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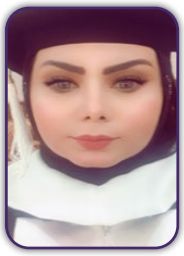

Improving energy and thermal performance of greenhouses in hot climatic regions using polymer aerogels

Abeer Abdullah Al Anazi

Austaralian College of Kuwait (ACK), Kuwait

Abstract

Greenhouses are needed in hot climates to protect plants from excessive heat, which limits productivity, and to reduce the excessive energy and water requirements associated with controlled environment agriculture under such conditions. In arid climatic regions, where ambient air temperature can easily reach 60°C during the summer and where fresh water is scarce, a new approach to greenhouse design should be used to make it more economically feasible. The approach is to use passive, as well as active, energy conservation measures, aimed mainly to reduce the cooling load in an arid climate. Conventional air cooling systems do not only increase the total energy consumption resulting in large carbon footprint, but also raise the peak load demand on power causing excessive strains on the power grid. Heat-driven air cooling systems that use solar energy are now emerging as alternatives to the electricity-driven refrigerated air coolers. These systems are found to be more energy efficient, with lower carbon emissions while also ensuring better indoor air quality and comfort when optimally designed. The concept is to reduce the amount of intense solar radiation as well as save power consumed for air conditioning the greenhouses. This is achieved in this study via coating greenhouses with polymer aerogel. Aerogel is a lightweight solid derived from gel in which the liquid component of the gel has been replaced with air and makes aerogel extremely low density with low thermal conductivity. Because of these unique properties, aerogel is considered one of the most efficient insulating materials. At a low temperature, radiation is not a significant problem for transparent material. However, at a high temperature, radiative transport is dominant for thermal conduction and this causes energy and thermal performance of greenhouses to improve significantly when coated with aerogels.

Biography

Abeer Abdullah Al Anazi is an assistant professor of Mechanical Engineering at Australian College of Kuwait (ACK). She received her Ph.D. in Mechanical Engineering from the University of Hertfordshire – UK for her work on the control of electro- kinetic microfluidic biochemical systems. Since then, she has worked on many research projects on fluidics, micro-, nano- and bio-fluidic applications to process and device fabrication technologies, with emphasis on approaches taking steps towards modeling and simulation - aided design methodology. Her past research include experimental heat transfer of Nano-fluids, carbon based Nano electro-mechanical systems, design optimization of solar cooling systems for arid climatic conditions. She has many publications and has been serving as an editorial board member of reputed journals.

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