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Yousef Shokoohi, Ehsan Khosrojerdi, B.h.Rassolian Shiadhi



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## Machining and Ecological Effects of a New Developed Cutting Fluid in Combination with Different Cooling Techniques on Turning Operation

Yousef Shokoohi<sup>a</sup>, Ehsan Khosrojerdi<sup>a,#</sup>, B.h.Rassolian Shiadhi<sup>b</sup>

<sup>a</sup> Faculty of mechanical engineering Babol university of technology, Babol, Iran, 7116747148

<sup>b</sup> Faculty of environmental engineering, Islamic Azad University of Science and Research, Damavand, Iran, 1477893855

### Abstract

Turning is deemed as one of the most fundamental processes of metal cutting in industry. The heat generated in the cutting zones during turning plays an essential role in the final workpiece quality and power consumption. The present work tried to elaborate the performance of a new cooling technique i.e. pre-cooling the workpiece integrated with a developed cutting fluid applied with minimum quantity cooling lubrication method. To do so, to produce the desirable eco-friendly and user-friendly cutting fluid, water mixed vegetable oil was combined with a little amount of anti-bacterial agent and a scented essence. To assess the machining parameters in question i.e. surface roughness, consumed machining power and chip formation as well as machining hazards, some tests were conducted on the hardened and tempered AISI 1045 steel. Based on the findings of the study, a great improvement was observed in terms of machining parameters as well as health and ecological-related issues. The better machining performance of the new method probably is mainly due to efficient penetration of the oil into the tool-workpiece interface and colder cutting zone when compared with the conventional machining. Also, compared to the straight oil, the new vegetable oil showed positive results in terms of controlling the growth of bacterial colony. It seems that the proposed combined cooling method may potentially enhance the productivity of cutting operations in terms of machining quality, costs, operator health and environmental protection.

**Keywords:** Vegetable Oil, Lubrication, Turning, Surface roughness, Machining power, Environment

### 1. Introduction

Along with the recent remarkable progress in metal products manufacturing processes and especially machining process, numerous studies have been conducted on how to improve the production performance. One of the most important and operational relevant fields of research has been focused on the assessment of metalworking fluids' behaviors and the effects these fluids place on environment, human operators as well as the quality of the products. It is well-known that metalworking fluids improve the efficiency of machining in terms of increased tool life, improved surface finish, improved tolerance and reduced cutting force and vibrations (Belluco and De Chiffre, 2002). Approximately 85% of lubricants being used around the world are petroleum-based oils. As it is evident, enormous use of these oils has had a lot of negative environmental and health-related consequences e.g. skin diseases (Shashidhara and Jayaram, 2010). Therefore, different investigations have been conducted on different vegetable-based cutting fluids which have had positive findings. In one study, Belluco and De Chiffre (Belluco and De Chiffre, 2002) evaluated the effects of new formulations of vegetable oils on part accuracy and surface integrity of AISI 316L during reaming and tapping. They reported that vegetable-based fluids performed better than mineral oil. Using three kinds of vegetable-based cutting fluids, Kuram et al. studied the effect of the type of cutting fluids on cutting parameters i.e. surface roughness and thrust

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