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

Edited by:
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Chapter 11

A New Method for Chatter Suppression and Improvement of Surface Roughness in End Milling of Mild Steel

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1.0 INTRODUCTION

Chatter is an abnormal tool behaviour which it is one of the most critical problems in machining process and must be avoided to improve the dimensional accuracy and surface quality of the product [1]. The most critical limitation in machining productivity and part quality is the occurrence of the instability phenomenon called regenerative chatter [2]. According to Ravikumar and Bhaskar [2] chatter is a self-excitation phenomenon occurring in machine tools, in which the cutting process tends to decrease the machine structural damping ending with an unstable behaviour. It results in heavy vibrations of the tool, causing an inferior work piece. According to Patwari and Amin [3] chatter is a very important phenomenon that needs to be taken into consideration whenever machining process is being performed. It is very important to avoid chatter in machining as it will effect others parameters which then will increase the cost of production. In a micromilling process, where the spindle rotates an end mill to remove a portion of the workpiece, the unstable phenomenon, regenerative chatter also occurs due to changes in the chip thickness similar with the macro machining [4-5]. Altintas and Chan [6] stated that one of the major limitations on productivity in metal cutting is chatter vibration, which causes poor surface finish and tool damage. Kim et al. [7] explained that most of the drawbacks that come from chatter are excessive tool wear, noise, tool breakage, and deterioration of the surface quality. Moreover chatter also results in reduced material removal rate (MRR), increased costs in terms of time, materials and energy, as well as the environmental impact of dumping non-valid final parts and having to repeat the manufacturing process as quoted from Quintana [8].

2.0 EXPERIMENTAL DETAIL

2.1 Experimental Setup

Cutting tests were conducted mainly on Vertical Machining Center (VMC ZPS, Model: 1060) powered by a 30 KW motor with a maximum spindle speed of 8000 rpm. Figure 1 shows the experimental set up cutting test conditions on end milling for machining of titanium alloy (Ti-6Al-4V) with TiN inserts. The main thrust of the experiments was on the study of surface roughness and monitoring of vibrations during end milling operations of medium carbon steel.