Sustain Ability of Modern Metal Cutting Processes

Assessment of Cryogenic Machining

Franci Pušavec
Janez Kopač

2012

Title:	Sustain Ability of Modern Metal Cutting Processes. Assessment of Cryogenic Machining
Authors:	Assist.Prof.Dr. Franci Pušavec, uni.dipl.ing. Prof.Dr.Dr.h.c. Janez Kopač, uni.dipl.ing. Faculty of Mechanical Engineering, University of Ljubljana Askerceva 6, SI-1000 Ljubljana Slovenia
Reviewer:	Prof.Dr. Franc Čuš (Slovenia) Prof.Dr. Joel Rech (France)
Design:	Darko Švetak (Slovenia)
Publisher:	PROFIDTP, d.o.o., Škofljica, Slovenia
Number of copies:	100

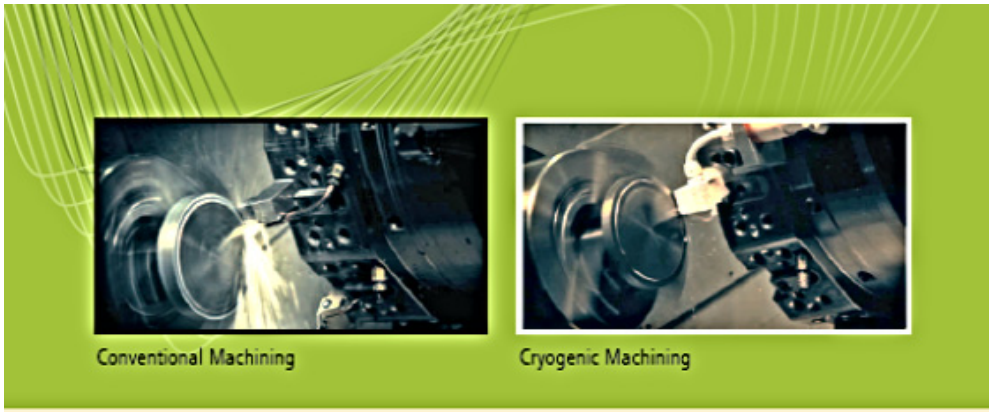
CIP - Kataložni zapis o publikaciji
Narodna in univerzitetna knjižnica, Ljubljana

621.91-026.656

PUŠAVEC, Franci
Sustain ability of modern metal cutting processes : assessment
of cryogenic machining / Franci Pušavec and Janez Kopač. -
Škofljica : PROFIDTP, 2012

ISBN 978-961-92659-3-2
1. Kopač, Janez, 1949-
261082624

Contents



Sustain Ability of Modern Metal Cutting Processes; Assessment of Cryogenic Machining explains how and why machining performance can be increase by application of cryogenic fluid to the cutting zone. While cryogenic machining is not a new process, its benefits have not been fully exploited by industry. One reason for this is very few source information that explain what it is, how it works and why it works. And the second reason lies in placing importance of economics over environment and health.

Manufacturing industry is under increasing pressure of global competition, stricter environmental legislation and supply-chain demand for improved sustainability performance. The latter can be achieved through changes in products, processes, and systems. Therefore, in the book sustainability in machining processes is under the scope. This book presents disseminated work related to sustainable cryogenic machining technology that has a high potential to cut production costs, raise the performances, and improve competitiveness by reducing resource consumption and creating less waste. The details about cryogenic fluids and their use in machining processes as an alternative to oil-based emulsions are presented. Further, the details of liquid nitrogen and the ways of their application in the machining processes are presented, with given deep review on current state-of-the-art. Experimental study of sustainable high performance machining of Inconel 718 with the development of performance-based predictive models for dry, near-dry (MQL), cryogenic and cryo-lubrication (cryogenic + near-dry) machining processes using response surface methodology (RSM), is performed. Cutting forces, tool-wear, chip breakability, and machined surface integrity were measured, analyzed, and modeled. Models are used in the overall process optimization procedure, based on genetic algorithms, defining the optimum for achieving improved overall machining performance, while fulfilling sustainability issues in terms of enhanced machined surface quality, tool-life, cutting forces, power consumption and increased productivity. The research is upgraded with the sustainability issues on a shop floor level that are pointed out via a life cycle assessment and an impact evaluation of the use of cryogenic technology on production costs. Additionally, the influence of cryogenic machining process on the dynamic characteristics of the machining process is in detail analyzed by chatter onset detection, with introduced machining process coupling dynamics characterization.

To strengthen the dealt with topics, author's most recent original research papers and two patent applications are added to the appendix of the book.

Overall, the book is pointing out that the cryogenic machining technology has a high potential to overcome position of conventional machining processes, fulfilling all the sustainability pillars: economical, social and environmental one, over conventional machining processes.

9 789619 265932