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

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Chapter 22

Modeling of Surface Roughness during End Milling of AISI H13 Hardened Tool Steel

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1.0 INTRODUCTION

Hard machining, a frequently used term in today's machine tool industries, refers to the machining of material with a hardness value over 45 HRC. The concept of hard machining was developed in 80s; however, the prevalent industrial implementation of hard part machining was adopted during the last decade [1]. Advantages in hard machining incorporate the complete machining process with a single fixture setup, eliminating intermediate heat treatment and final grinding process while still meeting the dimensional and surface roughness specifications [2]. The widespread demand of hardened tool steel like AISI H13 requires high speed machining (HSM). Over the last decade, HSM has been used to manufacture molds/dies made from AISI H13. Many progressive works have been carried out to improve the high speed machining performance of H13. However, despite the significant importance of surface finish most of the machining researchers to date have concentrated on chip morphology, tool life and wear mechanism. In hard part machining, surface finish is a major quality criterion. With an accurate level of roughness it is possible to eliminate final grinding process, sometime even the hand polishing [3]. Considering its importance some researchers conducted their studies on surface quality during hard machining. Choudhury at el. [4] applied Taguchi method for the prediction of surface roughness during the end milling of AISI H13 tool steel and found that roughness value tends to decrease with increasing cutting speed and decreasing feed rate. El-Baradie [5] drew similar conclusion on cutting speed. He observed that increase of cutting speed maximizes productivity, at the same time, it improves surface quality. However, in all of the above cases and other works related to the surface roughness study it was found that the lowest achievable surface finish was only 0.2 µm. at high cutting speed mode. In most of the cases roughness values were sufficiently high to fall in the grinding region (above 0.2 to 0.4 µm). Moreover, material removal rate was limited for using lower radial depth of cut and feed per tooth (Rd = 0.3 mm to 0.8 mm and f = 0.10 mm/tooth).

In this context, considering the influence of surface finish on mold/die for net shape manufacturing, current paper deals with the performance of PCBN and PVD-TiAlN coated carbide tool inserts in terms of surface roughness during the end milling of H13 hardened tool