An energy approach for the prediction of punch wear in blanking process

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Sheet metal blanking is one of the most employed forming processes in industry. Its reliability and capability of mass production are used to produce a large number of parts. As in each metal forming process, tool wear is of major concern in terms of part quality and economical impact (maintenance costs, tool life time, production down time, etc.). As production rates continually increase, control over this parameter constitutes a major asset for firm's competitiveness.

In this context, finite element simulations of the blanking process of stainless steel sheets have been performed by means of Abaqus/CAE software. The studied setup consists in a cylindrical punch passing through the metal sheet which is positioned over a die. A sheet-holder is added over the sheet to avoid springback effect, thus increasing the blanked edge quality. Data gathered from FE simulations have been processed by a wear algorithm programmed under Matlab environment in order to compute the frictional energy dissipated at punch surface during blanking operation. Frictional energy has been calculated to consider punch wear by using an energy approach. Fouvry et al. [FOU96] have shown that wear and the debris formation have led to a wear volume which presents a linear evolution with the cumulated dissipated energy. Frictional energy computed from blanking process simulation has been correlated with friction tests performed on a specific tribometer designed in the Department of Applied Mechanics of the FEMTO-ST Institute. This tribometer consists in a cylindrical barrel around which a metal sheet strip is wrapped. A prescribed load is applied to the tribometer lateral surface via a spherical pin made of the same material as the punch. The barrel rotation speed and the pin translation along the tribometer rotation axis are controlled in order to allow the rubbing surface to be constantly renewed. Thus, the friction conditions between the pin and the metal sheet are getting closer to the ones met during the blanking process since the punch penetrates an undamaged sheet at each stroke. This tribometer has been used to determine an energy wear coefficient which relates the energy dissipated by frictional force with the material loss.

The coupling between energy wear coefficient determined from tribological tests and the frictional energy computed from blanking process simulation is investigated in order to predict punch wear.

References

[FOU96] S. Fouvry, P. Kapsa, L. Vincent, *Quantification of fretting damage*, Wear 200 (1996) 186-205.