

ANALYSIS OF COMBUSTION CHARACTERISTICS AND EMISSIONS OF DIESEL ENGINE FUELED WITH WASTE SOURCE FUEL

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Abstract

Since the 18th century Industrial Revolution, fossil fuel has been the main energy source used to power the economy and becoming the global energy prominence until today. Furthermore, the advance in drilling technology in mid-19th century lead to the petroleum as a highly resourceful energy source powering transportation such as automobiles, ships, and even to generate electricity. The recent oil depletion crisis force many researchers to conduct a search to the new source of energy. In conjunction, the modernization also sees the new global problem such as an increment of waste products such as tires, plastic and cooking oil around the globe. Utilization of these waste products as an alternative fuel can reduce the dependent to the fossil fuel. In this paper, alternative fuels derived from the waste sourced fuels are discussed. Three type of waste sourced fuels are tire disposal fuel (TDF), waste plastic disposal fuel (WPD) and waste cooking oil (WCO). The combustion characteristics of the waste fuels are compared to diesel fuel (DF). The combustion curve and exhaust emissions of these pure concentrated fuels are discussed in this paper. The results indicate that WCO show comparable combustion characteristics and exhaust emission to DF. TDF can run at low engine speed but not at high engine speed due to the backfire phenomenon occurs when engine running at high speed region.

Keywords: Biodiesel, combustion, waste cooking oil, emission.

1. Introduction

Engines fuelled by fossil fuel are well known for their efficiency to fulfill the need and requirement. The increase in industrial activities and transportation around the world causes rising needs an efficient energy sources such as fossil fuel. Due to the non-renewable energy source along with the problems of diminishing of natural fuel supplies, there has been a growing interest in automobiles with renewable energy source. Researches have been conducted all around the world to search for renewable energy sources thus reduce the dependence to the fossil fuel. Utilization of common waste products such as tires, plastics and waste cooking oil to be used as an alternative fuel has raised interest in many researchers around the world [1, 2]. In this paper, the combustion characteristics of waste produces such as tire disposal fuel (TDF), waste plastic disposal fuel (WPD) and waste cooking oil (WCO) are evaluated and discussed. Utilization of these waste sources has potentially to be used as an alternative fuel for the diesel engine. The waste fuels are produced through the pyrolysis process which includes the process of thermal degradation with absence of oxygen. Panda [3] reported that pyrolysis process can be done on waste plastic with an addition of a catalyst. The temperature set during the process is between 350-500°C and even higher at 700-900°C. Meanwhile, two step catalyzed process was employed to prepare WCO. The first step is esterified process of free fatty acids with methanol catalyzed by ferric sulfate and the second step is transesterification process of triglycerides (TGs) with methanol catalyzed by potassium hydroxide [4]. The production of biodiesel must follow the regulation of biodiesel standard the European Union in the technical regulation EN14214 or in the United State, ASTM 6751-02. On the other hand, Ayhan suggested that supercritical transesterification could

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