ADVANCED MACHINING TOWARDS IMPROVED MACHINABILITY OF DIFFICULT-TO-CUT MATERIALS

Edited by:
A.K.M. Nurul Amin (Chief Editor)
Dr. Erry Yulian Triblas Adesta
Dr. Mohammad Yeakub Ali

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Chapter 6

Modeling in Preheated Machining of AISI D2 Hardened Steel

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1.0 INTRODUCTION

Tool life prediction plays an important role in modern industry for sustainable manufacturing and product design. The productivity of a machining system and machining cost, as well as quality and integrity of the machined surface strongly depend on tool wear and tool life. Sudden failure of cutting tools leads to loss of productivity, rejection of parts and consequential economic losses [1].

The advent of several advanced difficult-to-cut materials such as the heat resistant tool steels has posed a great challenge in their machining. During the last few decades numerous studies have been conducted to improve the machinability of these materials and many large organizations have invested considerably in exploring and developing new techniques to minimize machining costs of these materials while maintaining their quality requirements. The benefits for the manufacture of components from hardened steel are substantial in terms of reduced machining costs and lead times, in comparison with the more traditional route which involves machining in the annealed state, heat treatment, grinding or electrical discharge machining (EDM), and manual finishing [2]. Recent advances in cutting tool and machine tool technologies have opened up new opportunities for investigation in machining hard materials and especially for bulk removal of material. Preheating of workpiece by induction heating has been recently reported to enhance the machinability of materials. The latest work done by Amin et al [3] were carried out with induction heating in end milling of AISI D2 hardened steel using Poly Crystalline Cubic Boron Nitride (PCBN) inserts. They observed that preheated machining of the material leads to surface roughness values well below 0.4 µm, such that the operations of grinding as well as polishing can be avoided at the higher cutting speeds. They added that preheated machining was able to reduce the amplitude of the lower frequency mode of chatter by almost 4.5 times at the cutting speed of 50 m/min. It was also established by several earlier studies [4-7] that preheating had great potential in lowering chatter. The primary causes of this stable cutting need to be studied in the perspective of material properties and damping capability of the material in the preheated condition. The primary objective of preheating is to enhance the ductility of the material for