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Experimentally exploring nano-fluid of alumina nano-particles enriched waste coconut oil effects in cutting zone temperature reduction in motor shaft manufacturing process

G Anbuchezhiyan [a], R Saravanan [a], R. Pugazhenthi [b], V. Rathinam [c], Madhavi Nagireddy [d]

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Abstract

Metal cutting, in general, produces heat, which has an impact on the machining quality of the final job. The surface quality of the shaft is a major factor in fatigue stress shaft failures. Coconut oil or leftover coconut oil from Kerala chips was utilized here. shop The cutting zone temperature response is utilized to optimize the metal removal process's parameters. The cutting speed was changed from 40 to 190 m/min, the tool feed rate was varied from 0.05 to 0.20 mm/rev, and the CVD coated tool was employed with four different nose radius 0.3 mm, 0.6 mm, 0.9 mm, and 1.2 mm, and an L16 orthogonal array was used to generate the minimal experimental combinations. The results were compared to current dry machining procedures. According to the results of the experimental investigation, the proposed Alumina Nanoparticles enriched waste coconut oil based wet machining method reduces the Cutting zone temperature by 27.36 percent on average and ensures that the results do not violate the statistical assumption, it can be recommended for processing SAE 1045 material for shaft manufacturing.

Introduction

In motor shaft applications generally SAE 1045 steel is widely used [1]. 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 cutting zone temperature existed were compared with un treated tool. Found that the treated tool experiences less cutting zone temperature than un treated tool [2]. Tested the machining performance on Inconel 625 samples, and analyzed the cutting zone temperature data with advance optimization algorithms and prediction model prepared [3]. Analyzed 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 [4] analyzed 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 zone temperature 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 [5], [6]. Recommends low concentration of alumina nanoparticles for pumped flow in heat exchangers. [7] suggested that along with the twisted tape the metallic Nano fluid performance was found appreciable the authors used water as base fluid and thermal performance factor achieved was 2.15. [[8], [9], [10]] reported that the heat transfer performance of alumina Nano fluid found 28% higher when compared to base fluid performance for double tube heat exchanger. In this research the alumina Nano fluid prepared with waste (used) coconut oil for liquid lubricant for shaft machining (

Section snippets

Materials and methods

This study makes use of a heavy-duty, semiautomatic industrial class lathe. Steel of grade SAE1045 was chosen as the work material because it is commonly used in this technique and requires more investigation for a better end as shown in Fig. 1. As a base fluid, coconut oils, which have been used for cooking many times, were utilised. Nano alumina particles (Less than 5 Nano-meter sized) were suspended by thoroughly mixing them in an ultrasonication-type mixing method for 12 h. There is no…

Results and discussion

Table 3 shows the *t*-test first portion of the result, which shows that the mean of Cutting zone temperature observations in the conventional way of machining is 273.8750 °C whereas the same was found in the suggested nanofluid machining method at 198.9375 °C. Fig. 2 depicted the same information graphically.

Table 4 shows that the cutting force observations differ substantially between approaches as 74.93750oCwhen the significant value is less than 0.05. That is, the average Cutting zone…

Conclusion

Nanofluid was created from the liquid waste of used coconut oil and evaluated for use as a cooler and cum lubricant in the metal cutting zone while machining SAE1045 steel. The results were compared to green machining procedures that have been in use for a long time. As the current study focuses on converting waste into productive work, this method is referred to as clean machining practise. The machining parameters were improved and a mathematical model was constructed for prediction since the …

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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