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Comparing green Machining and clean technology based Machining for tool wear reduction in Machining SAE 1045 steel

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Abstract

The shafts of machines and motors are manufactured in Lathe and precision shaft machining requires costly cooling methods like Minimum Quantity Liquid coolant, cryogenic cooling or high-cost artificial coolant. On other hand some soft requires CNC machining for meeting the requirements. The machinability performance can be measured with respect to tool wear. If tool wear increases its affects surface quality. Here used coconut oil or waste coconut oil (WCCO) with Nanoparticles of Acidum Boricum for machining the precision shaft and measured tool wear responses to measure and optimize the machining performance. The conventional green machining and proposed nanofluid machining with proposed nanofluid performance compared. Taguchi L16 experimental deign employed with three factors varied at four levels. Cutting Vel. (40, 90, 140 and 190 m/min), Tool Feed (0.05, 0.10, 0.15 and 0.20 mm/rev) and The PVD coated insert used with Nose Radius (0.30, 0.60, 0.90 and 1.20 mm). The observation of both group of experiments statistically tested with independent samples test. The proposed method outperformed. Secondly the process parameters optimized with Taguchi analysis and further analyzed. Thirdly the mathematical model developed with ANOVA. This investigation focusses a passive technique of improving the flood cooling by use of biodegradable nanofluid as well as aimed to support the clean technology by identifying further use of WCCO.

Introduction

Tool wear is very important measure of performance in orthogonal machining. Because the Finishing of shaft machining and material removal rate are depending on the tool wear. EN31 steel face milling was investigated with green machining, near dry machining (MQL), wet machining, air cooling with tungsten carbide tool inserts. The authors L18 mean based Taguchi method (ANOM) and analysis of variance also used for optimization, mathematical model developed. MQL reduced the flank 5.29% than flood cooling [1], [2] investigated dry turning tool wear performance for machining AISI 52,100 steels. The experimental design and optimize the process parameters with use of response surface methodology. The authors vary only process inputs like cutting velocity, nose radius of the tool insert used, feed rate [3]. Tool wear was reduced up to 0.052 mm and there by obtained minimum surface roughness of 2.967 µm. the statistical model R^2 for surface roughness was 0.9921 and 0.9876 for tool wear. As R^2>0.95 indicated significant agreement between experimental results and model predictions [4], [5], [6], [7], [8], [9] suggested the mechanical fitness through the fatigue life of the steel grade SAE 1045 for meeting the requires of dual rotating shaft

[10], [11], [12], [13], [14], [15] ensured the endurance of fatigue loading capability in both the uniform speed and variable speed also investigated. Variety of steel works were investigated by various researchers and comparatively the steel of SAE 1045 is found fit for shock loading type applications [16], [17], [18], [19], [20], [21], [22], [23], [24], [25] ensured the tribological properties of SAE 1045. [26] preferred the water-based alumina nanofluid for as heat transfer fluid applications. This research aimed to support clean technology by identifying the alternate use of waste (used) coconut that is the coconut oil after used for preparing banana chips in the 'Kerala chips' at Chennai. The tool wear reduction by use of oil with Nano Acidum Boricum particles suspension in the flood cooling method. This investigation is novel and did not considered so far for the similar application.

Section snippets

Experimental setup

Tool wear minimization in SAE 1045 steel shaft manufacturing is prime objective of this study. This investigation utilized general purpose but semiautomated 8 speed heavy duty lathe (Fig. 1). The steel samples obtained from the industrial shaft manufacturers at Ambattur Chennai and prepared the specimens.…

Work and tool material

The steel samples obtained from the industrial shaft manufacturers at Ambattur Chennai and prepared the specimens.…

Nanofluid coolant

The used coconut oil pre-processed for cleanliness and free from foreign…

Results and discussion

The samples which machined without cooling environment is called as green machining or dry machining. Same experimental input conditions employed for both machining conditions. The observations of surface roughness of the samples from the dry machining and nanofluid based clean machining or wet machining were consolidated in the Table 2 and the same was used. T -test used for conducting the statistical test on observations for both machining practices. Table 3 illustrates differences in average …

Conclusion

The low cost nanofluid based machining was experimented and discussed. The result discloses that the proposed clean manufacturing method considerably reduced the Tool wear. The followings are silent points.

- The T test results reveals that the observations are statistically significant and value of P=0.028 which is less than 0.05.…
- The R^2 value is found 99.89% which indicates that good agreement between the predicted value with use of proposed mathematical model with experimented results.…
- 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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