Wear Rate Prediction in Hard Turning

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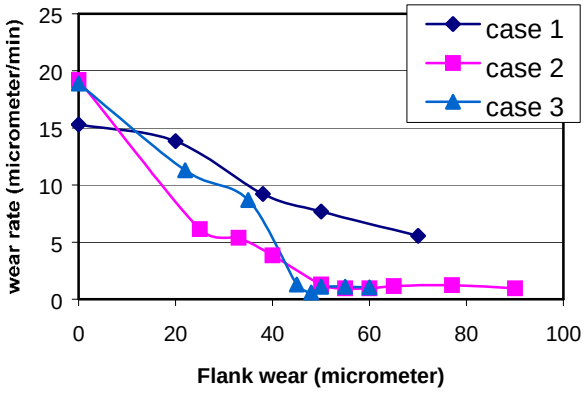
Cutting of hardened steel is a topic of high interest in today's industrial production and scientific research. Although it has been projected to replace some grinding processes for finishing the hardened steel, hard turning technology still has several key issues to address, for example, tool wear. CBN tool has attracted special interest in hard turning since it is able to machine hard materials efficiently and accurately with a relatively long tool life. But because of the high cost of CBN tool, tool wear is still one of the important issues to be focused on from the point of optimization of cutting condition and edge preparation.

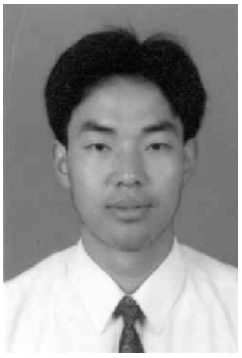


Plot of wear rate vs. flank wear length in hard turning for coated CBN tools during the different cutting conditions. An analytical model to predict the wear rate for a specific CBN tool under different cutting conditions is under development.

Based on the observed wear patterns during hard turning, the wear mechanisms of abrasion, adhesion and diffusion are proposed and discussed. Recently, as the result of a chemical reaction due to high stress and high temperature between the chip and tool rake face, a protective layer is reported also. Fundamentally, the dominant wear mechanisms between this protective layer and rake face are still adhesion and diffusion. So, the wear rate can still be modeled efficiently as an effect of combination of abrasion, adhesion, and diffusion.

Particularly, the wear rate is a function of temperature, stress and material properties under elevated temperature and high stress. The thermal and stress distribution modeling during hard turning are being developed at Georgia Tech. Due to the shortage of valid information on material properties for the hard turning process, a parameter identification algorithm is proposed and verified based on stochastic genetic searching.

Based on the available information, a robust wear rate model is under development and the wear rate can be estimated with reasonable accuracy for the different process conditions. Further research will address the tool life estimation and the optimization of cutting condition and edge preparation based on the developed wear rate model.



Yong Huang is a Ph.D Candidate working on research in the area of process modeling, tool life estimation and performance optimization in hard turning. He received his BS in Mechanical-Electrical Eng. degree from Xidian University, China in 1993, MS from Zhejiang University, China in 1996, MSME from University of Alabama in 1999 and continued studies at Georgia Tech in the Spring of 2000. He plans to graduate with a Ph.D. in mechanical engineering by the end of 2002. His research interests are: system/process modeling, performance optimization, process condition monitoring, artificial intelligence in engineering, automation and control, and DSP.

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