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

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68100 Batu Caves
Selangor Darul Ehsan
Tel: +603-6188 1542 / 44 / 45 Fax: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

Chapter 17

Development of a Mathematical Model for the Prediction of Surface Roughness in End Milling of Stainless Steel SS 304

A.K.M. Nurul Amin [1], Asif Mahmoud[1]
[1]Faculty of Engineering – International Islamic University Malaysia

e-mail address of the corresponding author: *akamin@iium.edu.my*

1.0 INTRODUCTION

The use of advanced computer-based systems for the selection of optimum conditions of mechanical components during process planning becomes essential for today's complex products. Computer aided manufacturing (CAM) has widely been implemented to obtain more accurate machining data and to ensure that optimum production is achieved. Machinability of a material provides an indication of its adaptability to be manufactured by a machining process. In general, machinability can be defined as an optimal combination of factors such as low cutting force, high material removal rate, good surface integrity, accurate and consistent workpiece geometrical characteristics, low tool wear rate and good curl or breakdown of chips.

In machinability studies investigations, statistical design of experiments is used quite extensively. Statistical design of experiments refers to the process of planning the experiment so that the appropriate data can be analyzed by statistical methods, resulting in valid and objective conclusions [1]. Design and methods such as factorial design, response surface methodology (RSM) and Taguchi methods are now widely use in place of one-factor-at-a-time experimental approach which is time consuming and exorbitant in cost. 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 [2]. 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 [3]. Many machining researchers have used response surface methodology to design their experiments and assess results. Kaye et al [4] 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 [5] applied response surface methodology to optimize the surface finish in end milling of Inconel 718 under dry condition