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

Edited by:
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Chapter 7

Relative Performances of Preheating, Cryogenic Cooling and Hybrid Turning of Stainless Steel AISI 304

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1.0 INTRODUCTION:

Chatter is an unwanted phenomenon in machining due to its adverse effects on the product quality, operation cost, machining accuracy, tool life, machine-tool bearings, and machine-tool life. The term defines the self-excited violent dynamic motion between the cutting tool and work piece [1]. During high speed machining of steel, large amount of energy is used in shearing process and substantial energy is converted to heat. Heat generation becomes more intensified in machining of high strength materials because the machining process requires more energy than that in cutting a low strength material. The rapid escalation of temperature at the cutting zone is the primary cause accountable for high diffusion wear rate leading to shorter tool life. High tool wear rate leads to high degree of chatter and poor surface finish. It is therefore essential to design effective cooling systems to bring down the temperature at the cutting zones. Cryogenic cooling is being looked at as a potential replacement of conventional mineral oil based coolants because the latter is being rejected on grounds on serious environmental and health problems that it causes [2].Cryogenic cooling is the cooling approach to replace conventional coolant by liquefied gas in machining process [3].The impact of cryogenic cooling on chip breaking and tool wear intensity during end milling and turning has been investigated by various researchers [3-7], but there has not been any study on the impact of cryogenic cooling on chip formation and chatter.Tungsten-inert-gas (TIG) plasma heating could be used to replace Laser Beam heating and high frequency heating since TIG plasma heating also offers high heating capacity and at the same time the use of inert gas would be able to protect the work surface against oxidation during machining. In this research the TIG or tungsten-arc welding machine would therefore be used as an well controlled and precise heat source to preheat the uncut layer of the work material before it enters into the shearing zone. The major advantages of the plasma preheating are increased metal removal rates, results in no metallurgical damage to the work piece and increase in tool life [8].Similarly there has been some works [9] on the influence of workpiece preheating using induction heating on machinability of work materials and chatter during end milling operation, the application of preheating technique in turning should be explored further to confirm its effectiveness of different heating process.It was found that preheating resulted in substantial lowering down of