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Reconnoitering the influence of nanofluid of Nano- alumina particles enriched waste coconut oil in Machining SAE 1045 shaft on modification Surface finish

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Highlights

- 5nm sized Alumina Nano-particles considered for suspension on the waste coconut oil.
- Variable input parameters are cutting velocity, depth of cut, and feed rate in millimetre.
- Waste coconut oil-based Nano fluid reduced the average Surface Roughness.
- Nose radius factor not influencing in the response of Surface Roughness.

Abstract

Nanofluids plays critical role in thermal engineering. In this research prepare nanofluid for improving the thermal as well as tribological properties for shaft manufacturing. The surface quality is a prime factor in the failures of shaft by fatigue load. Here used coconut oil or waste coconut oil from Kerala chips shop for base fluid. This study looked into the effect of a Nano fluid containing Nano-alumina particles which float on the base fluid ofcoconut oil for the purpose of act as coolant and therebyreducing surface roughness on machined surface. The samples in this study were divided into two groups: group I was the control group, and group II was the experimental group, in which the samples were machined (turned) on a heavy-duty lathe using the green machining process. The intervention group's sample was machined using a clean technology approach using 0.3 percent Nano-alumina particles enriched waste coconut oil based wet machining process. The sample size was estimated to be 12 per group using G-Power 80 percent, while 16 samples observationswere examined tooptimizeprocess parameters using Taguchi analysis and analysing further using ANOVA to validate the statistical model, observation fits, and mathematical model creation. The Surface Roughness encountered under various combinations of similar input conditions for both green machining and Nano- alumina particles enriched waste coconut oil based wet machining methods were compared, and it was discovered that material processing of AE 1045 shaft by graphite enriched waste coconut oil based wet machining method significantly reduced Surface Roughness. 0.006 (p 0.05) is indicated that observation are significant. According to the results of the experimental investigation, the proposed Nano-alumina particles concentrated waste coconut oil based wet machining method reduces Surface Roughness by 39.95% on average and ensures that the results do not violate the statistical assumption, it can be recommended to process SAE 1045 material for shaft manufacturing.

Introduction

The surface quality on shaft is a critical parameter which affects its life performance. One of the selective shaft materials is SAE 1045 steel, which is widely utilized in shaft manufacturing. [1] examined with a service load test on an SAE 1045 steel shaft under cyclic loading conditions. [2] The ability to determine fatigue endurance at room temperature was also investigated. [3] looked into SAE 1045 steel's lubricating and wear characteristics. It is clear from these that machining SAE 104 steel shafts is critical. [4] Develop a clean solution for converting recycled food containers into usable aluminium using nanoparticle reinforcement. [5] In surface grinding on EN 31

steel shafts, alumina Nano fluid and copper oxide Nano fluid were used to minimise Feed energy and hence Feed zone temperature. [6] Low concentrations of Nano particles in the heat transfer fluid wasused to improve heat transfer in twin tube heat exchangers, resulting in a more compact design. The alumina Nano particles availability is high as well as it can be produced from the aluminium waste scarps from the aluminium industries [7]. [8] recommends low concentration of alumina nanoparticles for pumped flow in heat exchangers. [9], [10], [11], [12], [13], [14] 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. [15] reported that the heat transfer performance of alumina Nano fluid found 28% higher when compared to base fluid performance for double tube heat exchanger. The alumina Nano fluid was created by utilizing waste (multiple times used) coconut oil as a liquid lubricant to shaft cutting in this study.

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Materials and methods

The improvement of surface quality was the primary focus of this investigation, which was carried out at Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai, using a research facility of a high precision heavy duty (5HP) lathe (refer Fig. 1). The facility has a high degree of machining accuracy and can work at eight different speeds ranging from 32 to 1200rpm, as well as 18 distinct automated feed conditions (0.05 to

Results and discussion

In Table 2, the Surface Roughness observations in a clean and green machining environment are compared. The findings are statistically confirmed using an independent samples test. T-Test results of significance, output of statistics about the samples machined by two different methods are shown in Table 3. Green machining was used in Green machining (conventional practice) while clean machining was used

in Al_2O_3 NF (experimental group). Table 3 shows that the average surface roughness

Conclusion

This study looked into the prospects of using a novel nanofluid made from waste coconut oil and enhanced with alumina for clean machining. 0.006 ($p<0.05$) is a significant value. According to the results of the experimental investigation, the proposed method reduced Surface Roughness by 39.95% on average. It can be recommended to process SAE 1045 material for shaft manufacturing. As a result, the concept was put to the test in the machining of an SAE 1045 shaft under flood cooling conditions.

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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