



Cooling garments for industry

TNO is leading the Prospie project involving European countries in the search for usable cooling systems that can be incorporated into protective clothing of employees. People with a sedentary job can cool down relatively easily but that is not the case for those employed in the field or on the work floor.



Physical effort produces heat and, therefore, perspiration. That's a natural form of cooling: when water evaporates, cooling results. If, for instance, you wear polypropylene underwear that is only able to hold very little moisture, the moisture is thus transported to the outermost layer of clothing where it evaporates: this layer then cools but the skin does not. According to Professor Hein Daanen, the skin does cool well if you wear cotton underwear. 'But if you then wear insular clothing over it, then there is very little difference between wearing polypropylene and cotton underwear.'

Intense exertion can result in people producing over a thousand watts of heat. Underwear which has ice water running through it can cool off a quarter of that heat, which is sufficient for light exertion, such as writing or computer work. For athletes that take part in endurance sport of at least ten minutes *pre-cooling* – cooling down before exertion – has become normal practice.

EXTRA WEIGHT

'What we are not yet able to do well is cool people in the field during their work,' Daanen says. 'Like soldiers in Afghanistan or blast furnace employees. We can build a cooling system for people that are seated in their jobs, like helicopter pilots, but for moving around the weight of a cooling system could prove problematic – just think of a pump and a fan. There are systems for soldiers and these are currently being evaluated by the American armed forces. We are also testing those systems here in our climate chambers. So far all the advantages of cooling are being negated by the additional weight of the cooling system.'

COMBINING METHODS

One of the aims of the European Union (EU) is to develop better protective clothing for industrial workers. In September the EU approved the three-year Prospie ('Protective Responsive Outer Shell for People in Industrial Environments') project geared to a new generation of personal protective clothing and equipment. The development of new cooling systems in the clothing is a key component. TNO is leading the Prospie project, with Daanen responsible for the science and Jan

Brouwer, his colleague, project leader. Sixteen companies and institutes from seven European countries (Belgium, Denmark, Great Britain, Italy, Switzerland, Lithuania and the Netherlands) are participating in the project.

Daanen: 'We try to combine all kinds of methods to get a step closer for people on the move on the work floor. A small company, Capzo International from Ootmarsum, is our country's participant. It makes special salts that cool once they come into contact with water (read: perspiration). We will also be investigating "phase change materials", substances that will cool when they change phase; when water changes into ice, you get additional heat removal. A third method involves the development of new ventilation systems in clothing.'

FULL MONITORING

Cooling is only useful when you are warm. Once the body is sufficiently cool, then the cooling must stop. Daanen: 'We will be incorporating a regulating mechanism to warn when the cooling must stop. We want to fully monitor the worker. As soon as the situation arises where body temperature and heart rate increase above safety thresholds, a warning signal will be sent to both the worker and the company's central monitoring unit. The nice thing about this set-up is that you get both a cooling and a physiological monitoring system.'

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