Identification of thermal/friction laws governing the tool-workmaterial interface behaviour and their integration in a FE code for machining processes analyses

B. Haddag*, S. Atlati, M. Nouari

Université de Lorraine, Laboratoire d'Énergétique et de Mécanique Théorique et Appliquée (LEMTA), CNRS-UMR 7563, GIP-InSIC, 27 rue d'Hellieule, F-88100, Saint Dié des Vosges, France.

*Corresponding author: Badis HADDAG, badis.haddag@univ-lorraine.fr

phone: +33 (0)3 29 42 18 21, fax: +33 (0)3 29 42 18 25

1. Abstract

Machining processes are widely used in different sectors of manufacturing industry. Metal cutting is characterised by high thermomechanical loads at the cutting zone, particularly at the tool-chip interface. In this work, the complex tribological behaviour at the tool-workmaterial interface in machining has been analysed in the frame of the finite element method. A new heat exchange law has been identified to represent the heat partition at the tool-workmaterial interface. A new VUINTER subroutine of Abaqus/Explicit FE code has been developed to implement the proposed contact behaviour. The thermomechanical laws governing the tool-workmaterial contact in machining have been implemented via this subroutine. Using this program, velocity-dependent heat partition coefficient of the frictional heat has been implemented. Numerical results (heat flux transmitted into the tool and cutting force) have been compared to experimental ones for different cutting conditions and they are in good agreement. With this new developed subroutine, it is now possible to implement mathematical models governing the friction and heat exchange for simulations of complex contact behaviours, as in machining, forging, braking, etc.

2. Keywords

Machining;
Tool-workmaterial interface;
Contact/Friction;
Heat exchange;
Contact implementation;
Finite Element.

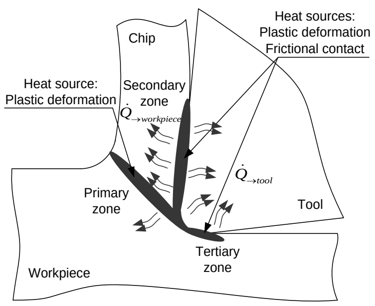

Fig.1 Illustration of heat sources during the chip formation in machining.

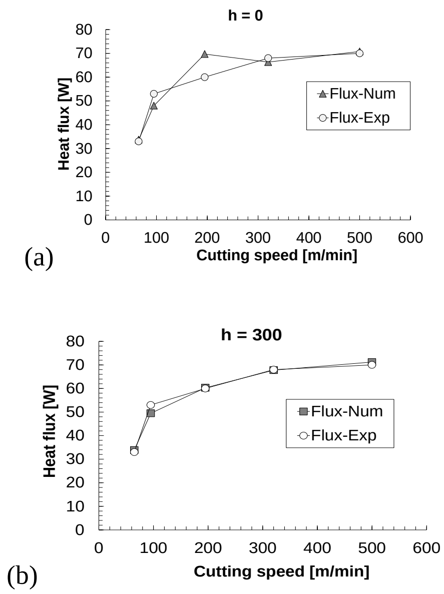

Fig.2 Comparison between numerical and experimental heat fluxes transmitted into the cutting tool using rate-dependent heat partition coefficient, for different cutting speeds. The heat transfer coefficient is equal 0 in (a) and 300 [mW/mm²/°C] in (b).

3. References

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