

# Science around us

Innovations from BASF illustratively explained



We create chemistry

## Mobile air conditioner to wear

Functional cooling textiles of core sports and occupational safety brands use a special superabsorber fleece from BASF

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Humans are born runners. Evolution once gave us the ability to overcome the distance of many kilometers through the hot savannas of Africa. In addition to the upright posture of the body and head and the optimized mechanics of legs and feet, cooling by millions of sweat glands plays a key role. Under extreme stress, they can release about one liter of sweat per hour and cool down the body by evaporation.

But as often seen in nature, this specialization comes at a price. To keep its core temperature stable, the body has to expend much energy to protect itself from overheating. About 75 percent of the energetic processes in physical exertion are used for thermoregulation and therefore only 25 percent of the energy can be used for muscular processes such as sports or work performance.

This limits our performance even at moderate outdoor temperatures. Athletes as well as workers and many other people worldwide who are exposed to high

- **Bionic system**

Evaporative cooling following the model of nature

- **Healthy performance**

Sustained support of physical function

- **Versatile use**

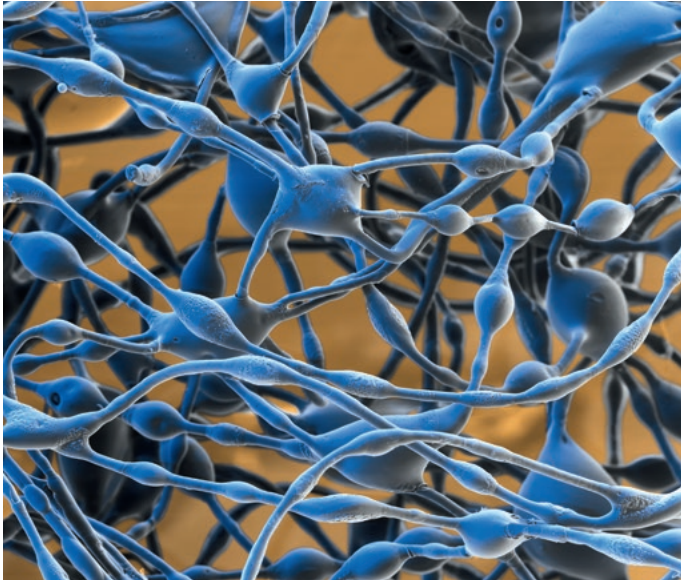
Relief in work, sports and therapy

temperatures are therefore now using active functional cooling clothing. Thanks to innovative materials, this provides evaporative cooling which is individually dosable and lasts for hours. The functional cooling textiles of the E.COOLINE and IDENIXX brands, incorporating the specially developed superabsorbent nonwoven fabric from BASF, offer a mobile air conditioning system to wear which effectively supports the cooling system of the human body.

Cooling vests, for example, are easy to use and can be worn like any other item of clothing once being activated by “charging” with water. The water enters the active layer – the Luquafl fleece® from BASF – after being rapidly absorbed and distributed through a bacteriostatic textile fabric. “The fibers of this nonwoven fabric are coated with superabsorbent polymers (SAP) through a special technology. They absorb the water in a few seconds and retain it,” explains the expert Norbert Heidinger of BASF New Business GmbH, who markets the material.



Like a fishing net, the polymer network of the superabsorber traps increasing numbers of water particles until its elastic restoring forces compensate the osmotic forces of the prevailing concentration gradient. In this way Luquafleece® can absorb ten times its weight in water and retain it so firmly, that the functional textiles are dry on the surface.



Electron micrograph showing the polyester nonwoven fabric coated with superabsorbers (75:1 magnification).

With higher outdoor temperatures or increasing skin temperature during sports or work activity, the water molecules firmly bound inside the functional cooling clothing absorb the thermal energy, evaporate from the large surface of the three-dimensional nonwoven structure and thereby cool down the wearer. The body sweats less and thereby saves energy that would usually be needed for thermoregulation. External cooling can therefore provide an increase in performance of up to ten per cent in hot conditions. Moreover, important body

parameters – such as heart rate – are improved which protects people’s health.

Athletes who work out want to have fun, while promoting their health and also testing their own limits. These limits are only reached through the interplay of mind and body, explains a prominent triathlon champion, who calls it a relationship of trust. If the head wants to increase performance, it has to learn how to interpret the body's signals correctly. You must not stop your efforts too early, neither exceed your own capabilities.

### Relief of circulatory and metabolic stress to protect health for hours

The functional clothing only cools the body to the extent required by the prevailing situation. The intensity of evaporative cooling adapts to the surrounding temperature and exertion. Thus no negative cooling effects can occur. “After a while, you even don't notice the cooling anymore because the body is air-conditioned,” is how Gabriele Renner CEO of the manufacturing company “pervormance international GmbH”, from Ulm (Germany), describes the benefits. “You sweat less and thereby relieve the load on the cardiovascular system, metabolism and energy balance.” Depending on the outdoor and body temperature, the cooling effect persists for up to 20 hours – and any other clothing stays dry.

Since the World Football Championship in 2014 in Brazil, functional cooling textiles have been used at many international sporting events worldwide. For example, the national football teams from Switzerland, Ireland and the USA nowadays use these cooling vests and headgear to improve their recovery during the half-time interval or before energy-intensive extra time.



10

Functional cooling textiles allow a performance increase of up to 10 percent, as sports scientists have demonstrated.



600

When water evaporates from the three-dimensional nonwoven structure, 600 watts per liter of cooling energy can be released.



20

The duration of cooling by the innovative functional clothing is up to 20 hours. This assures reliable protection.



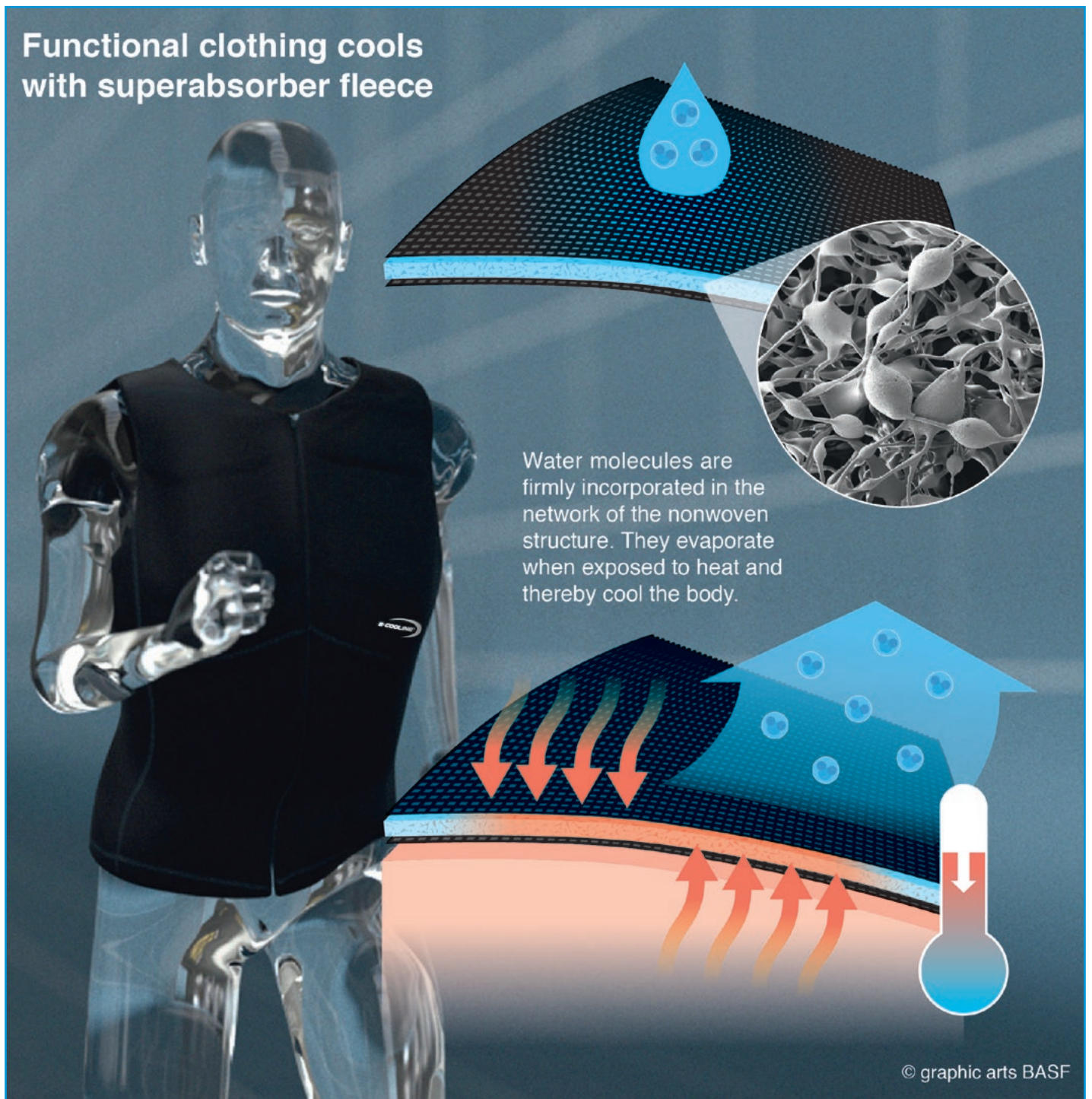


But not only top athletes are improving their health and performance with active functional cooling clothing. Many companies also use it to protect their employees from the hazards connected with overheating and overexertion.

With the E.COOLINE and IDENIXX brands, the idea of mobile, simple and effective cooling has therefore been successfully implemented and marketed. Apart from

innovative materials, the environmentally friendly because bionic system only requires water and the heat the user wants to get rid of anyway. "We compensate the CO<sub>2</sub> volume generated over the entire production chain by financing climate projects on the same scale," says Gabriele Renner, indicating that she has not only the individual body climate in mind, but also the world climate while operating a future-oriented, climate-neutral company.

## Functional clothing cools with superabsorber fleece



## “Cooling vests improve the health and safety of employees”

Interview with Gabriele Renner, CEO of the company “pervormance international GmbH” from Ulm (Germany)

What advantages offers the BASF product Luquafleece® for you?

In this joint project, it was particularly important for us to obtain a washable cooling product which is also hard-wearing and hygienic. The three-dimensional nonwoven fabric with its special fiber structure also offers an enormously large surface area capable of delivering 600 watts per liter of cooling energy through the evaporating water. Through our “cool to go” principle, the material generates a rapid and perceptible cooling effect even in extreme environmental conditions.



What areas of application of the cooling system are particularly important?

At present the main application is in the field of occupational health and safety, because many people worldwide have to work at high environmental temperatures, partly also because of climate change. The resulting cardiovascular strain, concentration problems and states of exhaustion impair health and safety at work. Studies have also shown that the productivity of companies is thereby reduced. Both can be improved by using our functional cooling textiles.

Where do you see further potential for air conditioning functional clothing in future?

Medicine is definitely another field of application in the future. Here we have already shown that we can significantly improve quality of life of people affected by multiple sclerosis with our cooling vests. There are also other valuable uses such as treating menopausal complaints like hot flushes or reducing fever with our calf coolers, to mention only two. We also have projects under development in the fields of orthopedics and even beauty medicine.

### Luquafleece® as problem solver for wound healing and moisture management

**Innovation for wound healing:** BASF together with OSNovative Systems, Inc. have developed an innovative universal wound dressing which is suitable for all types of wounds and creates ideal conditions for wound healing. The wound dressings are marketed under the name Enluxtra® in the USA. This disruptive technology based on the superabsorber nonwoven material Luquafleece® provided by BASF accelerates the wound healing process of most wounds and thereby reduces medical treatment costs.

**Passive seat temperature control:** In the lightweight comfort seat of the concept vehicle “smart forvision” from the Recaro company, as well as in office chairs of the Vitra company, the BASF nonwoven fabric Luquafleece® reduces moisture in the seat and on its surface. In this way, prolonged sitting remains pleasant even on stressful workdays and during long car journeys. This moisture management also plays an important role in electronics, which represents another future application for this innovative material. Moreover, intelligent ventilation elements for shoes, offered by the Hamburg company IQTEX, are already based on the moisture-absorbent fleece. Depending on the weather conditions, these elements are either breathable or watertight.

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