Effect of TMP-based-cottonseed oil-biolubricant blends on tribological behavior of cylinder liner-piston ring combinations


Abstract
Cottonseed oil-based biolubricant was synthesized by the TMP-based transesterification process. 10-50% by volume blends of TMP-based cotton biolubricant and SAE-40 were prepared and tested on the high-frequency reciprocating engine cylinder liner and piston ring combination to investigate their tribology. While tribological characteristics were also evaluated by four-ball tribotesters at high constant load of 785 N. 10% addition of cotton-biolubricant showed the lowest friction and wear as compared to SAE-40 but >10% volume of cotton biolubricant in blends increased the wear and friction considerably as tested by both HFRR and four-ball. Hence, 10% addition of TMP-cotton-biolubricant can be utilized as an energy-saving lubricant additive to partially reduce the dependency on petroleum-based lubricant for automotive engine application.

Keywords
Cotton biolubricant; COF; Wear; Engine cylinder-piston ring

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1. P, Lubricating oil anti-wear agent and preparation method thereof
   By: [Anonymous]
   Patent Number: CN103173268A
   Published: 2013
   China

2. Synthesis and characterization of rapeseed oil bio-lubricant dispersed with nano copper oxide: its effect on wear and frictional behavior of piston ring-cylinder liner combination
   By: Arumugam, S.; Sriram, G.

3. Synthesis and characterization of rapeseed oil bio-lubricant - its effect on wear and frictional behaviour of piston ring-cylinder liner combination
   By: Arumugam, S.; Sriram, G.

4. Effect of Bio-Lubricant and Biodiesel-Contaminated Lubricant on Tribological Behavior of Cylinder Liner-Piston Ring Combination
   By: Arumugam, S.; Sriram, G.

5. Bio-lubricant as an Alternative to Mineral Oil for a CI Engine-An Experimental Investigation with Pongamia Oil as a Lubricant
   By: Bekal, S.; Bhat, N. R.
   ENERGY SOURCES PART A: RECOVERY, UTILIZATION AND ENVIRONMENTAL EFFECTS Volume: 34 Issue: 11 Pages: 1016-1026 Published: 2012

6. Title: [not available]
   By: Bowden, F.P.; Bowden, F.P.; Tabor, D.
   The friction and lubrication of solids Volume: 1 Published: 2001
   Publisher: Oxford University Press, Oxford

7. Tribological aspects of biofuels - A review
   By: Dandu, Madhu Sudan Reddy, Nanthapandian, K.
   FUEL Volume: 258 Article Number: UNSP 116066 Published: DEC 15 2019

8. Title: [not available]
   By: Dattaro, S.G.
   Experimental investigation on usage of cottonseed oil and esterified cottonseed oil as lubricant in IC engines Published: 2018

   By: Dados, George S.; Anastopoulos, George; Zannikos, Fanourios
   SAE INTERNATIONAL JOURNAL OF FUELS AND LUBRICANTS Volume: 3 Issue: 2 Pages: 378-385 Published: 2010

10. Using of cottonseed oil as an environmentally accepted lubricant additive
    By: Durak, E.; Karasmanoglu, F
    ENERGY SOURCES Volume: 26 Issue: 7 Pages: 611-625 Published: JUN 2004

11. Oxidation and low temperature stability of vegetable oil-based lubricants
    By: Ethan, Sevim Z.; Sharma, Braetendra K.; Perez, Joseph M.
    INDUSTRIAL CROPS AND PRODUCTS Volume: 24 Issue: 3 Special issue: SI Pages: 292-299 Published: NOV 2006

12. Boundary lubrication performance of free fatty acids in sunflower oil
    By: Fro, N.; Tyrer, B.; Stachowiak, GW
    TRIBOLOGY LETTERS Volume: 16 Issue: 4 Pages: 275-281 Published: MAY 2004

13. A Review: Role of Fatty Acids Composition in Characterizing Potential Feedstock for Sustainable Green Lubricants by
    Times Cited: 4
14. **Tribological study of nanoparticles enriched bio-based lubricants for engine piston ring-cylinder interaction**
   By: Gulzar, M.
   **Thesis** Published: 2017
   Ph.D. thesis
   Publisher: Faculty of Engineering, University of Malaya, Malaysia

15. **Tribological Characteristics of Calophyllum inophyllum-Based TMP (Trimethylolpropane) Ester as Energy-Saving and Biodegradable Lubricant**
   By: Habibullah, M.; Masjuki, H. H.; Kalam, M. A.; et al.
   TRIBOLOGY TRANSACTIONS Volume: 58 Issue: 6 Pages: 1002-1011 Published: NOV-DEC 2015

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   FUEL Volume: 90 Issue: 3 Pages: 922-931 Published: MAR 2011

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   By: Heikal, E. K.; Elawly, M. S.; Khalil, S. A.; et al.
   [Show additional data]

18. **Tribological evaluation of coconut oil as an environment-friendly lubricant**
   By: Jayadas, N. H.; Nair, K. Prabhakaran; Ajithkumar, G.
   TRIBOLOGY INTERNATIONAL Volume: 40 Issue: 2 Pages: 350-354 Published: FEB 2007

19. **Fuel properties of cottonseed oil**
   By: Kansansinangkul, F.; Tuter, M.; Gollu, E.; et al.
   ENERGY SOURCES Volume: 21 Issue: 9 Pages: 821-828 Published: NOV 1999

20. **CHAPTER 11: Forensic applications of contaminant transport models in the subsurface**
   By: Katyal, A.; Morrison, R.D.
   Introduction to Environmental Forensics Pages: 513-575 Published: 2007
   Publisher: Academic Press, Burlington

21. **The effect of oxidation on the tribological performance of few vegetable oils**
   By: Mannekote, J. K.; Kallas, S.V.

22. **The prospects of biolubricants as alternatives in automotive applications**
   By: Mobarak, H. M.; Mohamad, E.; Nizam, M.; Masjuki, H. H.; et al.
   RENEWABLE & SUSTAINABLE ENERGY REVIEWS Volume: 33 Pages: 34-43 Published: MAY 2014

23. **Tribological Effects of Vegetable Oil as Alternative Lubricant: A Pin-on-Disk Tribometer and Wear Study**
   By: Noorazwani, Nuraliza; Samion, Syahrullail
   TRIBOLOGY TRANSACTIONS Volume: 55 Issue: 5 Pages: 831-837 Published: 2015

24. **The influence of fatty acids on tribological and thermal properties of natural oils as sustainable biolubricants**
   By: Reeves, Carlton J.; Menezes, Pradeep L.; Zen, Tien-Chien; et al.
   TRIBOLOGY INTERNATIONAL Volume: 50 Pages: 123-134 Published: OCT 2015

25. **Title: [not available]**
   By: Rudnick, L.R.
   Synthetics, mineral oils, and bio-based lubricants Published: 2020
   Publisher: CRC Press, Boca Raton

26. **The physicochemical and tribological properties of oleic acid based triester biolubricants**
   By: Salih, Nadia; Salimon, Jurmat; Youssif, Emad
   INDUSTRIAL CROPS AND PRODUCTS Volume: 34 Issue: 1 Pages: 1089-1096 Published: JUL 2011

27. **Comparative tribological investigation of bio-lubricant formulated from a non-edible oil source (Jatropha oil)**
   By: Shahabbudin, M.; Masjuki, H. H.; Kalam, M. A.; et al.
   INDUSTRIAL CROPS AND PRODUCTS Volume: 47 Pages: 323-330 Published: MAY 2013

28. **Title: [not available]**
   By: SINGHY
   EGYPT J PET Volume: 27 Pages: 1145 Published: 2018
Tribolelogcal characterization of Pongamia pinnata oil blended bio-lubricant
By: Singh, Yashvir; Singla, Amneesh; Singh, Anshul Kumar; et al.
BIOFUELS-UK Volume: 9