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Study on tribological characteristics of Bio-Lubricant formed from Brassica napus oil

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Abstract

Crude oil price is increasing day by day and the same time the universe's crude oil treasury is also reducing. The extensive use of crude oil derived products affects severely the environment worldwide. The replacement of conventional lubricating oil with vegetable oils-based bio-lubricants would be a promising option. Bio-related compounds are potential alternative lubricants because of their poor toxicity, fair lubrication, high flash point, improved machine life, good utilization, good friction coefficients, clear characteristic properties of multi-grade goods, lower rate of evaporation, and low environmental pollution which secured the environment from pollution. Therefore, green commodities like Brassica napus oil were introduced and their application investigated. It is essential to concentrate on renewable oils as lubricants to better understand the environmental and risk issues surrounding lubricants. This study is primarily concerned with assessing Brassica napus oil in accordance with the ASTM standard and proposing a 10% blend in order to maximize the lubricating properties of the oil.

Introduction

The combustion of fossil fuel produces harmful emissions which has adverse effect on human being and environment [1]. These issues have raised a serious concern about climate change. Government of India has target to replace 50% fossil fuel with renewable fuels before the year 2030 [2]. Lubrication process is one of the most significant activities of any internal combustion engine to reduce the friction power loss. Lubricating oil is one of the petroleum base product which is used to reduce friction between the components which has relative motion [3]. Conventional lubricant is obtained as one of the products of distillation of crude oil. However, the availability of crude oil is limited and exists in certain region of the world. One of the major consumers of lubricating oil is automobile industry. Due to growing environmental concern and strict regulations, automobile industries are also looking environment friendly lubricants. Bio-based lubricants are potential substitute due to their biodegradable, non-toxic, high flash point, high viscosity index, improved machine life, lower rate of evaporation, and good lubricating properties etc. Their inherent structural similarity with natural, non-toxic, economical and environmental characteristics are very close to those of long-chained hydrocarbons, and hence highly potential candidate to substitute the conventional petroleum based lubricating oil [4]. The bio-based lubricating oils can be derived through different sources including both edible and non-edible vegetable oil. Most of the research works have been conducted with the use of these oils as alternative to

fossil fuels [5], [6]. A very few research reports are available on the use of these oils as lubricants. However, there is low interest on the manufacturing of bio-based lubricants on a commercial basis.

Bio-based lubricants can be derived through variety of feedstocks such as plant oil and animal fats. There are different types of edible and non-edible oil seeds available, which differs based on geographical location [7]. The bio-based lubricants can be used in their original form. Few challenges with bio-based lubricants such as oxidation stability, bad smell, low temperature limitations etc. have been reported in past. These issues can be solved by transesterification process or Estolide formation process [8]. Bio-based lubricant exhibits many excellent properties in comparison with conventional lubricants which offers many technical advantages. The use of bio-based lubricants will not only help to lower the dependency on crude oil but also help the economy. The technical development of automobile also depends upon on performance of lubricants. The benefits of using bio-based lubricants are shown in Fig. 1.

In recent time, the use of renewable and environmentally sustainable lubricants is encouraged in response to increased environmental concerns. Many bio-based lubricants such as soybean oil, palm oil, jatropha oil, fish oil etc. have been used as sole or blended with mineral oil [9]. The use of raw vegetable oil as lubricating oil creates lot of issues such as poor oxidation stability and unstable thermal properties due to availability of more amount of unsaturated fatty acid. These issues can be resolve by some chemical treatment. The different treatment processes of raw vegetable oil are shown in Fig. 2.

Different tribological properties have been studied when bio-based lubricants were used. Bio-based lubricants are versatile and provides several benefits from traditional mineral oils in terms of costs and other enhanced properties. Some researchers have also studied on the production of lubricating oil through different bio-seeds and waste biomass due to environmental concerns and recommended as a potential solution. Brassica napus oil is one of the promising substitutes of mineral oil as it is renewable, biodegradable, and environmental benign.

Bio-lubricants are getting attention due to their sustainable and environmentally gracious properties; being resulting from the feedstocks from the vegetable oils. Certainly, the potential for bio-lubricants to ultimately put back conventional lubricants is at present viewed in the literature as a genuine opportunity. The current investigation is aimed to find the different lubricating properties of Brassica napus oil's when it is blended by 10 to 40% with base lubricant oil.

Section snippets

Bio-based lubricant’s characteristics

Brassica napus is one of the non-conventional oil’s crops, which is third largest oil seed crop, can be used as alternative to base lubricants. The oil contains different saturated and unsaturated fatty acids. The current investigation is focused its use as lubricant. The different important properties of Brassica napus oil are discussed in following sections.…

Wear characteristics

Wear is the harmful, gradual removal rate from the source material at solid surface. There are various causes to wear it may be erosion or corrosion etc. The wear of metals occurs by plastic dislocation of surfaces and near-surface matter and by impassiveness of atoms that form wear fragments. The wear rate of minimum 90L10BO, compared with 100% Lube oil, is shown in Fig. 8. This is due to the capacity of the oils to adsorb on the surface and form a crust, while the polar head adheres to the…

Conclusion

The rise in energy demand, depletion of fossil fuel as well as major environmental hazards due to combustion of fossil fuel are the major challenges of current time. Also, in the current scenario, the consumption of high amount of lubricating oil has noticed due to rise in number of automobile vehicle. To solve the issue, bio-based lubricants are

being developed. Researchers are interested in vegetable oil resources to obtain lubricating oi, because vegetable oil is a renewable resource.…

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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> ...It is a suitable candidate for generating biolubricants. This oil contains saturated and unsaturated oil (Balambica et al., 2022). Brassica napus oil is rich in oleic acid (Jan and Cavallaro, 2013) Biolubricants obtained from the Brassica napus oil have a viscosity of 10.65 mm2/s at the temperature 100 ° C (Nogales-delgado, 2021b)....

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