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IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Advanced Machining Towards Improved Machinability of Difficult-To-Cut Materials: A.K.M. Nurul Amin, Erry Yulian Triblas Adesta & Mohammad Yeakub Ali

ISBN: 978-967-418-175-8

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN.BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan
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Chapter 13

Application of Permanent Electromagnet for Chatter Control in End Milling of Titanium Alloy - Ti6Al4V

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1.0 INTRODUCTION

Chatter is a vibration that occurs during machining operations resulting from instability of the cutting process with system responses of the spindle tool chuck system. One of the most challenging issues in machining process is to know the chatter characteristics. The main problem with chatter is that its mechanics is still not yet fully understood. Chatter is inconsistent in character, making it difficult to analyze and predict. This research work investigates the performance of permanent magnet in suppressing the chatter phenomena in end milling operation. An experiment is designed based on response surface methodology (RSM) approach using DESIGN EXPERT software. The experiments are done under two different conditions. The first condition is without the presence of magnet while the other is with the presence of magnet. Titanium alloy (ti-6al-4v) WAS used as a work material. Chatter or vibration with high amplitude appears in the system during end milling at cutting speed 70 m/min when the frequency of chip formation instability, associated with the formation of serrate chip. Cutting under the existence of magnet did suppress the chatter about 40% and the surface roughness is much better and smoother with the magnet compared to the cutting under room temperature in general.Machining of metal is usually accompanied by a violent relative vibration between work and tool, known as chatter. Chatter arises as a result of resonance caused by the interaction of the vibrations due to the instability of chip formation and natural vibrations of the system components. Campa et al. [1] described chatter as a dynamic problem at high removal rate condition. In addition Quintana et al. [2] specified that chatter can be obviously predicted from the loud noise and the poor surface integrity due to the chatter mark. In machining process, there are some problems that propagate the end of result especially in metal cutting. Y. Altintas and Philips K. Chan [3] stated that one of the major limitations on productivity in metal cutting is chatter vibration, which cause poor surface finish and tool damage. Kim et al. [4] explained that most of the drawbacks comes from chatter is causes excessive tool wear, noise, tool breakage, and deterioration of the surface quality. According to Patwari et al. [5] chatter is a very important phenomenon that needs to be taken into consideration whenever machining process is being performed. Amin et al. [6] and Patwari et al. [7] found that the root cause of chatter lies in the coincidence of the frequency of instability of chip formation with one of the natural frequencies of the machine-spindle-tool system components during end milling machining operation