Public Abstract

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Title:THE MECHANICS OF FIBER-BASED ABSORBENT EVAPORATIVE COOLING (fbaEC) FOR TRANSPORT

For the purpose of food quality and safety during short-term transport and storage in developing or rural areas, low-energy consumption and environmental-friendly methods are needed for use in cooling systems and related applications. In prior research, a new evaporative cooling system model using absorbent fabric wrapping in curtain structure on a scaffold for short-term transport and storage was built in a laboratory scale, and a series of laboratory scale experiments to statistically verify the basic concept of the new model were performed. Three kinds of absorbent fabric materials in common use were evaluated based on their water absorbent characteristic to decrease temperature and then to increase humidity, which contribute to keeping food and other products that require low temperature and high humidity to stay fresh longer. To gain an understanding of the mechanics for the fiber-based absorbent evaporative cooling, an in-depth study that results in the mathematical modeling of the heat and mass transfer that takes place during cooling for both single-scaffold structure and multi-scaffold structure was built. From that model we can calculate the heat transfer coefficient based on the fiber material, airflow speed and scaffold characteristics, to develop a methodology to predict the water consumption during cooling. To validate the fbaEC's cooling effects in a transport scenario, a series of experiments in a real transport environment was designed and conducted. The driving testing transport experiments were conducted in a moving vehicle at 15 mph, 30 mph and 45 mph, respectively. Cotton was the absorbent fiber material used based on its cooling performance in prior laboratory experiments. Statistical analysis of the results showed a promising cooling performance for the fbaEC in a transport environment, with the lowest temperature generated at 17.6? while the environment temperature was 31.9?. The cooling efficiency was at 44.48%, without resorting to electricity, only wind power. The contribution of this study is summarized, and the future study direction is also discussed.

Keywords

Food safety, Absorbent, Fiber, Transport, Scaffold, Evaporative cooling