

Alone In The Heat

I think the biggest misconception for most people about the nature of cold is that it is something that comes and gets you, like when one opens a door or steps out into winter weather. They incorrectly believe it to be a physical thing that can be trapped into little ice cubes or fibers or what-have-you. Simply put, cold is the absence of heat, and from a clothing and textile point of view, any review of 'cooling' technologies is really a discussion of thermal transfer.

Let's start with those ice cubes. We pull them out of the freezer and presto, they cool down our drink, that's the thermal transfer most of us are interested in. To get that ice, the refrigerator used electricity to pump and compress gas, allowing it to expand through coils in the back of the 'ice box' and thus absorbing the heat within, all while being endlessly recycled. The heat that was in the water when we filled the ice cube tray was removed by this process and put into the kitchen. Or to put it another way, the thermal equilibrium is maintained even though we removed the energy from the water, allowing it to change its state into ice. Ahh, thermodynamics... good times.

Now if we take that fridge, and add an evaporative cooler, (a swamp cooler for y'all up north) we have a pretty good facsimile for the human body, the blood doing one job and sweat the other, just turn the thermostat up to 37 degrees C and change the power source from electricity to food. You are a chemical Frigidaire, a machine that produces, regulates and moves heat, in order to keep its insides



at a constant temperature. When the body senses that it is warming up down below, the skin capillaries flush with blood and heat is carried from core to skin. Overwhelm this system, by even a little tiny bit, and on comes the cooler, we start to sweat.

Here a key character emerges, one that is essential to both the biology and physics of the situation, H₂O. The body is happy to expend energy and lose this precious fluid in order to sweat, and thus benefit from a unique physical attribute of water; it has a huge thermal capacity. In order to evaporate, about 600 heat calories per gram are absorbed by that water on the skin as it turns into gas, i.e. water vapor. So when you are too hot, and you sweat, and the sweat

evaporates, the heat from your body becomes humidity.

Now clothing gets in the way.

While liquid water loves itself, happily forming little clumps or pulling itself in tango lines along a friendly surface, (i.e. wicking), water vapor, a gas, does not cooperate with itself at all. When water vapor gets crowded, like when it's clammy inside a clothing system, all the little vapor molecules push against each other and against the liquid water on the skin as well; they just don't like company. It is this build-up of humidity that dramatically slows down the heat exchanging evaporation. If the vapor doesn't get out of the system, the temperature/humidity

inside goes up and our clothing becomes a little pressure cooker.

Textile design faces a conundrum in this process. If the fabric wicks the moisture off the skin, it gets wet, and wet fabric isn't very air permeable (anyone remember putting a wet sheet over a dorm room door in order to prevent the escape of a certain aroma..?). Wet clothing inhibits both air flow and the vaporization going on beneath it. But, if sportswear doesn't move the sweat and speed up the evaporative cooling process, it can't overcome the thermal wrench it throws into the body's attempt to stay homeostatic. 'Cooling' sportswear must be efficient enough to account for itself in the thermal budget.

What to do? Hot weather clothing is certain to be a growth industry at retail in the near future. Apparel designers and textile mills will need to develop products that work in concert with the human body and there will be different solutions for extreme and temperate environments, as well as athletic and pedestrian users. Like most technical apparel there will be a shopping list of attributes to choose from, and retailers will boutique little collections of garments in the fronts of their stores. The market and product language around the idea of textiles helping keep the body cool is just forming now, but soon enough clerks will have another new, jargon filled pitch to leverage their customers, those perpetually ensconced in cotton tees and shorts. "It's all about thermal transfer," they'll say, "Don't leave your body alone in the heat... help stay in balance with better clothing."