

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

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Edited by:

A.K.M. Nurul Amin (Chief Editor)

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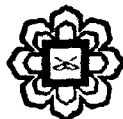
**ADVANCED MACHINING**  
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## **The Effect of Cryogenic Cooling on Machinability of Stainless Steel during Turning**

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### **1.0 INTRODUCTION**

A high cutting temperature inherently characterizes high production machining. Such a high cutting temperature adversely affects tool life, dimensional and form accuracy and surface integrity of the product. Currently, an effort is being made to control this problem by reducing heat from the cutting zone through proper selection of machining parameters, cutting fluid application and heat resistant tools. The objective of this project is to investigate the effect of cryogenic cooling in machinability of stainless steel during turning. Cryogenic cooling is a promising new technology, which economically addresses the current processes environmental, and health, concerns. Cooling the cutting tool with liquid nitrogen (-320°F) is expected to maintain tool hardness and life. Cooling the chip makes it brittle and aids removal. Because nitrogen is an abundant atmospheric constituent and the quantities used are small, there is no unfavorable environmental effect or health impact or coolant disposal cost, and the chips are readily recycled. It was assumed that using cryogenic cooling during turning operation would discover some improvement in machinability of stainless steel by using cryogenic cooling during turning operation. Large number of research works performed in the area of metal cutting has contributed towards understanding the basic principles of improving machinability. It is therefore worthwhile to explore the possibility to strengthen the continuity of these works. This research intends to emphasize on chatter analysis to establish a correlation between chatter and machinability, which is seldom highlighted by scientists and researchers. 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]. Chatter analysis could be another accurate, precise, effective and efficient method to analyze instantaneous cutting environment and performance. Cryogenic cooling is the cooling approach to replace conventional coolant by liquefied gas in machining process [2]. In most cases, the liquid nitrogen (LN2) is chosen because of its availability and cost. There were many research works [3-5] on the application of cryogenic cooling to improve the machinability of the hard to cut materials. Liquid nitrogen (LN2) as a cryogenic coolant has been widely investigated, especially for machining hard to cut material [6,7]. 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 [8]. It is therefore essential to design efficient cryogenic cooling systems for high speed machining applications of hard-to-machine materials. The impact of cryogenic cooling on chip breaking and tool wear intensity during end milling and