Accepted Manuscript

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Tongchit Suthisripok, Pattawee Semsamran

PII: S0301-679X(18)30380-3

DOI: 10.1016/j.triboint.2018.07.042

Reference: JTRI 5336

To appear in: *Tribology International*

Received Date: 18 May 2018

Accepted Date: 26 July 2018

Please cite this article as: Suthisripok T, Semsamran P, The impact of biodiesel B100 on a small agricultural diesel engine, *Tribology International* (2018), doi: 10.1016/j.triboint.2018.07.042.

The Impact of Biodiesel B100 on a Small Agricultural Diesel Engine

Tongchit Suthisripok* and Pattawee Semsamran

Automotive Engineering Department, College of Engineering, Rangsit University, Thailand

*tongchit.s@rsu.ac.th

Abstract

To use the engine with confidence over the long term, it is necessary to test the engine's reliability and durability. Field tests that used a 14-hp Kubota RT140 Di diesel engine fueled with palm biodiesel B100 were conducted after approximately 800 hours of operation, running with a heavy load continuously at low speed for 12-hours to aerate a fish pond from dusk till dawn. Multi-grade lubricating oil was changed and collected after every 100-h of operation. The laboratory analysis and the ferrographic results suggested degradation of oil. Provided that the lubricating system was maintained, the B100 engine's operating condition was as good on biodiesel as on diesel fuel, undergoing the usual rate of wear without sacrificing mechanical reliability and durability.

Keywords: biodiesel, B100, alternative fuel, agricultural diesel engine, used lubricating oil, ferrography

Nomenclatures

η_f	fuel conversion efficiency
l_b	Belt pitch length (mm)
d_f	Driven pulley diameter (mm)
d_m	Driving pulley diameter (mm)
l_{fm}	Center distance between the pulleys (mm)

1. Introduction

Biodiesel is easily produced from the transesterification of vegetable oils (both edible and non-edible), animal fats, used cooking oil, and algae oil [19-23,27]. Hence, biodiesel is a renewable, biodegradable, nontoxic and environmentally friendly biofuel. For example, biodiesel can be derived from palm oil, which is an edible oil; Jatropha, which is a non-food plant growing in dry and marginal land; [4-5] or used cooking oil, which reduces the health risk from the repetitive re-use of oil. Biodiesel has similar properties to diesel, which is selectively used as an alternative fuel for diesel engines. Two important fuel properties for diesel engines are its cetane number and fuel viscosity. The cetane number is defined as the measure of the fuel's ignition quality, which is very important to determine a diesel engine's operating characteristics. High cetane fuels having shorter ignition delay usually produce more complete combustion of the fuel, which results in a smoother engine operation, ease of cold starts, reduction of smoke during engine starting, better fuel efficiency, quieter operation (reduced noise and vibration), less harmful emissions, and reduction of varnish formation rate and carbon deposits [7,12,26]. The diesel engine is a compressed ignition combustion engine whose combustion process details depend on the fuel's characteristics, the design of the engine's combustion chamber and fuel