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Uniform Short-Wave Infrared Heating of a Thermo-Accumulation Rotating Collector

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ABSTRACT

Non-contact heating with a short-wave infrared heater does not provide a uniform temperature field on the body being heated. Some parts of the body surface may be overheated while others are not heated to the required temperature. To homogenize the temperature field this study focuseds on the analysis of short-wave infrared heating of a solid-walled disk filled with nano-enhanced phase change material (NePCM). By adding nanoparticles to the basic PCM, its thermal and physical characteristics are improved. The disk serves as rotating collector, which rotates vertically relative to a stationary infrared heater at different speeds, with and without acceleration. The temperature of the heat source varies within the short-wave range and the shape of the heat source is also varied, along with the distance from the rotating disk, which significantly affects the visibility factor between the heater and the rotating collector. The metodology established in this study is based on analytical modeling of thermal irreversibilities and the efficiency of the heating process. Experimental testing of the system involves thermographic infrared analysis of the temperature field of the disk surface combined with the measurement of relevant process quantities. The thermograms obtained serve as the basis for directly connecting thermal irreversibility and heating efficiency. This heating system describes allows for the creation a rotating collector for short-wave infrared heating of various bodies while simultaneously accumulating heat. The methodology implemented enables the optimization of process and geometric parameters of the heating system, reducing total thermal irreversibility and maximizing thermal efficiency.

Keywords: infrared thermography; NePCM; efficiency; thermal irreversibility