

A Review on Sustainable Eco-friendly Cutting Fluids

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Abstract: In machining industries, cutting fluids plays a vital role as they are used to improve machinability and to have better productivity. Using mineral oil as cutting fluids has a negative impact on environment and also on the operator's health as it is non-bio-degradable and hazardous. Research work is been carried out for replacing these mineral oils by bio-degradable oils. The few vegetable oils possess characteristics of good cutting fluids such as viscosity, heat absorption capacity, fatty acid chains, biodegradability, non-toxicity etc. This paper reviewed research works carried out on different types of eco-friendly oils used as cutting fluids for different machining operations and on different materials. The effects of using different vegetable oils as cutting fluids on machining parameters have been discussed. From the results, it was observed that, the bio-oils possesses properties of good cutting fluids and has shown better results in terms of improving machining efficiency when compared to mineral or petroleum oils. These bio-oils possess better sustainability and biodegradability. Hence also called as eco-friendly cutting fluids. There is more scope for modification of bio-oils by having some additives and nano particles to have improved lubricating properties.

Keywords: Bio-degradable oils, Cutting fluids, Flooded cooling, Machining operations, Mineral oils, MQL

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1. Introduction

The key objective of any Industries is to deliver finished goods as per the customers' requirements. In machining Industries, to deliver finished goods, raw metals are processed under various machining operations. During machining, the friction takes between work piece and tool which will lead to increase in heat at the machining zone. The heat generated will lead to tool wear and increases surface roughness of work piece. To minimize this heat generation between work piece and tool, cutting fluids were introduced in early 1900 (1984) which was reported by F.Taylor i.e. application of large amount of water as cutting fluid can increase 33% of cutting speed without affecting the tool life (Jeevan & Jayaram, 2018).

Later, lot of research works were carried out on different types of cutting fluids and mineral or petroleum based oils as cutting fluids. Majority of industries were using petroleum based oils as cutting fluids for machining. But, it was observed that, the use of mineral based cutting

fluids had negative impact on health related issues of operators like skin diseases, as well as environment pollution because of their non-biodegradability. To overcome these problems and to have green manufacturing system, the research work has been focused on eco-friendly cutting fluids. The property of eco-friendliness and biodegradability was found in vegetable based oils and therefore the vegetable based oils have gained attention to use as cutting fluids.

2. Literature Review

2.1. Vegetable based cutting fluids

Many researchers were started working on vegetable based oils which can be used as cutting fluids and have potential to replace mineral based oils. Lawal et. al. (2011) reviewed the application of vegetable oils as metalworking fluids in machining ferrous metals. The paper highlighted the advantages and disadvantages of