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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Advanced Machining

List of Contents

SECTION A: HEAT ASSISTED MACHINING

1. CHAPTER 1: INFLUENCE OF WORKPIECE PREHEATING ON CHATTER AND MACHINABILITY OF TITANIUM LOY - Ti6Al4V

2. CHAPTER 2: MACHINABILITY IMPROVEMENT IN END OF MILLING TITANIUM ALLOY TI-6AL-4V THROUGH PREHEATING

3. CHAPTER 3: SOME ASPECTS OF IMPROVED MACHINABILITY IN PREHEATED MACHINING OF TITANIUM ALLOY TI-6AL-4V

4. CHAPTER 4: MACHINABILITY ASPECTS IN HEAT ASSISTED MACHINING OF HARDENED STEEL AISI H13 USING COATED CARBIDE TOOL

5. CHAPTER 5: TOOL WEAR AND SURFACE ROUGHNESS ASPECTS IN HEAT ASSISTED END MILLING OF AISI D2 HARDENED STEEL

6. CHAPTER 6: MODELING IN PREHEATED MACHINING OF AISI D2 HARDENED STEEL

7. CHAPTER 7: RELATIVE PERFORMANCES OF PREHEATING, CRYOGENIC COOLING AND HYBRID TURNING OF STAINLESS STEEL AISI 304

SECTION B: CHATTER AND SELECTED METHODS OF CHATTER SUPPRESSION

8. CHAPTER 8: ROLE OF THE FREQUENCY OF SECONDARY SERRATED TEETH IN CHATTER FORMATION DURING TURNING OF CARBON STEEL AISI 1040 AND STAINLESS STEEL

9. CHAPTER 9: INFLUENCE OF THE ELASTIC SYSTEM AND CUTTING PARAMETERS ON CHATTER DURING MACHINING OF MILD STEEL

10. CHAPTER 10: INFLUENCE OF CHATTER ON TOOL LIFE DURING END MILLING OF ALUMINIUM AND ALUMINIUM ALLOY ON VMC
CHAPTER 11: A NEW METHOD FOR CHATTER SUPPRESSION AND IMPROVEMENT OF SURFACE ROUGHNESS IN END MILLING OF MILD STEEL

CHAPTER 12: APPLICATION OF PERMANENT ELECTROMAGNET FOR CHATTER CONTROL IN END MILLING OF MEDIUM CARBON STEEL

CHAPTER 13: APPLICATION OF PERMANENT ELECTROMAGNET FOR CHATTER CONTROL IN END MILLING OF TITANIUM ALLOY - Ti6Al4V

CHAPTER 14: CHATTER SUPPRESSION IN END MILLING OF TITANIUM ALLOY Ti6Al4V APPLYING PERMANENT MAGNET CLAMPED ADJACENT TO THE WORKPIECE

SECTION C: MODELING AND OPTIMIZATION IN MACHINING

CHAPTER 15: A COUPLED ARTIFICIAL NEURAL NETWORK AND RSM MODEL FOR THE PREDICTION OF CHIP SERRATION FREQUENCY IN END MILLING OF INCONEL 718

CHAPTER 16: APPLICATION OF RESPONSE SURFACE METHODOLOGY COUPLED WITH GENETIC ALGORITHM FOR SURFACE ROUGHNESS OF INCONEL 718

CHAPTER 17: DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE PREDICTION OF SURFACE ROUGHNESS IN END MILLING OF STAINLESS STEEL SS 304

CHAPTER 18: DEVELOPMENT OF AN ARTIFICIAL NEURAL NETWORK ALGORITHM FOR PREDICTING THE CUTTING FORCE IN END MILLING OF INCONEL 718 ALLOY

CHAPTER 19: DEVELOPMENT OF AN ARTIFICIAL NEURAL NETWORK ALGORITHM FOR PREDICTING THE SURFACE

CHAPTER 20: DEVELOPMENT OF TOOL LIFE PREDICTION MODEL OF TiAIN COATED TOOLS DURING PART C: HIGH SPEED HARD MILLING OF AISI H13 STEEL

CHAPTER 21: MODELING FOR SURFACE ROUGHNESS IN END-MILLING OF TITANIUM ALLOY Ti-6Al-4V USING UNCOATED WC INSERTS
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>CHAPTER 22: MODELING OF SURFACE ROUGHNESS DURING END MILLING OF AISI H13 HARDENED TOOL STEEL</td>
<td>167</td>
</tr>
<tr>
<td>23</td>
<td>CHAPTER 23: MODELING OF TOOL LIFE USING RESPONSE SURFACE METHODOLOGY IN HARD MILLING OF AISI D2 TOOL STEEL</td>
<td>175</td>
</tr>
<tr>
<td>24</td>
<td>CHAPTER 24: OPTIMIZATION OF SURFACE ROUGHNESS IN HIGH SPEED END MILLING OF TITANIUM ALLOY Ti-6Al-4V UNDER DRY CONDITION</td>
<td>181</td>
</tr>
<tr>
<td>25</td>
<td>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</td>
<td>189</td>
</tr>
<tr>
<td>26</td>
<td>CHAPTER 26: ASSESSMENT OF PERFORMANCE OF UNCOATED AND COATED CARBIDE INSERTS IN END MILLING OF Ti-6Al-4V THROUGH MODELLING</td>
<td>195</td>
</tr>
<tr>
<td></td>
<td>SECTION D: CRYOGENIC AND HIGH SPEED MACHINING OF METALS AND NON METALS</td>
<td>203</td>
</tr>
<tr>
<td>27</td>
<td>CHAPTER 27: THE EFFECT OF CRYOGENIC COOLING ON MACHINABILITY OF STAINLESS STEEL DURING TURNING</td>
<td>203</td>
</tr>
<tr>
<td>28</td>
<td>CHAPTER 28: COMPARISON OF MACHINABILITY OF CERAMIC INSERT IN ROOM TEMPERATURE AND CRYOGENIC COOLING CONDITIONS DURING END MILLING INCONEL 718</td>
<td>209</td>
</tr>
<tr>
<td>29</td>
<td>CHAPTER 29: HIGH SPEED END MILLING OF SINGLE CRYSTAL SILICON SING DIAMOND COATED TOOL</td>
<td>217</td>
</tr>
<tr>
<td>30</td>
<td>CHAPTER 30: IMPLEMENTATION OF HIGH SPEED OF SILICON USING DIAMOND COATED TOOLS WITH AIR BLOWING</td>
<td>225</td>
</tr>
<tr>
<td>31</td>
<td>CHAPTER 31: ELIMINATION OF BURR FORMATION DURING END MILLING OF POLYMETHYL METHACRYLATE (PMMA) THROUGH HIGH SPEED MACHINING</td>
<td>233</td>
</tr>
<tr>
<td>32</td>
<td>CHAPTER 32: WEAR MECHANISMS IN END MILLING OF INCONEL 718</td>
<td>239</td>
</tr>
</tbody>
</table>
CHAPTER 33: PERFORMANCE OF UNCOATED WC-CO INSERTS IN END MILLING OF ALUMINUM SILICON CARBIDE (ALSiC) 247

CHAPTER 34: APPLICATION OF PCD INSERTS IN END MILLING OF ALUMINUM SILICON CARBIDE (ALSiC) 253

CHAPTER 35: EFFECTS OF SCRIBING WHEEL DIMENSIONS ON LCD GLASS CUTTING 259
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 et al. [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