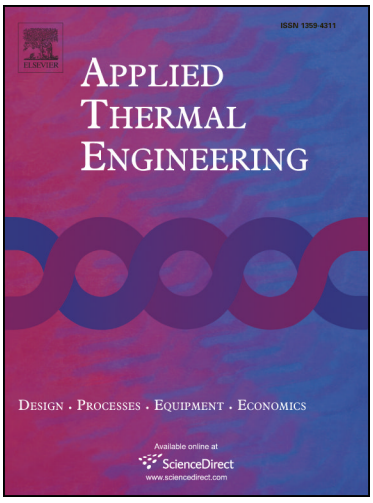

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PII: S1359-4311(17)31293-0
DOI: https://doi.org/10.1016/j.applthermaleng.2017.10.018
Reference: ATE 11216

To appear in: *Applied Thermal Engineering*

Received Date: 28 February 2017
Accepted Date: 2 October 2017

Please cite this article as: M. Lucchi, M. Lorenzini, Transient analysis of the radiative heating of rotating PVC pipes in a oven for end-forming process, *Applied Thermal Engineering* (2017), doi: https://doi.org/10.1016/j.applthermaleng.2017.10.018

Transient analysis of the radiative heating of rotating PVC pipes in a oven for end-forming process

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Abstract

In polymer industry several applications are aimed at obtaining products by deforming preforms or sheets after a heating process which, if not carried out properly, may lead to unacceptable defects in the final product. A common example of such an application is the end-forming process of polyvinyl chloride (PVC) tubes, in order to allow piping connections. One end of the tube undergoes a deformation process preceded by a heating phase, which is conducted in a oven equipped with infrared lamps. The pipe rotates with a given angular velocity, in order to ensure uniform heating. Hence, the pipe angular velocity represents a fundamental parameter for the proper success of end-forming process. In this work, the transient analysis of the radiative heat exchange between rotating PVC pipes and infrared lamps of a oven for end-forming process has been carried out by means of a finite element model, in order to investigate the influence of cylinder angular velocity on the temperature distribution in the tube. Local view factors were calculated as a function of geometry and oven configuration and were expressed as a function of angular velocity, allowing pipe rotation to be simulated as a time-dependent boundary condition, instead of using a moving mesh. Simulations were carried out for tubes of different geometries and for different values of angular velocity and results were compared with the case of a uniformly irradiated tube. The model realized represents a tool to characterize the end-forming process for different polymeric materials and different oven configurations.

Keywords: radiation heat transfer, rotating cylinder, transient conduction, end-forming

1. Introduction

In the second half of the twentieth century, the evolution of the polymer industry has been characterized by a rapid increase in the production scales and in the variety and complexity of manufacturing processes, [1]. In industrial applications aimed at obtaining products by deforming polymeric preforms or sheets, such as thermoforming, the study of the thermal stage allows to ensure

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