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Applied Thermal Engineering

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Prof. Dr. Yuyang Li

School of Mechanical Engineering, Shanghai Jiao Tong University, Shanghai 200240, China

Section Information

Applied Thermal Engineering is open to receiving highquality state-of-the-art reviews, original full research, short communications, and case studies, covering all technologies based on heat transfer processes. Therefore, challenging works dealing with applied thermodynamic problems up to real applications are welcomed in this section. Both theoretical and experimental works with rigorous and replicable methodology can be submitted in this section. Both basic and applied research and anything in between is acceptable in this section, and many different applications can be covered, such as domestic, commercial, industrial, marine, aeronautics, aerospatial, transport, primary/secondary/tertiary sector, and clean energy.

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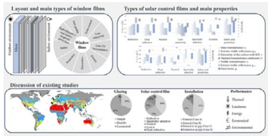
Section Applied Thermal Engineering

Featured Papers

DOI:10.3390/app12125923

Performance of Solar Control Films on Building Glazing: A Literature Review

Authors: Júlia Pereira, Henriqueta Teixeira, Maria da Glória Gomes and António Moret Rodrigues

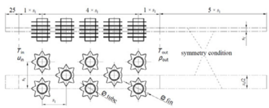


Abstract: Buildings with a high window-to-wall ratio tend to suffer from excessive solar gains/losses that usually result in high energy demand and discomfort for occupants. Solar control films (SCFs) are a passive solution with the potential to increase the performance of new or refurbished glazing they are applied to. This paper presents a comprehensive literature review of the performance of SCFs applied to glazing systems of buildings. Research studies with experimental, analytical and computer simulation approaches were gathered and analyzed, identifying glass and film systems, climatic conditions, energy savings and comfort performance. The research approaches and main findings of existing research studies were compared and discussed. The presence of SCFs significantly reduced indoor solar radiation and illuminance levels, particularly with reflective films applied to south-oriented glazing (northern hemisphere). Glazing systems with SCFs were reported to promote cooling energy savings compared with clear glazing in hot climates. Few studies have explored the visual and thermal comfort performance of SCFs, concluding that these films promote thermal comfort, and reduce excessive illuminance and potential glare. Furthermore, this paper helps to highlight areas of guidance for future studies on the topic.

DOI:10.3390/app12104857

Numerical Analysis of Tube Heat Exchanger with Trimmed Star-Shaped Fins

Authors: Mladen Bošnjaković and Simon Muhič

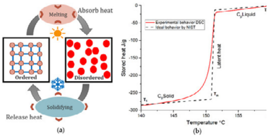


Abstract: In some engineering applications, it is very desirable that the heat exchanger is as light as possible while maintaining the heat transfer rate at an acceptable level. In this context, the possibility of reducing the weight of the heat exchanger with the star-shaped fins by cutting off the thermally least efficient part of the fin was investigated. For this purpose, the rear part of the fins was trimmed to Ø28, Ø31 and Ø34 mm. Numerical analysis was used to determine the influence of each variant on the flow characteristics in the air–water heat exchanger and on heat transfer for the range of 2300 < *Re* < 16,000. The best results were obtained by trimming the rear part of the fin to Ø28 mm. With a 5.53% reduction in fin weight, heat transfer can be increased by up to 8.12% compared to the star-shaped fins without trimming. The pressure drop can be reduced by up to 0.92%. The trimmed fins were also compared with perforated star-shaped fins (perforation Ø2). At approximately the same weight, the trimmed fins increase the heat transfer coefficient by up to 5.75% with a reduction in pressure drop of up to 0.76% compared to the perforated fins.

DOI:10.3390/app122312019

Thermal Characterization of Phase Change Materials by Differential Scanning Calorimetry: A Review

Authors: Hazhir Fatahi, Jérôme Claverie and Sébastien Poncet

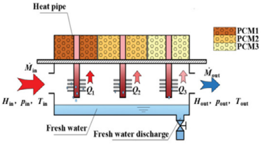


Abstract: The use of phase change materials (PCMs) in thermal energy storage (TES) applications as a system that can fill the gap between the energy supply and demand has sharply increased over recent years. Due to the dependence of the storage capacity in a TES on the transition (mostly solid/liquid) of PCMs, knowing the thermal properties of PCMs is of high importance. Calorimetric methods have an inevitable role in PCMs' characterization methods. The most important properties of PCMs that lead us to integrate them in a specific application can be determined by the calorimetric method. These properties are transition temperatures, the enthalpy of transition and the heat capacity. Among the calorimetric methods, differential scanning calorimetry (DSC) is widely available and accurate results can be obtained at a reasonable cost. Furthermore, the thermal stability of PCMs can be determined after a hundred cycles of melting and solidification. The present work proposes an extensive and comprehensive review on calorimetric measurements of PCMs via the DSC method. The objective is to highlight the relevant research with a focus on DSC characterization of PCMs. This review includes studies from 1999 to 2022 and provides a summary of the methods, results and recommendations for future measurements.

DOI:10.3390/app12031303

Experimental Investigation and Exergy Analysis of Dehumidification Performances for a Cascaded Phase Change Heat Storage Dehumidifier

Authors: Lixi Zhang, Yi Jia, Zhida Fan and Kangbo Wang



Abstract: In the humidification and dehumidification solar desalination system, the recovery of vapor condensation latent heat is the key problem. Using a cascaded phase change heat storage method to recover vapor condensation latent heat can improve the phase change heat storage rate and the water production performance of dehumidifier. The exergy analysis and experimental methods are used to study the cascaded phase change storage dehumidifier. The results show that the more stages of phase change materials in the cascaded phase change heat storage device, the greater the exergy efficiency will be. The heat transfer performance of phase change materials increases with the increase of hot and wet air temperature and flow at the inlet of the dehumidifier. The exergy efficiency and gain output ratio of three-stage phase change heat storage are higher than that of the single-stage. The three-stage one is recommended. If the heat recovered by the cascaded phase change heat storage device is supplied to the passive humidification dehumidification desalinator for secondary water output, the water output and gain output ratio will increase by 25% and the water production cost will be reduced by 20%. The results can provide a basis for the design and application of a cascaded phase change heat storage dehumidifier.

Featured Papers

DOI:10.3390/app12052738

Sensitivity Analysis for Transient Thermal Problems Using the Complex-Variable Finite Element Method

Authors: Juan-Sebastian Rincon-Tabares, Juan C. Velasquez-Gonzalez, Daniel Ramirez-Tamayo, Arturo Montoya, Harry Millwater and David Restrepo

Abstract: Solving transient heat transfer equations is required to understand the evolution of temperature and heat flux. This physics is highly dependent on the materials and environmental conditions. If these factors change with time and temperature, the process becomes nonlinear and numerical methods are required to predict the thermal response. Numerical tools are even more relevant when the number of parameters influencing the model is large, and it is necessary to isolate the most influential variables. In this regard, sensitivity analysis can be conducted to increase the process understanding and identify those variables. Here, we combine the complex-variable differentiation theory with the finite element formulation for transient heat transfer, allowing one to compute efficient and accurate first-order sensitivities. Although this approach takes advantage of complex algebra to calculate sensitivities, the method is implemented with real-variable solvers, facilitating the application within commercial software. We present this new methodology in a numerical example using the commercial software Abaqus. The calculation of sensitivities for the temperature and heat flux with respect to temperature-dependent material properties, boundary conditions, geometric parameters, and time are demonstrated. To highlight, the new sensitivity method showed step-size independence, mesh perturbation independence, and reduced computational time contrasting traditional sensitivity analysis methods such as finite differentiation.