Data Article

Data set on performance and relative exhaust emission (REE) characteristics of fish oil ethyl ester with fuel preheating in diesel engine

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A B S T R A C T

The present data article is centered on the research work which examines the effect of fuel preheating on DI diesel engine fuelled with Fish Oil Ethyl Ester (FOEE). Kirloskar TV1 model water cooled diesel engine with eddy current dynamometer was used in the experiment. Crude fish oil was converted into FOEE using transesterification process. The physical and chemical properties of FOEE were examined based on American Standards for Testing Materials (ASTM) biodiesel standards and data’s were offered. To achieve better engine characteristics, a fuel preheater was designed and fabricated to work at different temperatures (60, 70 and 80 °C).

Fuel preheating temperatures were achieved using three different shell and tube heat exchanger at various dimensions. Heat exchanger was designed to work with waste heat obtained from the engine exhaust. Engine tailpipe emission was recorded using AVL make 444 di-gas analyzer and smoke was measured using AVL make 437C free accelerometer smoke meter. Data related to fuel

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samples like neat diesel, FOEE blends with and without fuel preheating were presented.

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Specifications Table

| Subject area | Alternative fuels and waste to energy |
|--------------|--------------------------------------|
| More specific subject area | 2nd generation biodiesel |
| Type of data | Table and graph |
| How data was acquired | Engine performance and emission characteristics were determined using computerized Kirloskar TV1 model diesel engine equipped with and without fuel preheating technique. Emission data's were recorded using AVL 444 di-gas analyzer and 437C smoke meter equipment. |
| Data format | Raw, analyzed. |
| Experimental factors | Performance and emission characteristics of fuel depends on properties like kinematic viscosity, density, energy content, oxygen content, flash point and fire point. |
| Experimental features | FOEE was produced using two-stage transesterification process owing to high acid value. Fuel properties were determined based on ASTM standards. Engine fuel preheating device was designed and fabricated to achieve three different exit temperatures of 60, 70 and 80°C based on shell and tube design condition. |
| Data source location | Department of Mechanical Engineering, Kampala International University, Western Campus, P.O. Box 71, Bushenyi-Ishaka, Uganda |
| Data accessibility | Data's are presented within this article and supplementary document. |

Value of the Data

- The data can be used by other researchers in Africa and the whole universe to compare the performance and emission characteristics of FOEE in normal engine with and without fuel preheating.
- The data conveyed the technical feasibility of using fish oil ethyl ester as an alternative to conventional diesel. It provides the way to explore the concept of converting waste to energy.
- The data made a provision to research community as the physical and chemical properties of FOEE were examined based on ASTM biodiesel standards and compared with diesel.
- The data can be used to study the effect of various blends of FOEE in diesel engine and provide information about the engine characteristics to the research community.

1. Data

The data presented in this article includes the production of alternative fuel from waste fish oil using transesterification process. The physical and chemical properties of fish oil ethyl ester was determined based on ASTM biodiesel standards and compared with diesel. This experiment was carried out in a Kirloskar TV1 model diesel engine. The data on engine performance and exhaust emissions were recorded and presented. The engine experiment was modification with fuel preheating technique and data relevant to engine characteristics were presented.

Table 1 represents the physical and chemical properties of diesel and fish oil ethyl ester based on ASTM standards under laboratory condition. The major performance characteristics of engine was denoted as brake thermal efficiency (%) and brake specific fuel consumption (kg/kWh) with corresponding various loads at (20, 40, 60, 80 and 100%) were presented in Tables 2 and 3 respectively. Relative exhaust emission of various fish oil ethyl ester blends (FOEE25, 50, and 75) at engine full load was presented in Fig. 1. Similarly, Relative exhaust emission of various fish oil ethyl ester blends at different preheating temperatures and engine full load conditions were depicted in Fig. 2. The raw data associated with Figs. 1 and 2 can be found in supplementary file.
2. Experimental design, materials, and methods

Waste to energy conversion concept is an innovative technique for waste valorization and management which reduces environmental pollution and offers socioeconomic benefits [1-4]. The fish oil was chosen as the primary source for fuel production and converted into biodiesel using transesterification process [5,6]. The fish oil was heated to about 60–70 °C for few minutes and stirred continuously with magnetic stirrer. The three-neck apparatus with condenser was placed in the heating unit and process was started. 235 ml of ethanol with potassium hydroxide was dissolved for homogeneity existence and mixed with fish oil solution instantly. Operating conditions were fixed as 60–70 °C (heating temperature), 650 rpm (stirring speed) and 60 minutes (time period). In addition, the acquired solution was shifted to separation funnel and allowed undisturbed for one complete day. Based on weight, different glycerol along with excess alcohol and catalyst settles at lower region which rises the biodiesel up [7,8]. At last, neat biodiesel was washed with warm de-ionized water thrice to improve the purity content and reheated to neglect the presence of water molecules. Due to ethanol addition, the last solution obtained was termed as fish oil ethyl ester (FOEE).

This experiment was carried out in Kirloskar TV1 model diesel engine. The air flow and fuel flow were calculated using electronic flowmeters. Rotometers were used for cooling of engine combustion chamber and calorimeter. Using eddy current dynamometer, the brake power was provided to engine. Load to engine was measured using S-type strain gauge connected to the control panel with eddy current dynamometer controller. Online data recording and analysis were performed using EngineSoft V4.0 Matlab base software. All sensors were connected to the National Instruments based Data Acquisition Unit. Engine emissions like carbon monoxide, hydrocarbon and oxides of nitrogen were determined using AVL 444 di-gas analyzed based on measuring standards prescribed in the

| Table 1 | Physical and chemical properties of fish oil ethyl ester and diesel. |
|---------|---------------------------------------------------------------|
| Properties | ASTM Standards | Diesel | Fish oil ethyl ester |
| Density (kg/m³)* | D1298 | 835 | 882 |
| Viscosity at 40 °C (cSt)* | D445 | 2.57 | 4.21 |
| Calorific value (MJ/kg)* | D240 | 43.26 | 38.1 |
| Cetane index* | D976 | 48 | 52.3 |
| Flash point (°C)* | D93 | 56 | 169 |
| Fire point (°C)* | D93 | 62 | 173 |

*ASTM standards under laboratory condition.

| Table 2 | Data of brake thermal efficiency (%) for diesel and FOEE with and without preheating at various engine loads. |
|---------|---------------------------------------------------------------|
| Load | Diesel | FOEE | Fuel preheating @60 °C | Fuel preheating @70 °C | Fuel preheating @80 °C |
|-------|--------|------|------------------------|------------------------|------------------------|
| 20    | 14.6   | 12.8 | 13.3                   | 13.98                  | 14.42                  |
| 40    | 23     | 20.3 | 20.88                  | 21.78                  | 22.49                  |
| 60    | 26.5   | 23.4 | 24.45                  | 25.38                  | 26.01                  |
| 80    | 28.9   | 25.4 | 26.13                  | 27.04                  | 28.18                  |
| 100   | 31.2   | 27.5 | 28.46                  | 29.68                  | 30.26                  |

| Table 3 | Data of brake specific fuel consumption (kg/kWh) for diesel and FOEE with and without preheating at various engine loads. |
|---------|---------------------------------------------------------------|
| Load | Diesel | FOEE | Fuel preheating @60 °C | Fuel preheating @70 °C | Fuel preheating @80 °C |
|-------|--------|------|------------------------|------------------------|------------------------|
| 20    | 0.575  | 0.681 | 0.661                  | 0.625                  | 0.595                  |
| 40    | 0.395  | 0.476 | 0.455                  | 0.431                  | 0.412                  |
| 60    | 0.34   | 0.422 | 0.401                  | 0.381                  | 0.368                  |
| 80    | 0.321  | 0.389 | 0.372                  | 0.351                  | 0.338                  |
| 100   | 0.296  | 0.345 | 0.331                  | 0.32                   | 0.305                  |
manufacture catalogue. Also, smoke presence in exhaust of engine was measured using AVL 437C smoke meter equipment. This observation was carried out on the same day to prevent the occurrence of variations in the experiment [9,10]. To increase the reliability of the results, each observation was made twice with all blend fuels in Kirloskar TV1 model diesel engine.

Data depicted in this article explores the usability of various blends of fish oil ethyl ester as an alternative fuel in diesel engine. In addition, neat FOEE was attempted with different preheating temperatures like 60, 70 and 80 °C with different shell and type heat exchangers [11–13].

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2020.105237.
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