

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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SECTION A: HEAT ASSISTED MACHINING	1
1. CHAPTER 1: INFLUENCE OF WORKPIECE PREHEATING ON CHATTER AND MACHINABILITY OF TITANIUM LOY - TI6AL4V	1
2. CHAPTER 2: MACHINABILITY IMPROVEMENT IN END OF MILLING TITANIUM ALLOY TI-6AL-4V THROUGH PREHEATING	9
3. CHAPTER 3: SOME ASPECTS OF IMPROVED MACHINABILITY IN PREHEATED MACHINING OF TITANIUM ALLOY TI-6AL-4V	19
4. CHAPTER 4: MACHINABILITY ASPECTS IN HEAT ASSISTED MACHINING OF HARDENED STEEL AISI H13 USING COATED CARBIDE TOOL	27
5. CHAPTER 5: TOOL WEAR AND SURFACE ROUGHNESS ASPECTS IN HEAT ASSISTED END MILLING OF AISI D2 HARDENED STEEL	35
6. CHAPTER 6: MODELING IN PREHEATED MACHINING OF AISI D2 HARDENED STEEL	43
7. CHAPTER 7: RELATIVE PERFORMANCES OF PREHEATING, CRYOGENIC COOLING AND HYBRID TURNING OF STAINLESS STEEL AISI 304	49
SECTION B: CHATTER AND SELECTED METHODS OF CHATTER SUPPRESSION	57
8. CHAPTER 8: ROLE OF THE FREQUENCY OF SECONDARY SERRATED TEETH IN CHATTER FORMATION DURING TURNING OF CARBON STEEL AISI 1040 AND STAINLESS STEEL	57
9. CHAPTER 9: INFLUENCE OF THE ELASTIC SYSTEM AND CUTTING PARAMETERS ON CHATTER DURING MACHINING OF MILD STEEL	65
10. CHAPTER 10: INFLUENCE OF CHATTER ON TOOL LIFE DURING END MILLING OF ALUMINIUM AND ALUMINIUM ALLOY ON VMC	75

11	CHAPTER 11: A NEW METHOD FOR CHATTER SUPPRESSION AND IMPROVEMENT OF SURFACE ROUGHNESS IN END MILLING OF MILD STEEL	83
12	CHAPTER 12: APPLICATION OF PERMANENT ELECTROMAGNET FOR CHATTER CONTROL IN END MILLING OF MEDIUM CARBON STEEL	91
13	CHAPTER 13: APPLICATION OF PERMANENT ELECTROMAGNET FOR CHATTER CONTROL IN END MILLING OF TITANIUM ALLOY - Ti6Al4V	99
14	CHAPTER 14: CHATTER SUPPRESSION IN END MILLING OF TITANIUM ALLOY Ti6Al4V APPLYING PERMANENT MAGNET CLAMPED ADJACENT TO THE WORKPIECE	107
	SECTION C: MODELING AND OPTIMIZATION IN MACHINING	117
15	CHAPTER 15: A COUPLED ARTIFICIAL NEURAL NETWORK AND RSM MODEL FOR THE PREDICTION OF CHIP SERRATION FREQUENCY IN END MILLING OF INCONEL 718	117
16	CHAPTER 16: APPLICATION OF RESPONSE SURFACE METHODOLOGY COUPLED WITH GENETIC ALGORITHM FOR SURFACE ROUGHNESS OF INCONEL 718	123
17	CHAPTER 17: DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE PREDICTION OF SURFACE ROUGHNESS IN END MILLING OF STAINLESS STEEL SS 304	133
18	CHAPTER 18: DEVELOPMENT OF AN ARTIFICIAL NEURAL NETWORK ALGORITHM FOR PREDICTING THE CUTTING FORCE IN END MILLING OF INCONEL 718 ALLOY	143
19	CHAPTER 19: DEVELOPMENT OF AN ARTIFICIAL NEURAL NETWORK ALGORITHM FOR PREDICTING THE SURFACE	149
20	CHAPTER 20: DEVELOPMENT OF TOOL LIFE PREDICTION MODEL OF TiAlN COATED TOOLS DURING PART C: HIGH SPEED HARD MILLING OF AISI H13 STEEL	155
21	CHAPTER 21: MODELING FOR SURFACE ROUGHNESS IN END-MILLING OF TITANIUM ALLOY Ti-6Al-4V USING UNCOATED WC INSERTS	161

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

33	CHAPTER 33: PERFORMANCE OF UNCOATED WC-CO INSERTS IN END MILLING OF ALUMINUM SILICON CARBIDE (ALSiC)	247
34	CHAPTER 34: APPLICATION OF PCD INSERTS IN END MILLING OF ALUMINUM SILICON CARBIDE (ALSiC)	253
35	CHAPTER 35: EFFECTS OF SCRIBING WHEEL DIMENSIONS ON LCD GLASS CUTTING	259

Chapter 2

Machinability Improvement in End of Milling Titanium Alloy Ti-6Al-4V Through Preheating

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1.0 INTRODUCTION

Titanium alloys are used widely in the aerospace, chemical and ship building industry because of their superior mechanical properties, heat resistance and corrosion resistance. Titanium alloys, however, are materials that are extremely difficult to machine. During the machining of titanium alloy, tool wear progresses rapidly because of the high cutting temperature and strong adhesion between the tool and the work material, owing to their low thermal conductivity and high chemical reactivity [1,2]. However, by properly selecting the tool material and cutting conditions an acceptable rate of tool wear may be achieved and thus lowering the total machining cost [3]. The performance of a cutting tool is normally assessed in terms of its life. Mostly, flank wear is considered, since it largely affects the stability of the cutting wedge and consequently the dimensional tolerance of the machined work surface [4].

The use of workpiece preheating (hot machining) as a technique for improving machining operations has been under consideration since the late 19th century. This was informed by understanding that metals tend to deform more easily when heated, thus enhancing machining. The principle behind hot machining is increasing difference in hardness of the cutting tool and workpiece, leading to reduction in the component forces, improved surface finish and longer tool life [5]. Amin and Talantov [6] studied the influence of the furnace method of preheating of workpiece on machinability of titanium alloy BT6 (Russian Standard) and found that the vertical cutting force component decreases with the increase in the preheating temperature but the radial and the axial components sharply increase to their peak values at a particular temperature. Ozler et al [7] used gas flame heating to improve the machinability of austenitic manganese steel. Wang et al [8] performed LAM using YAG continuous solid laser on Al₂O₃ particle reinforced aluminum matrix composite (Al₂O₃p/Al). The result of their study showed that in machining of Al₂O₃p/Al composite the cutting force was reduced by 30-50 %, tool wear was reduced by 20-30 % in laser assisted machining as compared with conventional cutting. Tosun and Ozler [9] studied hot machining in turning high manganese steels using liquid