat from the body are nearly completely inhibited. This limits the operation time and thus the time available to rescue miners while keeping the rescuers themselves save. Currently these limits are written into tables that are standardized without a dependency on the workload or the individual resistance against thermal stress. This leads either to calling back rescuers earlier than thermally necessary or to a dangerous situation where one is overheating faster than expected. The heart rate, which is today measured even in recreation activities, can be one parameter to monitor the team in operation, but regarding the thermal situation, it does not show the whole picture.
Ideally, the core temperature has to be measured to reliably evaluate the situation. While in the past accurate measurements where only possible with invasive methods, recently sensor have been developed that can be worn on the skin and deliver the body core temperature with high accuracy and continuously. With such sensors, not only current values can be displayed to the rescuer or the director of operations, but also trends and even forecasts for the development of the core temperature can be possible. This has the potential to increase the time available for the rescue and provides an individual control for each person. Like diving computers, that assist the wearer during a dive to calculate the remaining air and exit procedures, such a device could help to decrease number of accidents in mines. The concept of the physiological stress index (PSI) combines the heart rate and body core temperature to a single value that makes it easy to evaluate the overall physiological stress.
In this report, we will present the general mechanisms of heat transfer, how a human can influence **it** to adapt to different environmental conditions and how, as a consequence of extreme environmental conditions, these mechanisms can fail. This failure might lead to overheating without being able to be recognized by the rescuer or by only monitoring the heart rate. Statistics are shown, that show the connection between hyperthermia and mortality depending on the temperatures reached.
We will then present new technologies to continuously monitor the core temperature and show experimental results from the firefighting or hospital use that demonstrate the accuracy of the measurements and how fast core temperatures can change under strain.