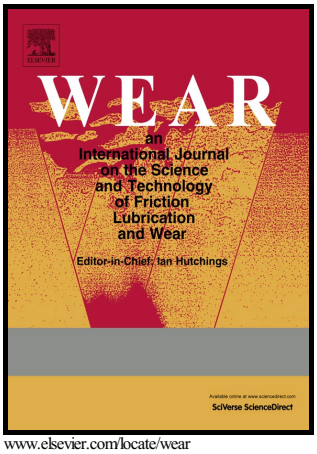
Investigating wear behaviour in sheet metal stamping using acoustic emissions

Vignesh.V. Shanbhag, Bernard. F. Rolfe, Narayanan Arunachalam, Michael. P. Pereira



www.elsevier.com/locate/wear

PII: S0043-1648(18)30102-9
DOI: https://doi.org/10.1016/j.wear.2018.07.003
Reference: WEA102451

To appear in: *Wear*

Received date: 5 February 2018
Revised date: 3 July 2018
Accepted date: 3 July 2018

Cite this article as: Vignesh.V. Shanbhag, Bernard. F. Rolfe, Narayanan Arunachalam and Michael. P. Pereira, Investigating wear behaviour in sheet metal stamping using acoustic emissions, *Wear,* https://doi.org/10.1016/j.wear.2018.07.003

Investigating wear behaviour in sheet metal stamping using acoustic emissions

Vignesh.V.Shanbhag[1*], Bernard. F.Rolfe [2], Narayanan Arunachalam[3], Michael. P.Pereira[2]

[1] Institute for Frontier Materials, Deakin University, Waurn Ponds, VIC, 3216, Australia
[2] School of Engineering, Deakin University, Waurn Ponds, VIC, 3216, Australia
[3] Mechanical Engineering Department, Indian Institute of Technology Madras, India, 600036

Corresponding Author*:

Vignesh Shanbhag

Email ID: vshanbha@deakin.edu.au

Institute for Frontier Materials, Deakin University, Waurn Ponds, VIC, 3216, Australia

Abstract

Galling wear in sheet metal stamping processes can degrade the product quality and adversely affect the mass production. Studies have shown that acoustic emissions sensors can be used to measure galling. However, the link between the features of the acoustic emissions signal and galling during complex manufacturing processes, such as sheet metal stamping, are not well understood. In the first section of this paper, it is shown that time domain features of the acoustic emission signal, such as RMS and peak, can be used to identify when the tooling is unworn or severely worn. These results were correlated with the wear measurement of the maximum depth of the surface profile of the stamped part. In the second section of the paper, time-frequency techniques were used to understand the characteristics of the AE signal associated with wear of the sheet metal stamping dies. The results show that it is possible to identify changes in acoustic emission signal using time-frequency techniques much prior to the observation of major changes in the time domain features and visual observation of wear. In the third section of the paper, a new acoustic emission feature known as mean frequency estimate is proposed for the condition monitoring of the stamping wear. This mean frequency estimate feature showed a clear shift in the acoustic emission signal much before the observation of severe wear. The methodology used in this paper to study wear progression can lay the basis for real-time monitoring of tool wear in the stamping industry.

Keywords: Stamping, Galling, Acoustic emissions, Mean frequency estimate, Condition monitoring, Fault diagnosis.

1. Introduction

Sheet metal stamping is an important manufacturing process, used to form products ranging from small battery caps to large automotive panels with complex shapes [1]. The tool costs for individual automotive stamping processes can vary from 1 to 62 million US dollars, depending on the complexity of the parts to be