

Sustainable cooling

M. Petersen and A.K. Huntley

DTU Mechanical Engineering, Technical University of Denmark

BACKGROUND

The basic concept originates from fundamental principles of cooling physics, the energy consumption in an evaporation process. The device consists of an inner compartment covered with a constant wet material where the boundary layer is exposed to airflow thus removing the evaporated water forcing more evaporation hence extracting energy from the system, all in an insulated constellation.

Areas where conventional refrigeration is unavailable uses the evaporation principle as a cooling system and is essential for their livelihood. One may argue that most appliances for which this technology are implemented miss a few essential initiatives in certain aspects for optimally utilize the cooling effect, insulation of the system as a whole and boundary layer theory. Insulation minimize the impact from heat radiation of the sun and considering boundary layer theory one may argue that air flow speeds up the principle by removing the microscopic boundary layer increasing the rate of evaporation hence quicker energy extraction – more cooling effect.

The main objective was to create a cooling concept with minimum energy consumption primarily for areas where cooling is difficult to establish sustainably. The initial thought base on sustainable cooling of foods in collaboration with Roskilde Festival since this field is the biggest energy thief by far of the festival. The project is possible due to their financial support.

CONCEPT MECHANISM

The mechanism of evaporation process may be considered as an equilibrium. When the airflow removes the microscopic evaporated boundary layer it forces the generation of a new evaporation layer and the subsequent evaporation extracts energy from the inner compartment thus generating a cooling effect. Two other essential mechanisms are used in this concept, air pressure and capillary suction, for generating air flow and keeping the cloth material wet respectively. It means that the generation of air flow is the only energy consuming part in the concept, a small one that is.

POTENTIAL

Conceptually, this cooling system has potential locally and globally. Locally, it may replace temporary high-energy consuming devices such as refrigerators for festivals and camping fields. Globally, it may optimize existing cooling systems or even enable substantial cooling in areas with limited or non-existing power supply.