

# International Journal of Innovative Research in Science, Engineering and Technology

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## Thermal and Fluid Analysis of Alternative Diesel Engine Lubrication Oil

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**ABSTRACT:** Chemically modifying vegetable oils to produce an alternative to petroleum-based materials is one of the most important emerging industrial research areas today because of the adverse effects of petroleum products on the environment and the shortage of petroleum resources. Bio lubricants, bio plasticizers, non-isocyanate polyurethanes, bio fuel, coating materials, bio composites, and other value-added chemicals can easily be produced by chemically modifying vegetable oils. This short review discusses using vegetable oils or their derivatives to prepare lubricants that are environmentally safe. Chemically modified vegetable oils are generally used as base fluids to formulate environmentally friendly lubricants reports of their application as sustainable additives have attracted special attention recently because of their enhanced multifunctional performances (single additives perform several functions, i.e., viscosity index improver, pour point depressant, antiwear products) and biodegradability compared with commercial additives. Here, we have reviewed the use of chemically modified vegetable oils as base fluids and additives to prepare a cost-effective and environmentally friendly lubricant composition.

**KEYWORDS:** vegetable oil; triglyceride; chemical modification; bio lubricant; base stock; additive.

### I. INTRODUCTION

Producing materials from renewable feed stocks that are useful to various industrial fields as alternatives to depleting petro-originated resources has attracted considerable attention in recent years. Vegetable oils (VOs) have low eco toxicity and are readily available and biodegradable. They can be used to produce a variety of environmentally safe chemicals that can compete or even surpass the performance of the existing petroleum-based materials. Materials obtained from vegetable oils (edible or non edible), such as cotton oil, sunflower oil, neem oil, rapeseed oil, and castor oil, have an application in various fields, including foods, fuels, bio lubricants, coatings and paints, adhesives, cosmetics, pharmaceuticals, plasticizers, and construction materials. This review highlights the application of vegetable oils to formulate bio lubricants.

Lubricants are the materials (generally liquids, but may be solids or semi-solids) used to lubricate machinery parts to reduce friction and increase their lifetimes. Lubricants have a significant role in teratology, and are formulated from a range of base fluids and chemical additives. Depending on the nature of the base oil, which is the main component of lubricants, they might be categorized as mineral (petroleum origin), synthetic (e.g., poly alpha olefins, poly alkaline glycols, synthetic esters, silicones, etc.), or as a bio lubricant/green lubricant. Mineral lubricants, currently the most commonly used commercial lubricants around the world, are a complex mixture of paraffinic (linear/branch), olefin, naphthenic, and aromatic hydrocarbons of 20 to 50 carbon atoms. They are quite stable (higher oxidation stability) and less expensive than other types of lubricants.

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However, mineral lubricants have poor biodegradability and release toxic materials into the environment. As compared with vegetable-based lubricants, mineral lubricants have lower viscosity indices, higher boundary friction coefficients, and a higher volatility. Moreover, the non-renewable petroleum resources used to produce mineral lubricants are depleting. In order to address the problems associated with petro-based mineral lubricants, the demand to produce environmentally acceptable lubricants from renewable resources is increasing.

Lubricant additives that are produced from petroleum resources such as acrylates and zinc dialkyldithiophosphates (ZDDP) create many materials that are harmful to the environment, including heavy metals and sulphur compounds.

The friction modifier, such as molybdenum dithiocarbamate complexes used in solid lubricants, releases heavy metals and sulphur compounds, and their activity decreases with fluid aging. Therefore, interest in research on bio-based lubricant additives is also increasing. Synthetic lubricants have advantages over mineral lubricants; such as they are environmentally benign, have a higher viscosity index, lower pour points, and higher oxidative stability.

## II. LITERATURE REVIEW

**2.1 TITLE:** Physical characteristics, Chemical composition and Distribution of constituents of the Neem seeds (*Azadirachta indica* A. Juss) collected in Senegal

**AUTOHR:** DiedhiouDjibril, Faye Mamadou, Vilarem Gérard, Mar-DiopCodouGeuye, Sock OumarandRigal Luc

**PUBLISH YEAR :** 2015

Neem seeds (*Azadirachta indica* A. Juss) collected in southwest Senegal were characterized. The physical characterization revealed an average seed weight of 0.28 g with 50.89% of kernel and 49.11% of hull. These seeds contain 29.27±0.06% of lipids, 12.10±0.32% of proteins and 43.98±2.67% of parietal constituents (celluloses, hemicelluloses and lignins) with 30.33±1.12% of cellulose containing 68.96% of fibers. The study of the constituent(s) distribution showed that 96.82% of the lipids and 92.20% of the proteins are localized in the kernel, while 92.22% of the parietal constituents are localized in the hull. The azadirachtin is localized in the kernel (99.35%). Neem seeds also contain 14.99±0.37% of hydrosoluble, 0.11±0.05% of polyphenols and 0.76‰ of essential oil. The composition of the proteins revealed 17 amino acids with the predominant compound being glutamic acid (23.65%). The oil fatty acids are oleic acid (41.91±0.69%), linoleic acid (19.59±0.44%), stearic acid (18.71±0.46%) and palmitic acid (15.59 ± 0.27%)

**2.2 TITLE:** An Overview on Manufacturing of Lubricating Greases and Testing Processes

**AUTOHR:** BhupenderSingh ,Gajram Singh , S. C. Sati, SudhirSachdeva

**PUBLISH YEAR :** 2015

Lubricating grease is one of the basic needs of Industrial and Received 1 January 2014Automobile sector to upgrade the durability and dependability, Received in revised formserviceability and service efficiency of mechanisms, machines and 10 January 2014equipment. Grease is manufactured through various processes with the Accepted 20 January 2014help of pressure vessels or open cooking kettles under high temperature Available onlineFebruary 2014 and pressure. Lubricating greases were manufactured on the basis of application required. Grease-making can be a long, energy-consuming,

**2.3 TITLE:** Synthesis and Study of Properties of Biolubricant based on *Moringaoleifera* Oil for Industrial Application

**AUTOHR:** Francis UchennaOzioko

**PUBLISH YEAR :** 2014

Blends of *Moringaoleifera* oil with conventional lubricant, SAE 40 were studied for industrial application. The *Moringaoleifera* seed oil was extracted using soxhlet extractor. The oil was filtered, degummed and blended with SAE 40 in different percentage from 10% - 40% by volume using a magnetic stirrer. The viscosity and density properties as well as wear rate property using aluminium pin against carbon steel disc were studied. In cases of 40°C and 100°C, viscosity of MOL 10 satisfied SAE 30 and SAE 40 grade requirements. Next to it was MOL 20 which satisfied SAE 30

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grade requirement at 40°C and 100°C but did not meet SAE 40 grade requirement at both temperatures. In case of 100°C, the biolubricants MOL 30 and MOL 40 did not meet the SAE requirements.

**2.4 TITLE:** Formulation and physico-chemical characteristics of biolubricant

**AUTOHR:** D.I Ahmed, S. Kasolang, R.S. Dwyer-Joyce K.I. Sainan, N.R. Nik Roselina

**PUBLISH YEAR :** 2014

The interest in bio lubricant has grown over the past years due to its promising benefits such as environment-friendly, renewable, less toxic and readily biodegradable. In recent years, many studies explored the potential of bio lubricants for industrial applications. This study was dedicated to develop a new formulated bio lubricant having viscosity fitted to a commercialized industrial lubricant. From nine different samples, the blend having a mixture of 52.70 % (wt) soybean oil, 40.55 % (wt) mineral oil, and 6.75 (%) additives produced the best results for the viscosity fitting. The selected blend was also tested for physico-chemical characteristics. The results on viscosity index, pour point, and flash point indicate positive characteristics for application in wider temperature change, cold weather, and safer transportation. Outcome of degradation test was also promising

## III. NON EDIBLE OILS

### 4.1 NEEM OIL.



Fig 1 Neem oil

Neem oil is a vegetable oil pressed from the fruits and seeds of the neem (*Azadirachta indica*), an evergreen tree which is endemic to the Indian subcontinent and has been introduced to many other areas in the tropics. It is the most important of the commercially available products of neem for organic farming and medicines.

Neem oil varies in color; it can be golden yellow, yellowish brown, reddish brown, dark brown, greenish brown, or bright red. It has a rather strong odour that is said to combine the odours of peanut and garlic. It is composed mainly of triglycerides and contains many triterpenoid compounds, which are responsible for the bitter taste. It is hydrophobic in nature; in order to emulsify it in water for application purposes, it is formulated with surfactants.

Azadirachtin is the most well known and studied triterpenoid in neem oil. Nimbin is another triterpenoid which has been credited with some of neem oil's properties as an antiseptic, antifungal, antipyretic and antihistamine. Neem oil also contains several sterols, including campesterol, beta-sitosterol, and stigmasterol.

### 3.2 castor oil.



Fig 2 castor oil

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Castor oil is a vegetable oil pressed from castor beans. The name probably comes from its use as a replacement for castoreum.

Castor oil is a colourless to very pale yellow liquid with a distinct taste and odour. Its boiling point is 313 °C (595 °F) and its density is 961 kg/m<sup>3</sup>. It is a triglyceride in which approximately 90 percent of fatty acid chains are ricinoleates. Oleate and linoleates are the other significant components.

Castor oil and its derivatives are used in the manufacturing of soaps, lubricants, hydraulic and brake fluids, paints, dyes, coatings, inks, cold resistant plastics, waxes and polishes,

Castor oil is well known as a source of ricinoleic acid, a monounsaturated, 18-carbon fatty acid. Among fatty acids, ricinoleic acid is unusual in that it has a hydroxyl functional group on the 12th carbon. This functional group causes ricinoleic acid (and castor oil) to be more polar than most fats. The chemical reactivity of the alcohol group also allows chemical derivatization that is not possible with most other seed oils. Because of its ricinoleic acid content, castor oil is a valuable chemical in feedstocks, commanding a higher price than other seed oils.

### 3.3 LINSEED OIL.



Fig 3 Linseed oil

Linseed also known as flaxseed oil or flax oil, is a colourless to yellowish oil obtained from the dried, ripened seeds of the flax plant (*Linum usitatissimum*). The oil is obtained by pressing, sometimes followed by solvent extraction. Linseed oil is a drying oil, meaning it can polymerize into a solid form. Owing to its polymer-forming properties, linseed oil can be used on its own or blended with combinations of other oils, resins or solvents as an impregnator, drying oil finish or varnish in wood finishing, as a pigment binder in oil paints, as a plasticizer and hardener in putty, and in the manufacture of linoleum. Linseed oil use has declined over the past several decades with increased availability of synthetic alkyd resins—which function similarly but resist yellowing.

Linseed oil is a triglyceride, like other fats. Linseed oil is distinctive for its unusually large amount of  $\alpha$ -linolenic acid, which has a distinctive reaction with oxygen in air. Specifically, the fatty acids in a typical linseed oil are of the following types:<sup>[3]</sup>

The triply unsaturated  $\alpha$ -linolenic acid (51.9–55.2%),

The saturated acids palmitic acid (about 7%) and stearic acid (3.4–4.6%),

The monounsaturated oleic acid (18.5–22.6%),

The doubly unsaturated linoleic acid (14.2–17%).

Having a high content of di- and tri-unsaturated esters, linseed oil is particularly susceptible to polymerization reactions upon exposure to oxygen in air. This polymerization, which is called "drying", results in the rigidification of the material. The drying process can be so exothermic as to pose a fire hazard under certain circumstances. To prevent premature drying, linseed oil-based products (oil paints, putty) should be stored in airtight containers.

### 3.4 RAPESEED OIL.



Fig4 rapeseed oil.

Rapeseed (*Brassica napus*), also known as rape, oilseed rape, and, in the case of one particular group of cultivars, canola, is a bright-yellow flowering member of the family Brassicaceae (mustard or cabbage family), cultivated mainly

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for its oil-rich seed. It is the third-largest source of vegetable oil and second-largest source of protein meal in the world. Rapeseed flowers are yellow and about 17 mm (0.67 in) across.

They are radial and comprise of four petals in a typical cross-form, alternating with four sepals. They have indeterminate racemose flowering starting at the lowest bud and growing upward in the following days. The flowers have two lateral stamens with short filaments, and four median stamens with longer filaments whose anthers split away from the flower's center upon flowering.

The rapeseed pods are green and elongated siliquae during development that eventually ripen to brown. Each pod has two compartments separated by an inner central wall within which a row of oilseeds develop. The oilseeds are black and hard at maturity.

## IV. EXPERIMENTAL WORK

### 4.1. Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester ASTM D92 - 18



Fig 5 astm D92-18

#### 1. Scope

- This test method describes the determination of the flash point and fire point of petroleum products by a manual Cleveland open cup apparatus or an automated Cleveland open cup apparatus.
- The precisions for fire point were not determined in the current interlaboratory program. Fire point is a parameter that is not commonly specified, although in some cases, knowledge of this flammability temperature may be desired.
- This test method is applicable to all petroleum products with flash points above 79 °C (175 °F) and below 400 °C (752 °F) except fuel oils.
- This test method may occasionally be specified for the determination of the fire point of a fuel oil. For the determination of the flash points of fuel oils, use Test Method D93. Test Method D93 should also be used when it is desired to determine the possible presence of small but significant concentrations of lower flash point substances that may escape detection by Test Method D92. Test Method D1310 can be employed if the flash point is known to be below 79 °C (175 °F).

#### 2. Significance and Use

- The flash point is one measure of the tendency of the test specimen to form a flammable mixture with air under controlled laboratory conditions. It is only one of a number of properties that should be considered in assessing the overall flammability hazard of a material.
- Flash point is used in shipping and safety regulations to define flammable and combustible materials. Consult the particular regulation involved for precise definitions of these classifications.
- Flash point can indicate the possible presence of highly volatile and flammable materials in a relatively nonvolatile or nonflammable material. For example, an abnormally low flash point on a test specimen of engine oil can indicate gasoline contamination.
- This test method shall be used to measure and describe the properties of materials, products, or assemblies in response to heat and a test flame under controlled laboratory conditions and shall not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions.

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However, results of this test method may be used as elements of a fire risk assessment that takes into account all of the factors that are pertinent to an assessment of the fire hazard of a particular end use.

- The fire point is one measure of the tendency of the test specimen to support combustion.

## 4.2. Standard Test Method for Kinematic Viscosity of Transparent ASTMD445-06



Fig 6 astm D445-06

### 1. Scope

- This test method specifies a procedure for the determination of the kinematic viscosity,  $\nu$ , of liquid petroleum products, both transparent and opaque, by measuring the time for a volume of liquid to flow under gravity through a calibrated glass capillary viscometer. The dynamic viscosity,  $\mu$ , can be obtained by multiplying the kinematic viscosity,  $\nu$ , by the density,  $\rho$ , of the liquid. Note 1 For the measurement of the kinematic viscosity and viscosity of bitumens, see also Test Methods D 2170 and D 2171.

ISO 3104 corresponds to Test Method D 445.

- The result obtained from this test method is dependent upon the behavior of the sample and is intended for application to liquids for which primarily the shear stress and shear rates are proportional (Newtonian flow behavior). If, however, the viscosity varies significantly with the rate of shear, different results may be obtained from viscometers of different capillary diameters. The procedure and precision values for residual fuel oils, which under some conditions exhibit non-Newtonian behavior, have been included.
- The range of kinematic viscosities covered by this test method is from 0.2 to 300 000 mm<sup>2</sup>/s (see Table A1.1) at all temperatures (see and ). The precision has only been determined for those materials, kinematic viscosity ranges and temperatures as shown in the footnotes to the precision section.
- The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.
- This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

### 2. Significance and Use

- Many non-petroleum materials, are used as lubricants, and the correct operation of the equipment depends upon the appropriate viscosity of the liquid being used. In addition, the viscosity of many petroleum fuels is important for the estimation of optimum storage, handling, and operational conditions. Thus, the accurate determination of viscosity is essential to many product specifications.

## 4.3. Standard Test Method for Pour Point of Lubricant Products ASTM D97 - 17b

The pour point of a liquid is the temperature below which the liquid loses its flow characteristics. In crude oil a high pour point is generally associated with a high paraffin content, typically found in crude deriving from a larger proportion of plant material.

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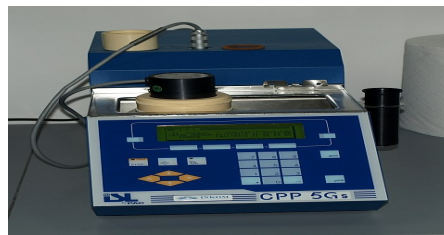


Fig 7 astm D97-17b

## 1. Scope

- This test method is intended for use on any petroleum product.2 A procedure suitable for black specimens, cylinder stock, and nondistillate fuel oil is described in 8.8. A procedure for testing the fluidity of a residual fuel oil at a specified temperature is described in Appendix.
- Several ASTM test methods offering alternative procedures for determining pour points using automatic apparatus are available. None of them share the same designation number as Test Method D 97. When an automatic instrument is used, the ASTM test method designation number specific to the technique shall be reported with the results. A procedure for testing the pour point of crude oils is described in Test Method D 5853.
- This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

## 2. Summary of Test Method

- After preliminary heating, the sample is cooled at a specified rate and examined at intervals of 3°C for flow characteristics. The lowest temperature at which movement of the specimen is observed is recorded as the pour point.

## V. MOTIVATION

Significant interest is focused on improving environmental friendliness, reliability, durability, and energy efficiency in the automotive and machinery industries. Developing new technological solutions, such as The increasing oil prices, the depletion of the crude oil reserve in the world, and the demand to protect the environment against pollution caused by lubricating oils and their uncontrolled spillage have renewed interest in developing and using alternative lubricants. Biolubricant oils are perceived as alternatives to mineral oils because they possess certain natural technical properties and they are biodegradable.

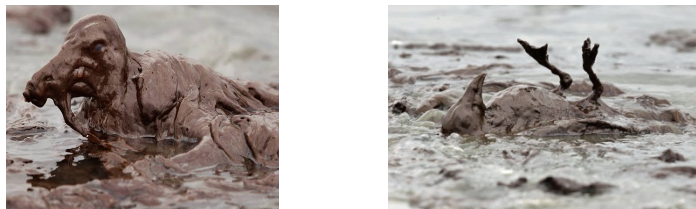


Fig 8 motivation image

## VI. ADVANTAGES

1. Low cost compare to other SAE oils.
2. Easily reliable and easily obtainable

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3. It can use to hydraulic system.
4. It specified use for 4 stroke engine and light vehicle.

## VII. CONCLUSION

This project proves that these non edibles oils can used for engine oils. This multi grade oil used for cooling process in engine instead of using normal synthesis oil with an advantage of low cost. it fulfil the quality standard of SAE(society of automotive engineers) It can used in order light vehicles without any chances and any damage .

In this project analysis first step of alternative engine oil by using non edible oils. If we can update this project with more non edible oils for get more than good result. And we are learn

## VIII. REPORT COPY

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<b>TEST REPORT</b> Page 1 of 1				
Issued To :	SUBMITTED SAMPLE			
H. Thank ismail Mysien S. Venkat Prasad A. Srinivasa Perumal K. Tharavanan				
Fa. Engineering College, Tirunelveli	Date of report : 19/02/2019			
	Received on : 19/02/2019			
	Commenced on : 19/02/2019			
	Completed on : 19/02/2019			
Report Number : 19020122.01				
Sample Description : Neem Oil				
S No	Parameters	Protocol	Unit	Result
1	Fire point	ASTM D 93-08	°C	207
2	Flash point	ASTM D 93-08	°C	198
3	Kinetic Viscosity @ 40°C	ASTM D 445-06	csf	25.4
4	Pour Point	ASTM D 97-17b	°C	+8
Verified By		For CVR LABS PVT. LTD.  Authorized Signatory E. JANAKI Asst. Quality Manager		
***** END OF REPORT *****				
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<b>TEST REPORT</b>		<b>SUBMITTED SAMPLE</b>		
Issued To: H.Thank ismail Mydeen, S.Venkai Ramani, S.Srinivasa Perumal, K.Tharavasewaran Fx. Engineering College, Trunelveli				
Report Number: 19020122.03 Sample Description: New oil (Linseed oil 70% +Rapeseed oil 30%)		Date of report: 19/02/2019 Received on: 15/02/2019 Commenced on: 18/02/2019 Completed on: 19/02/2019		
S No	Parameters	Protocol	Unit	Result
1	Fire point	ASTM D 93-08	°C	270
2	Flash point	ASTM D 93-08	°C	263
3	Kinetic Viscosity @ 40°C.	ASTM D 445-06	cm <sup>2</sup>	125
4	Pour Point	ASTM D 97-17b	°C	-45
Verified By: 				
For CVR LABS PVT. LTD., Authorized Signatory: E.JANAKI, Asst. Quality Manager				
**** END OF REPORT ****				
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<b>TEST REPORT</b>		<b>SUBMITTED SAMPLE</b>		
Issued To: H.Thank ismail Mydeen, S.Venkai Ramani, S.Srinivasa Perumal, K.Tharavasewaran Fx. Engineering College, Trunelveli				
Report Number: 19020122.02 Sample Description: Castor Oil		Date of report: 19/02/2019 Received on: 15/02/2019 Commenced on: 18/02/2019 Completed on: 19/02/2019		
S No	Parameters	Protocol	Unit	Result
1	Fire point	ASTM D 93-08	°C	240
2	Flash point	ASTM D 93-08	°C	238
3	Kinetic Viscosity @ 40°C.	ASTM D 445-06	cm <sup>2</sup>	106.7
4	Pour Point	ASTM D 97-17b	°C	+4
Verified By: 				
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