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Experimental analysis on Feed force reduction performance by nano fluid of nano- alumina particles enriched waste coconut oil in wet machining of SAE 1045 steel shaft

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Highlights

- Waste coconut oil is utilized for preparing a novel Nano fluid.
- Feed force at clean and green machining environment.
- Minimum Feed force at 40m/min cutting velocity 0.05 tool feed 1.2mm depth of cut.
- Waste coconut oil based wet machining method reduces the Feed forces averagely by 35.83%

Abstract

Waste utilization is act of clean technology. The multiple times used cooking oils are called as waste cooking oil. This investigation focuses specific type of such vegetable oil (coconut oil) for synthesizing the nanofluid for metal machining purposes Used coconut oils are considered as waste and disposed on open channel and that is against to eco-friendliest. The use of such liquid waste for machining coolant is investigated in this piece of research. Liquid Waste used for creating nanofluid for metal cutting is novel approach. If it is feasible the coolant cost will be significantly reduced and waste such oil disposal will also be reduced. This piece of research work aims to investigate the effect of Nano- alumina based Nanofluid in machining of steel work in the lathe machine. The novelty in this investigation is the used coconut oil is reused as base fluid for preparing the nanofluid. Feed force response is used for optimizing the parameters of the metal removal process. For investigating the effects, the cutting speed varied as 40 to 190 m/min, feed rate of the tool varied as 0.05 to 0.20 mm/rev and the CVD coated tool with 4 different nose radiuses used such as 0.3 mm, 0.6 mm 0.9 mm, and 1.2 mm, L16 orthogonal array involved to form the minimum experimental combinations. The results compared with existing practice of dry machining. The test revels that the feasibility of use of liquid waste of used coconut oil for coolant as in the proposed Nanofluid form. The new fluid based cutting out performed and its process parameters influences were studied, optimized and mathematical model developed for prediction of feed force. The Nanofluid reduced the cutting force averagely 35.83%

Introduction

Feed force is prime importance factor to be considered in the field of machining. [1], [2], [3], [4], [5], [6] investigated the C45 steel machining with cryo-treated HSS tool of M2 grade under dry machining condition. They used L9 experimental plan and optimized parameters with the outputs of Taguchi analysis like signal to Nosie ratio and ANOVA results. The components of cutting force like feed force was high when compared with un treated tool. Found that the treated tool experiences less cutting force than un treated tool [7], [8], [9], [10], [11], [12]. [13] tested the machining performance on Inconel 625 samples, and analysed the cutting force data with advance optimization algorithms and prediction model prepared. [14], [15], [16], [17], [18], [19] analysed the cutting parameters for AISI10140 steel and insisted that at elevated temperature the tool wear and surface roughness are must be taking care so coolant is mandatory to avoid such deterioration and recommended Sunflower oil-based Nano crystalline Graphite enriched fluid in MQL form. The tool profile is

another important thing in the orthogonal cutting So [20] analysed the Rack angle's consequences for machining the Hardened Steel with c-BN Tools in lathe. They compared with strain field with use of Digital Image Correlation. The cutting force model is created in terms of micro sized uncut chip thickness. The relationship between the specific cutting energy and nose radius were established. The alumina Nanoparticles availability is high as well as it can be produced from the aluminium waste scarps from the aluminium industries and it recommends low concentration of alumina nanoparticles for pumped flow in heat exchangers [21]. [22], [23], [24] suggested that along with the twisted tape the metallic nanofluid performance was found appreciable the authors used water as base fluid and thermal performance factor achieved was 2.15. [25] reported that the heat transfer performance of alumina nanofluid found 28% higher when compared to base fluid performance for double tube heat exchanger. In this research the alumina Nanofluid prepared with waste (used) coconut oil for liquid lubricant for machining of steel works. The novelty of this research is the Nanofluid prepared from multiple times used and waste coconut oil for machining coolant. The use of such Nanofluid in flood coolant will permits multiple time usage than MQL. This results also recommended a coolant for machining the steel. But the coolant was synthesized in the route of liquid waste, that is used coconut oil by suspending the alumina nanoparticles.

Section snippets

Materials and methods

The lathe of heavy duty and semiautomatic industrial class machine is employed in this research as shown in Fig. 1. The work material of steel of grade SAE1045 was preferred as it is widely involved in this process and needy research for better outcome. The multiple time used coconut oils for cooking was employed as base fluid. Nano alumina particles suspended by thorough mixing them for 12 h in the ultrasonication type mixing process. The nanofluid kept 48 h and notices no sedimentation. The

Results and discussion

In Table 2, the observations of Feed force in a clean and green machining environment are compared. The findings are statistically confirmed using an independent samples test. Table 3 displays the results of the independent samples test (T-Test) for the statistics of the observations of feed forces on conventional and proposed methods. Green machining was used in green machining whileAl_2O_3Nf means the clean machining was used in Group 2 (intervention group). Table 4 shows that the average Feed

Conclusion

The Clean technological approach was experimented to identify the feasibility for machining the commercial shaft (SAE1045 grade steel). The waste of used coconut oils for cooking was employed as base fluid. In this study, the feed force reduction is the focus, and the clean machining possibilities are studied using Novel Nano fluid, which is made from waste coconut oil and enhanced with Alumina Nano-particles. The test revels that the feasibility of use of liquid waste of used coconut oil for

Declaration of Competing Interest

No funding was received for the curreent research work

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