Title: Thermal loads of working coils in electromagnetic sheet metal forming

Author: S. Gies C. Löbbe C. Weddeling A.E. Tekkaya

PII: S0924-0136(14)00172-1
DOI: http://dx.doi.org/doi:10.1016/j.jmatprotec.2014.05.005
Reference: PROTEC 13992

To appear in: *Journal of Materials Processing Technology*

Received date: 24-1-2014
Revised date: 30-4-2014
Accepted date: 2-5-2014

Please cite this article as: Gies, S., Löbbe, C., Weddeling, C., Tekkaya, A.E.,Thermal loads of working coils in electromagnetic sheet metal forming, *Journal of Materials Processing Technology* (2014), http://dx.doi.org/10.1016/j.jmatprotec.2014.05.005

Thermal loads of working coils in electromagnetic sheet metal forming

S. Gies[1*], C. Löbbe[1], C. Weddeling[1], A. E. Tekkaya[1]

[1] Institute of Forming Technology and Lightweight Construction, TU Dortmund University, Baroper Str. 301, 44227 Dortmund, Germany

ABSTRACT:

One basic problem of electromagnetic forming is the limited tool life. Besides the mechanical loads especially thermal loads acting on the tool coil affect its lifetime. In electromagnetic forming about 50% of the deployed electrical energy is lost because of joule heating in the working coil. In case of high volume production, an accumulation of this heat promotes failure of the coil and reduces the coil lifetime. Despite this importance of the thermal loads only insufficient information about the coil temperature and its influencing parameters is available. Focus of this paper is on the determination of the temperature distribution in case of long-term discharge sequences. Experimental investigations using an infrared camera were performed to measure the coil surface temperature. Numerical process simulation is used to gather information about the temperature inside the working coil. The results prove that the coil reaches an equilibrium temperature after several discharges. For the analyzed range of input power the maximum coil surface temperature and the maximum coil winding temperature reached values of 92°C and 178°C respectively. These temperatures exceed the weakening temperature of most reinforcement and insulation materials. The derived knowledge about the parameters influencing the coil temperature can be used for an improved process design to avoid thermal overstressing of the coil. A comparison of experiments with and without workpiece deformation revealed that the temperature in case of prevented deformation is always higher, and thus, represents an upper bound for the coil temperature.

KEYWORDS: electromagnetic forming, joule heating, thermal loads, tool design

* S. Gies: +49-231-7555238, soeren.gies@iul.tu-dortmund.de