DEVELOPMENT AND EVALUATION OF A CLOTHING SYSTEM FOR OFFSHORE INDUSTRY WORKERS IN COLD ENVIRONMENTS

M. Sandsund[1], A. Paasche[2] and R.E. Reinertsen[1], [1]Department of Health and Work Physiology, SINTEF Unimed, Trondheim, Norway and [2]Thelma, Trondheim, Norway.

People working in the offshore environment in northern regions are exposed to harsh climatic conditions characterised not only by low air and water temperatures, but also by wind, high humidity, rain and snow. Cold environments affect the health, safety, comfort and performance of workers and cold interferes with work and may impair performance and productivity. Protection is needed against cold, wetness and physical hazards, and appropriate clothing should also be selected on the basis of the work activity involved. The development of work clothing for extreme work environments is a complicated process, in which protection and comfort properties have to be balanced and objective properties and subjective preferences have to be considered. The aim of this study was to develop a tool for the development, testing and evaluation of work clothing for offshore industrial workers. A further aim was to identify, on the basis of preferences indicated by offshore industry workers, a combination of materials, construction and design that would provide optimum solutions for work in cold and wet environments. **Methods:** The first step involved the specification of requirements using a modified concept-engineering model. This customer-centred process is used to clarify the end users' needs and wishes before detailed design and product development. This stage was performed in the course of individual interviews on board an oil production platform in the North Sea. The workers' preferred requirements for a new offshore work suit were established before a questionnaire, that aimed to identify the priority order of the requirements was sent out to a sample of workers. The next stages in the project involved the establishment of technical requirements, selection, testing and evaluation of materials, and prototype design. Prototypes were produced on the basis of the selected textiles and end-user requirements. During the final step the newly designed outer garments were compared with a reference outer garment using six test subjects in simulated work environments (T_a = 2°C / wind speed 5 m · sec^{-1}). The test protocol comprised two-hour working-resting periods. One bout of 30-min cycle exercise was followed by a 30-min rest, a 30-min exercise period that included lifting and carrying, and a final 30-min rest. Between the working and resting periods the subjects were exposed to rain, simulated by exposing them, fully clothed, to a water shower. Physiological variables; skin temperatures, heart rate, humidity accumulation and subjective evaluation were recorded throughout the tests. In this project the systematic design process involved defining requirements, selecting materials, designing the garments and testing prototypes. This study focuses on improvements in resistance to air penetration, water permeability, insulation properties and moisture transport capacity in relation to the physiological parameters measured. The clothing physiology tests demonstrated improved properties of the new garments. Both the thermal protective properties and the subjective evaluations of the garments were improved in comparison with current models. The tests further demonstrated the necessity of planning the protective clothing system as a total system, including underwear, middle layer clothing and outer garments.

mariann.sandsund@unimed.sintef.no