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Abstract Title: Thermal Diffusivity Estimation of Band Heaters

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Abstract

Band heaters are extensively used across industries such as plastic extrusion, injection molding, die casting, food processing, chemical manufacturing, and packaging. These heaters are available in various material types, including ceramic, mica, mineral-insulated, and aluminum. However, manufacturers often provide limited data on material composition and thermal properties, making it challenging to fully understand their thermal performance. This study presents a methodology to estimate the thermal diffusivity of band heaters using surface temperature measurements and inverse techniques. A controlled test case (R23B11G1T0) with known thermal properties is developed to validate the proposed approach. Inner surface temperature data is collected and used in a parameter estimation algorithm to infer the thermal diffusivity. The results show agreement between the estimated and reference values, confirming the feasibility and accuracy of the method. Using only the inner surface temperature profile, the model achieves reliable estimates even under transient heat flux conditions. To the authors' knowledge, this is the first study to establish a systematic and non-intrusive methodology for determining the thermal diffusivity of band heaters. The proposed approach can support more accurate performance evaluation, enhanced design optimization, and improved energy efficiency analysis, particularly in cases where material properties are uncertain or unavailable.

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