



Feed force based optimization of process parameters by bio-nanofluid for machining SAE 1045 steel

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Abstract

Waste generated from shop of Kerala Chips is utilized for preparing a novel Nano fluid. Such Nano fluid can be alternatively used for lubricating purpose for machining the precision shaft. This piece of research work investigating the effect of Nano fluid of Nano Nano-Boracic acid particles concentrated used coconut oil (Waste) in machining shat. The objective is analyzing the machinability performance and optimize process parameters based on the response of Feed force. Used coconut oil (Waste)/ Nano-Boracic acid particles, bio- Nanofluid synthesized and tested in semi-automated heavy-duty lathe. The cutting speed varied between 40m/min to 190m/min, the tool feed rate given in the range of 0.05mm/rev to 0.20mm/rev as finish cut, the tool tip's nose radius varied from 0.30mm to 1.20mm. all three factors considered to feed at 4 levels so Taguchi L16 orthogonal array type experimental design utilized. Taguchi analysis, ANOVA and T -test used for analyzing results, study the factors influences and optimizing the process parameters. The finding was the proposed bio-nanofluid performance is found good and significant. The process parameters optimized and presented the factors and levels contribution in minimizing the feed force in the finishing the steel shaft.

Introduction

The motor shafts are widely manufactured in SAE 1045 steel material due to its unique properties [1] experimented the fatigue strength of the SAE 1045 steel and recommended for motor shafts. [2] evaluated its performance at various cyclic loading and for ensuing the strength on fatigue for such steel. Hence many reliable reports reported about the compatibility of SAE 1045 steel. [3] experimented the tribological properties of such steel and found that SAE1045 steel widely preferred the motor shaft. The importance the work preferred was listed in many literatures [4], [5], [6], [7]. Many researchers used the clean technology-based solution for highly commercial use. [8], [9], [10], [11], [12] utilized the waste in to the useful form. In this research such clean technology is utilized to prepare coolant from the used coconut oil [8], [9], [10]. The waste food containers were melted and reused with reinforced aluminum alloy for some other application. Like the used coconut oils are scraped one. Disposing them is waste. [8], [9], [10], [11], [12] preferred the alumina nanoparticles based nanofluids with water as base fluid, similarly copper oxide nanoparticles suspended water based nanofluid as heat transfer fluid for heat exchanger with twisted tube setup. Nanofluid were used for EN31 steel grinding that is shaft finishing works. [13], [14], [15], [16], [17] handled graphene nanoplatelets as reinforcement agent for enhancing the self-lubricating properties. [18], [19], [20], [21], [22], [23] used the graphene nanoplatelets as a

nanofiller for polymer composites and tested the tribological properties. [24], [25] proposed the boric acid as coolant. So, in this investigation the Nano boric acid particle suspended waste coconut oil-based Nano fluid is utilizing to improve the machinability by reducing the feed force while machining the in SAE 1045 steel shaft.

Section snippets

Materials and methods

Generally, feed force considerably affects the quality of the shaft as well as machinability performance [21], [22], [23], [24], [25]. The feed force can be reduced by increasing the lubrication properties of coolant. The coconut oil basically possesses the lubrication property and widely used lubrication oil. Hence Waste generated from shop of Kerala Chips is used in this investigation. Boracic acid powder is proven compounds of lubrication which exhibited outstanding performance on wear and...

Results and discussion

The observations of Feed force at clean and green machining environment presented comparatively in the Table 2. T – test used to test the observations of both green and clean machining. It can be understood from the Table 4 that the first decision is made based on the significance (p) value. As it is less than 0.05 ($p=0.000$) the observations are classified as significant. That is statistically acceptable. Then the table indicates that $t_{22,933}=34.18000N$. it means that the proposed machining ...

Conclusion

The investigation compared the influence of Novel nanofluid which prepared from the waste of used coconut oil from the shops of 'Kerala Chips' as base fluid and Nano Boracic acid particles as enhancer. The results reveals that the average feed force from 124.5194N to 90.3394N by used of proposed Nanofluid. The clean machining is meant here dry machining. There is no coolant used for machining. The clean machining is used the eco-friendly biodegradable coolant. The use and disposal are not...

CRedit authorship contribution statement

C. Gnanavel: Conceptualization, original draft. **R. Saravanan:** Supervision, Validation, Visualization, Writing. **Avinash Malladi:** Data curation, Writing – review & editing. **C.B. Sekar:** Project administration, Resources, Software. **S. Rajesh:** Investigation, Methodology. **D.K. Nagarathi:** Formal analysis....

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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