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

Edited by:
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Chapter 26

Assessment of Performance of Uncoated and Coated Carbide Inserts in End milling of Ti–6Al–4V Through Modelling

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1.0 INTRODUCTION

Materials used in the manufacturing of aero-engine components generally comprise nickel and titanium base alloys. A major requirement of cutting tool materials used for machining aero-engine alloys is that they must possess adequate hot hardness to withstand the elevated temperatures generated at high speed conditions of aerospace alloys. Most cutting tool materials lose their hardness at elevated temperatures resulting in the weakening of the inter-particle bond strength and consequent acceleration of tool wear which results in deterioration of surface roughness. So it is very essential to establish an adequate functional relationship between the responses (such as surface roughness, tool life) and the cutting parameters (cutting speed, feed and depth of cut). Response surface methodology (RSM) may help in establishing the relationships between surface roughness and the cutting parameters for coated and uncoated inserts. The method was introduced by G.E.P Box and Wilson [1]. The main idea of RSM is to use a set of designed experiments to obtain an optimal response with limited number of experiments to save cost and time. RSM is a dynamic and foremost important tool of design of experiment (DOE), wherein the relationship between response(s) of a process with its input decision variables is mapped to achieve the objective of maximization or minimization of the response properties [1,2]. Many machining researchers have used response surface methodology to design their experiments and assess results. Analytical models have been created to predict surface roughness and tool life in terms of cutting speed, feed and axial depth of cut in milling steel material [3] and [4]. An effective approach has also been presented to optimize surface finish in milling Inconel 718 [5]. Kaye et al [6] used response surface methodology in predicting tool flank wear using spindle speed change. Wu [7] first pioneered the use of response surface methodology in tool life testing. Thomas et al. [8] used a full factorial design involving six factors to investigate the effects of cutting and tool parameters on the resulting surface roughness and on built-up edge formatting in the dry turning of carbon steel. Choudhury and El-Baradie [9] had used RSM and 2^3 factorial designs for predicting surface roughness when turning high-strength steel. The main objective of the current work was to develop RSM models for surface roughness based on cutting speed, axial depth of cut and feed for uncoated and coated inserts and then