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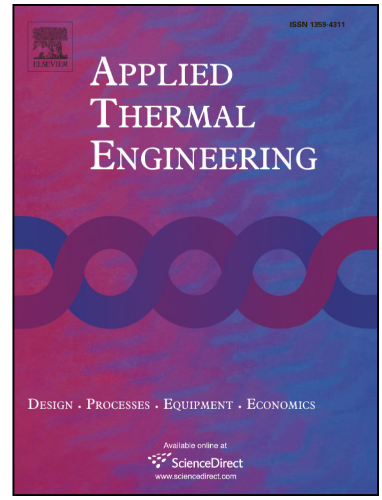

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Hybrid experimental/modelling methodology for identifying the convective heat transfer coefficient in cryogenic assisted machining

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HIGHLIGHTS

- Investigation of heat transfer coefficient between LN_2 and titanium alloy
- Influence of LN_2 projection parameters on temperature distribution in the workpiece
- Determination of *h* (W/m².K) with temperature measurement and CFD simulations
- Results highly depends on LN_2 projection parameters (pressure and nozzle diameter)
- Mathematical development for predicting convective heat transfer coefficient

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ABSTRACT

Cryogenic assisted machining has become a very popular method in the metal cutting industry, as it enables the cooling of a cutting zone for improving surface integrity or/and tool life without contaminating the machined part. However, the thermal interaction between liquid nitrogen (LN_2) and a hot cutting zone remains unclear. The main objective of this work is to analyse the thermal phenomena occurring at the LN_2 jet/workpiece interface. The nitrogen liquid/gas phase proportion has a significant influence on the heat transfer. To determine the influence of LN_2 jet parameters on the convective heat transfer coefficient, a model based on the projection of an LN_2 jet on a workpiece instrumented with thermocouples is proposed. The most influential parameters of the thermal distribution and heat transfer coefficient are LN_2 pressure, nozzle diameter, projection angle and the distance between the nozzle and the workpiece surface.

1 INTRODUCTION

The heat generated during machining operations is particularly significant when cutting difficult-to-cut materials such as Ti6Al4V alloy because of its poor thermal conductivity [1] and its high friction coefficient combined with strong adhesion [2]. Thus, tool wear is accelerated, and the surface integrity becomes deteriorated.