INDUSTRIAL SAFETY HELMETS - HEAT STRESS STUDY

Study Abstract

Heat stress is becoming an increasingly critical topic within occupational personal protective equipment. The aim of this study was to investigate the influence of impact absorption materials in industrial helmets on heat stress, allowing comparison of the microclimate buildup of different industrial helmets. Ultimately, the results elucidate which type of helmet impact absorbers are less likely to contribute to heat stress, and help develop recommendations for the design of helmets that reduce heat stress.

TEST METHODOLOGY

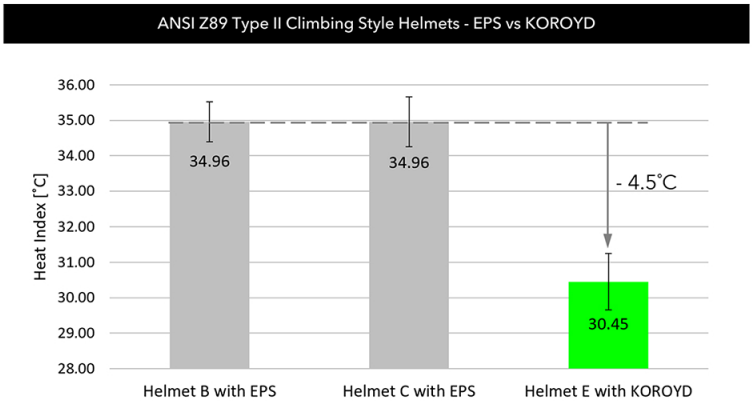
The tests were conducted in a controlled climate chamber with a maintained temperature of 21°C and 50% relative humidity. A sweating thermal head form at a constant temperature of 37°C and constant emission of water vapour was used. Fourteen sensors were placed onto the head form underneath the helmet in an evenly spaced matrix to measure temperature and relative humidity. Measurements were taken every 5 seconds for one hour per test run. Two runs were recorded for each helmet on two consecutive days, reversing the order of testing on the second day to evaluate measurement repeatability. This test setup is designed to produce a comparable, reproducible and steady microclimate inside the helmets compared to testing on human subjects.

STUDY RESULTS

Helmets with KOROYD integration show significant reduction in heat index. The helmets with KOROYD performed with significantly lower heat indices for both type I and type II helmets, with type II testing resulting in up to 8 F / 4.5 C reduction in heat index over traditional EPS construction.

» The temperature improvement is likely linked to less insulative properties thanks to the open-cell structure of the KOROYD material, which is 95% air.

» The insulating material characteristics of the EPS foam as well as its closed cell structure is thought to be the main factor explaining the higher heat indices.



Why it Matters

Protective equipment must be evaluated for its potential contribution to heat stress. Heat stress is a significant problem in industrial occupational settings where workers may be exposed to hot environments for extended periods of time, leading regulatory bodies and industry leaders such as OSHA, NIOSH and ISEA to consider related rules and recommendations. As heat-related injuries and fatalities mount, it is imperative to find innovative solutions to worker protection. According to Page and Sheppard (2019), heat shocks significantly increase accident rates, while Hancock and Vasmatzidis (2003) found a link between heat stress and rise of deep body temperature leading to decrease of cognitive performance. Heat stress relief can reduce the risk of heat-related injuries and fatalities, but can also help prevent potentially unsafe workplace behavior like short term removal of PPE.

What is Heat Stress?

Heat stress is a state that occurs when the body is unable to cool itself effectively. The body works hard to regulate temperature, primarily through evaporation of sweat. Thermoregulation keeps deep body temperature at safe levels of between 37°C ± 1°C. As surrounding relative humidity in an environment increases, due to climate, workplace conditions, or when wearing protective equipment that restrict heat loss, the effectiveness of sweat evaporating decreases significantly. Thus, as temperature and humidity increase, the level of heat stress experienced by humans increases.

Sources Behind the Study

Chris Ellerby
Director of Industrial Safety, KOROYD
Chris Ellerby has worked in PPE/RPE for 20 years in product leadership and development roles, and has seen firsthand that a solution to heat stress is an unmet need in industrial head protection. This study is something Ellerby has championed at KOROYD, knowing the innovative technology company can solve real-world problems and increase safety.

Mathilde Nais
Senior R&D Engineer, KOROYD
Mathilde Nais studied mechanical engineering at INSA Lyon that led to research and development work, including finite element analysis, prototyping, test protocols and design of experiment. As the lead engineer on the heat stress study, Nais has played a crucial role at KOROYD in evaluating the impact of energy absorbing materials on heat accumulation in helmets.