Effects of Biodiesel Saturation Degrees on NOx Emission and FTIR Spectroscopy

Mohd Fareez Edzuan Bin Abdullah[1], Nadzirah Binti Madzrol[2] and
Rolf Willa Anak Patrick Sandin[3]
[1,2,3]*Fakulti Kejuruteraan, Universiti Malaysia Sarawak, Kota Samarahan, Malaysia.*
[1]*Email: amfedzuan@feng.unimas.my,* [2]*Email: nadz_irah92@yahoo.com,*
[3]*Email: willarop@gmail.com*

Abstract

The Fourier Transform Infrared (FTIR) spectroscopic characteristics of biodiesel produced from vegetable oils with different saturation degree was investigated in this study. Unsaturation degree, usually determined by the Iodine Value (IV) indicates the sum of double bonds, triple bonds and/or rings. In this work, biodiesels were produced by canola oil, palm oil and coconut oil that have saturation degree of 7.0 wt%. 45.6 wt% and 81.5 wt%, respectively. Biodiesel blends of B10, B15 and B20 were tested in a direct injection diesel engine and the NOx emissions were measured with a flue gas analyser. The NOx emission was increased in all biodiesel cases, where the NOx emission seems to be proportional with the biodiesel unsaturation degree. The FTIR spectroscopy of each biodiesel was analysed with FTIR spectrometer. Each biodiesel produced different FTIR spectroscopy characteristics and the double bond of C=O was the most abundant in highly unsaturated canola oil methyl ester which suggested that FTIR spectroscopy can be suitable to analyse biodiesel characteristics.

Keywords: *FTIR spectrometer, spectroscopy analysis, biodiesel, saturation degree, NOx emission*

1. Introduction

Diesel engine have proved to be an indispensable technology despite of constant concern regarding its harmful exhaust pollutant. Numerous efforts have been carried out in the past two decades to reduce diesel engine pollutant in order to meet ever stringent regulation requirements. Recent technology to simultaneously reduce particulate matter (PM) and nitrogen oxides (NOx) emission including homogenous-charged compression ignition (HCCI) engine and exhaust gas recirculation (EGR) system are being developed with promising results [1, 2]. However, conventional diesel engine needs to be replaced or undergone extensive alterations to adopt those strategies.

Due to the limited petroleum fuel supply and environmental concerns, researches on sustainable alternative fuels are gaining attraction. Diesel engine was originally envisioned to run with a pure vegetables oil but due to its much higher viscosity than petroleum based diesel fuel, it cannot be burned properly and may damage modern diesel engine. Transesterification process converts vegetable oil to a less viscous fatty acids methyl ester (FAME) famously known as biodiesel nowadays. Biodiesel is particularly a standout alternative fuel because it can be used with the conventional diesel engine without any major modification. It is biodegradable, oxygenated and low toxicity fuel that can be derived from various feedstocks such as vegetable oils, woods and even

Manuscript History:
Received 15 September, 2015, Revised 7 March, 2016, Accepted 22 March, 2016, Published 31 March, 2016

e-ISSN 2289-7771