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Review Paper on - Evaluation of Cutting Fluid Mixed with Nanoparticles on Surface Roughness and Tool Wear

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Abstract: ***Cutting fluids of various types are usually employed to control the heat generated in machining. The continued application of conventional cutting fluids is being challenged by the need to reduce overall volume of fluids, minimize health risks. Functions such as improving tool life and machining process efficiency, enhancing surface integrity are obtained by using cutting fluids. While the effect of formulated cutting fluids on surface roughness and tool wear in machining SS202 with coated carbide were investigated and compared with conventional oil-in-nanoparticles emulsion cutting fluid. Mineral, synthetic and semi-synthetic cutting fluids involve in the ecological cycle with air, soil and water and their toxicity effect damages the ecosystem. By study of various research papers we concluded that to overcome problems in machining, vegetable based cutting fluids can be used to optimize machining conditions but we choose coconut oil due to its thermal and oxidative stability which is higher than that of other vegetable based cutting fluids. We used coconut oil while machining of stainlesssteel 202 material with coated carbide tool and analysis of material and tool.***

Keywords: Coconut oil, CNC lathe machine, Nano solid lubricant, Tool wear, Surface roughness, Tool-Workpiece interface temperature, Cutting speed, Feed, Depth of cut.

1. Introduction

Machining is one type of process in which a fraction of raw material is cut into a desired final shape and size with good surface finishing by a controlled material-removal process. Machining is a part of the manufacturing of many metal products, but it can also be used on materials such as wood, plastic, ceramic and composites.

Cutting fluids have been widely used in machining operations in efforts to increase cooling and lubricity, and as a result enhance tool life, reduce process variability, etc. However, over the last decade, it has become apparent that fluid-related decisions have all too frequently been based upon industrial folklore rather than knowledge-based quantitative evidence. Recently there has been a change in this situation, in part driven by the fact that costs associated with fluid use often constitute between 7% and 17% of total production costs, as compared to 4% for tooling costs. Now-a-days cutting fluids are used as coolants while performing any machining operation on machines. The use of cutting fluids also helps in lubricating the cutting process primarily at low cutting speeds. Cooling the workpiece primarily at high cutting speeds. Flushing chips away from the cutting zone.

1.1 Problem Definition

The continued application of conventional cutting fluids is being challenged by the need to reduce overall volume of fluids, minimize health risks and bio-confirmation. Functions such as improving tool life and machining process efficiency, enhancing surface integrity are obtained by using cutting fluids.

While the effect of formulated cutting fluids on surface roughness and tool wear in machining SS202 with coated carbide were investigated and analyzed.

Mineral, synthetic and semi-synthetic cutting fluids involve in the ecological cycle with air, soil and water and their toxicity effect damages the ecosystem.

In the reviewed papers researchers suggested that to overcome problems in machining, vegetable based cutting fluids (coconut oil) can be used to optimize machining conditions. We used coconut oil while machining of SS202 material with coated carbide tool.

1.2 Objectives

We can achieve the following objectives:-

- To evaluate the machining on SS202 material using coconut oil mixed with aluminum oxide nanoparticles by measuring surface roughness and tool wear rate.
- To create an eco-friendly environment for the worker during machining process by using oil as a cutting fluid.
- Analysis of the material by Mat lab (taguchi's doe).
- To increase the tool life.
- To improve surface roughness.

1.3 Components

1) **Coolant:** Coconut oil is being used as one of the cutting fluids in this work because of its higher thermal conductivity and oxidative stability. It has been found

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that coconut oil improves the tool life with a better surface finish for machining at low and medium cutting speed.

2) **Material of workpiece:** The stainless steel is selected as the material of the workpiece for performing turning operation on the CNC lathe machine. AISI 202 stainless steel is an austenitic stainless steel formulated for primary forming into wrought products. 202 is the AISI designation for this material. S20200 is the UNS number. Additionally, the British Standard (BS) designation is 284S16.It has a moderately low base cost among wrought austenitic stainless steels. In addition, it can have a moderately high tensile strength and has a moderately low embodied energy. Grade 202 stainless steel is a type of Cr-Ni-Mn stainless with similar properties to Grade 302 stainless steel. The toughness of grade 202 at low temperatures is excellent. It is one of the most widely used precipitation hardening grades, and possesses good corrosion resistance, toughness, high hardness, and strength.
3) **Nanoparticles:** Nano-sizes aluminum oxide (Nano sized alumina) occurs in the form of spherical or nearly spherical Nano particles, and in the form of oriented or undirected fibers. Properties, of the final material, defined as the set of properties of the solid Aluminum oxide and specific properties of nanostructures. Properties of nanoscale colloidal alumina particles:-
   - Small diameter of the particles/fibers (2-10 nm).
   - High specific surface area (>100 m^2/g).High defectiveness of the material surface and specific structure of the nanoparticles (the volume and size of pores, degree of crystallinity, phase composition, structure, and composition of the surface — modification possibility).
   - The properties of the nanoscale fibers of aluminum oxide are the ratio of length-diameter about 20,000,000:1.
   - A high degree of orientation of the fibers. The weak interaction of the fibers among themselves. Absence of surface pores. High surface concentration of hydroxyl groups.
4) **Tool Material:** The capability and overall performance of the cutting tools depend upon; the cutting tool materials, the cutting tool geometry, proper selection and use of those tools, the machining conditions and the environments.

2. Work Plan

A total of 3 workpiece of SS202 are selected for performing turning operation on a CNC Lathe Machine using coated carbide tool. On first workpiece, turning operation would be done without using any coolant, on second workpiece, turning operation would be done using coconut oil as coolant and on last workpiece, and turning operation would be done using coolant which is mixture of coconut oil with 2% aluminum oxide nano-particles by weight.

- While doing machining on workpiece, the following things are going to measured i.e. the tool-workpiece temperature, surface roughness of the workpiece after doing turning operation and also measure tool wear with increase in cutting speed and feed simultaneously.
- After getting the readings of the above said things, optimization of reading to be performed in MATLAB software using the taguchi's doe principle.

3. Result

The result which will be obtained after performing the machining of workpiece will be:-

- Variation in surface roughness with change in cutting speed, depth of cut and feed;
- Variation in tool wear with change in cutting speed, depth of cut and feed;
- Variation in tool-workpiece interface temperature with change in cutting speed, depth of cut and feed.

MAT Lab:-

- Variation of cutting temperature with speed.
- Variation of cutting temperature with feed rate.
- Variation of tool flank wear with cutting speed.
- Variation of tool flank wear with depth of cut.
- Variation on surface roughness with feed rate.
- Variation on surface roughness with depth of cut.

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