

Development of Bio-Cutting Fluid (*Cirtullus lanatus*) and its Performance Assessment on the Machining of AISI 1525 Steel Using Taguchi Technique and Grey Relational Analysis

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Received: 8.07.2021; Revised: 15.08.2021; Accepted: 20.08.2021; Published: 18.10.2021

Abstract: Due to traditional mineral oils' adverse environmental and health effects, vegetable oil-based cutting fluids have become widely attractive in machining. The majority of the vegetable oils used in literature are edible and may compete with human consumption if promoted, thereby making it more expensive as cutting fluids. However, few studies have been carried out on the applicability of lesser-known vegetable oils as cutting fluids. This study, therefore, aims at investigating the efficiency of lesser-known vegetable oil (watermelon oil) as a machining cutting fluid. The developed watermelon oil was mechanically compared to the traditional mineral oil in turning AISI 1525 steel based on cutting temperature, surface roughness, and chip formation mode. The experiment depended on Taguchi plan with L_8 orthogonal arrangement utilizing feed rate, depth of cut, and cutting speed as critical input parameters. Moreover, the grey relational analysis optimization approach was employed to analyze the parameter impacts and achieve the best possible cutting parameters. The optimization showed that the best combinations of cutting parameters for cutting speed, feed rate, and depth of cut were (355 rev/min, 0.1 mm/rev and 1 mm), and (355 rev/min, 0.1 mm/rev, and 1.25 mm) for watermelon and mineral oils, respectively.

Keywords: AISI 1525 steel; watermelon oil; cutting temperature; cutting fluid; surface roughness; mineral oils.

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1. Introduction

Metal cutting fluids are added to reduce friction and wear between two moving parts (i.e., workpiece and cutting instrument) and thereby improve the tool life expectant and surface quality of the material being machined. Metal cutting fluids also significantly reduce strength and energy consumption; they further wash off the chips, cocool Mineral-based cutting fluids are approximately 85% of the metal cutting fluids used worldwide [2]. Mineral-based cutting fluids have numerous benefits but are adversely affected by health and environmental problems. Studies on workplace exposures to mineral oil-based cutting fluids have shown that technicians in machining industries are at risk of contracting allergenic conditions and diseases. Skin and airborne exposures to cutting fluids have been linked with health issues such as

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