11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

SIMULATION OF TOOL WEAR IN PRESS HARDENING

Liang Deng[1], Sergej Mozgovoy[2], Jens Hardell[2], Braham Prakash[2] and Mats Oldenburg[1]

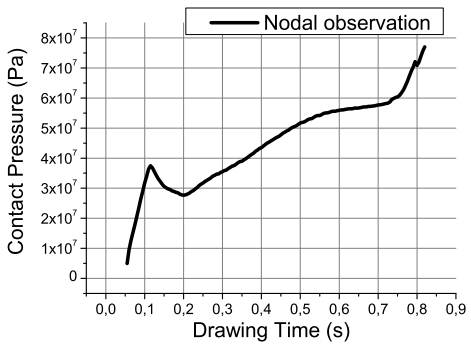
[1] Division of Mechanics of Solid Materials, Luleå University of Technology, SE-971 87 Luleå Sweden

[2] Division of Machine Elements, Luleå University of Technology, SE-971 87 Luleå Sweden

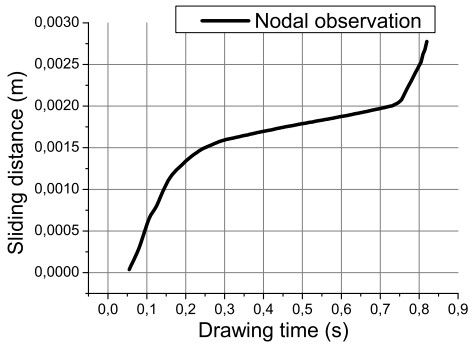
Key words: *tool wear prediction, tribological conditions, simulation, press hardening, tribological experiment.*

The tool wear caused by the harsh working conditions in press hardening shortens the service life of the stamping tools. High costs and long durations of full-scale press hardening experiments led to the development of a simulation model to predict tool wear taking place between blank and stamping tools. This simulation model is combined with simple model experiments as the main research approach is to investigate tool wear evolution during the press hardening process. A simulation model of the press hardening process is established in a commercial finite-element software, LS-DYNA, where the tribological contact conditions between blank and stamping tools were studied. This model describes the behaviour of the blank and is based on a coupled thermo-mechanical material model available in LS-DYNA based on [1][2]. An experimental program for high temperature tribological experiments mimicking the conditions in press hardening is defined, in which two tool steel pins consecutively slid over fresh blank strips heated to temperatures in the interval 600 °C to 800 °C beforehand. To study the relationship between tribological conditions and wear depth, the process parameters including temperatures, pressure and sliding distance are varied in specified ranges, that were calibrated with help of the tribological conditions prevalent in the simulation model (see Figure 1a-c). After calibration of the Archard wear model [3] through the tribological experiments, the prediction of wear depth on the stamping tools was achieved from simulation of the press hardening of a dog-bone shaped component (see Figure 1d). The computed tool wear depth and distribution was compared with results from press hardening experiments.

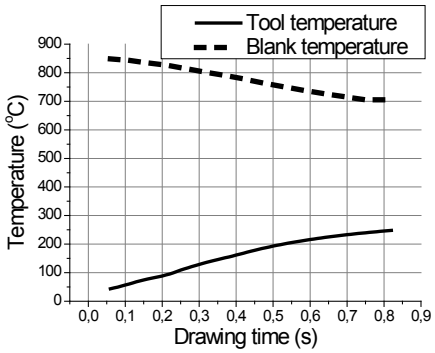
†Corresponding auther email: liang.deng @ltu.se



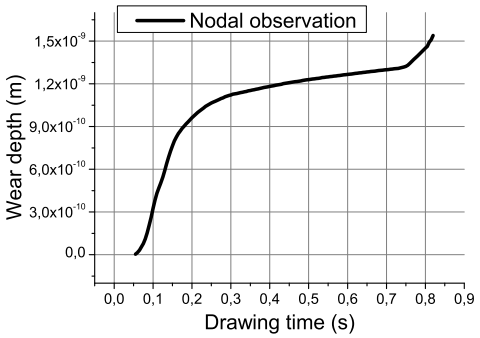
(a) Contact pressure



(b) Sliding distance



(c) Nodal temperature in stamping tool and its corresponding passing nodal temperature in blank



(d) Wear depth

Figure 1: Illustration of contact conditions occurring on a specific node in stamping tool

REFERENCES

[1] P. Åkerström and M. Oldenburg. Austenite decomposition during press hardening of a boron steel - computer simulation and test. *Journal of Materials Processing Technology.*, Vol. **107**, 399–406, 2006.

[2] P. Åkerström, G. Bergman and M. Oldenburg. Numerical implementation of a constitutive model for simulation of hot stamping. *Modelling Simul. Mater. Sci. Eng.*, Vol. **15**, 105–119, 2007.

[3] J.F. Archard. Contact and rubbing of flat surface. *J. Appl. Phis.*, Vol. **24**, 981–988, 1953.