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 25

Comparison of Surface Roughness in End-Milling of Titanium Alloy Ti-6Al-4V Using Uncoated WC-Co and PCD Inserts through Generation of models

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1.0 INTRODUCTION

Titanium alloys are widely known as difficult to cut materials, especially at higher cutting speeds, due to their several inherent properties. Siekmann [1] suggested that machining of titanium and its alloys would always be a problem, no matter what techniques are employed to transform this metal into chips. When machining Ti-6Al-4V, conventional tools wear rapidly because the poor thermal conductivity of titanium alloys resulting in higher cutting temperature closer to the cutting edge. There also exists strong adhesion between the tool and workpiece material [2]. Since the performance of conventional tools is poor in machining Ti-6Al-4V, a number of newly evolved tool materials, such as cubic boron nitride (CBN) and polycrystalline diamond (PCD), are being considered to achieve high-speed milling [3]. A machinability model may be defined as a functional relationship between the input of independent cutting variables (speed, feed, depth of cut) and the output known as responses (tool life, surface roughness, cutting force, etc) of a machining process [4]. Response surface methodology (RSM) is a combination of experimental and regression analysis and statistical inference. 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 [5-6]. Many machining researchers have used response surface methodology to design their experiments and assess results. Kaye et al [7] used response surface methodology in predicting tool flank wear using spindle speed change. A unique model has been developed which predicts tool flank wear, based on the spindle speed change, provided the initial flank wear at the beginning of the normal cutting stage is known. An empirical equation has also been derived for calculating the initial flank wear, given the speed, feed rate, depth of cut and workpiece hardness. Alauddin et al [8] applied response surface methodology to optimize the surface finish in end milling of Inconel 718 under dry condition. They developed contours to select a combination of cutting speed, and feed without increasing the surface roughness.

Fuh and Wang [9] developed a model for predicting milling force model in end milling operation. They found that the proposed model is suitable for practical engineering application, since the milling force analyzed in the model has already encompassed the structural characteristics of the milling machine and the real conditions of the tool and workpiece. They also suggested that the proposed force model had a good correlation with experimental values. Choudhury and el-Baradie [10] found that response surface