Data in Brief 31 (2020) 105799

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Data on combustion chamber measurements of a diesel engine fuelled with biodiesel of *jatropha curcas* and fatty acid distillates

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A R T I C L E I N F O

Article history:
Received 4 May 2020
Revised 20 May 2020
Accepted 26 May 2020
Available online 2 June 2020

Keywords:
Jatropha curcas
Biodiesel
Diesel engine
Ignition delay
Fatty acid distillates

A B S T R A C T

Data in this paper covers in-cylinder pressure and volume, crank angle degrees as time magnitude, first derivate of in-cylinder pressure, admission pressure and injection pressure in a diesel engine fuelled with biodiesel. This data brings additional information such as ignition delay and rate of heat released. As condensed information, some graphs were obtained and are into the database such as in-cylinder vs. CAD, first derivate of in-cylinder pressure vs. CAD and ROHR vs. CAD. The data shows the measurements of the cylinder pressure behaviour of biodiesel from two different sources, which are both of interest of bioenergy industry at local scenarios (*Jatropha curcas* and Fatty Acid Distillates). Data in the paper are shown in Tables and Graphs. Through this data, a more accurate approach to engines performance and com-

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https://doi.org/10.1016/j.dib.2020.105799

bustion can be reach, enhancing combustion efficiency and understanding of differences with standard diesel fuel.

Specifications table

Subject	Bioenergy
Specific subject area	Biodiesel and engine tests
Type of data	Tables Graphs
How data were acquired	The engine used for the research is a single cylinder Lister Petter diesel engine PH1W. It is a four-stroke single cylinder engine with direct injection. It is a test bench setup. Kistler pressure sensors were installed in order to measure pressure at three places. The experiments were developed at medium engine loads and different engine speeds, measuring each biofuels and the reference diesel fuel.
Data format	Raw and primary processed data
Parameters for data collection	A detailed overview of all experimental parameters and uncertainties are included in the manuscript.
Description of data collection	Data obtained with the data acquisition system was processed using software (dataflow programming language), which provided the programming interface between the hardware and development environments. The engine tests were developed following researches protocols for pressure measurements and performance features. Uncertainty and external conditions that may influence the results were fixed or kept under control. Data represents a wide range of working conditions in a single cylinder diesel engine at medium loads.
Data source location	**Biodiesel of *Jatropha curcas*** City: Matanzas Region: Caribbean Country: Cuba (20°N, 75°W) **Biodiesel of Fatty Acid Distillates** City: Havana Region: Caribbean Country: Cuba (23°N, 82°W)
Data accessibility	Repository name: Data on combustion chamber measurements of a diesel engine fuelled with biodiesel of Jatropha curcas and Fatty Acid Distillates Data identification number: Mendeley dataset, Mendeley Data, v1, 2020 Direct URL to data: http://dx.doi.org/10.17632/yfp368tf32.1

Value of the data

- The data shows the measurements of the cylinder pressure behaviour of two biodiesel from different sources, which are both of interest of bioenergy industry at local scenarios.
- The data is valuable information since in-cylinder measurements are costly, and the results let the engineers to adjust engine working parameters in order to a more efficient use of these biodiesel.
- By-products of low commercial value are obtained from the vegetable oil refining (FAD). These by-products are harmful to the environment if they cannot be used for any beneficial activity. There are several reports of their use to produce biofuels, but a lack of reports related to engine performance and exhaust emissions is found.
- This data may be relevant for researchers seeking for the use of biodiesel of Jatropha or FAD. Through this, a more accurate approach to engines performance and combustion can be reach.

Table 1
Characteristics of the Lister Petter single cylinder diesel engine.

Item	Value
Bore	87.3 mm
Stroke	110 mm
Compression ratio	16.5:1
Injection type	Direct injection
Injection pressure	197–217 bar (between 1100–2200 rpm)
Maximum Torque	78 Nm
Maximum Power	6.7 kW at 2200 rpm
Cubic capacity	659 cm^3
Fuel injection timing	24° before Top Dead centre (up to 1650 rpm); 28° before Top Dead centre (1651–2000 rpm)
Speed range	1000–2000 rpm

1. Data description

The database is a collection of in-cylinder pressure data as a function of crank angle degrees (CAD) and related engine measurements such as rate of heat released (ROHR) that let the researchers and scientific community to assess the behaviour of a single cylinder diesel engine when fuelled with two particular cases of biodiesel (100%), and also the comparison with standard diesel fuel at the same experimental conditions can be made through it. Concerning *Jatropha curcas*, there are many information respect biodiesel and even for engines performance, but a lack of information about in-cylinder combustion. The same happens with biodiesel obtained from FAD. Both are contributions to sustainable development if they are converted into bioenergy [1, 2].

Data consist of information in tables and graphs obtained by a data acquisition system installed and measuring what is happening in real time into the combustion chamber for the fuels tested at different engine work conditions. Data covers in-cylinder pressure and volume, crank angle degrees as time magnitude, first derivate of in-cylinder pressure, admission pressure and injection pressure. As condensed information, some graphs were obtained and are into the database such as in-cylinder vs. CAD, first derivate of in-cylinder pressure vs. CAD and ROHR vs. CAD. The results corresponding to the comparison between *Jatropha curcas* biodiesel and diesel fuel at 1300 rpm and 78 Nm are shown in Figs. 1–3.

Biodiesel obtained from the two feedstocks studied represent second generation biofuels with no direct competition with food production, since *Jatropha curcas* produces a non-edible oil and FAD are waste. The use of neat biodiesel or blends of it with diesel fuel has different advantages: significant reduction of exhaust emissions compared to diesel fuel; energy independence by reducing the dependency on fossil fuels, mainly for non-oil producers; sustainability due to reduction of greenhouse gases but it is totally biodegradable and a renewable energy source.

2. Experimental design, materials, and methods

The engine used for data collecting was a Lister Petter diesel engine PH1W. This is a four-stroke single cylinder diesel engine with direct injection. The main engine characteristics are shown in Table 1. The schematic diagram of the experimental setup used for the engine tests is shown in Fig. 4. The engine is equipped with load cell, hydraulic brake (type: Froude), four K-type thermocouples and a tachometer. A piezoelectric relative pressure sensor (Kistler; model: 6067C, water-cooled) mounted directly on the cylinder head is used to measure the in-cylinder pressure. A piezoresistive absolute pressure sensor (4075A10) mounted in the admission duct is used to register the intake air pressure. In addition, a data acquisition system, a signal conditioning platform Kistler with a charge amplifier (model 5064), a piezoresistive amplifier (model 4665) are used. The engine is also equipped with a Kistler system 2614A to measure the crank

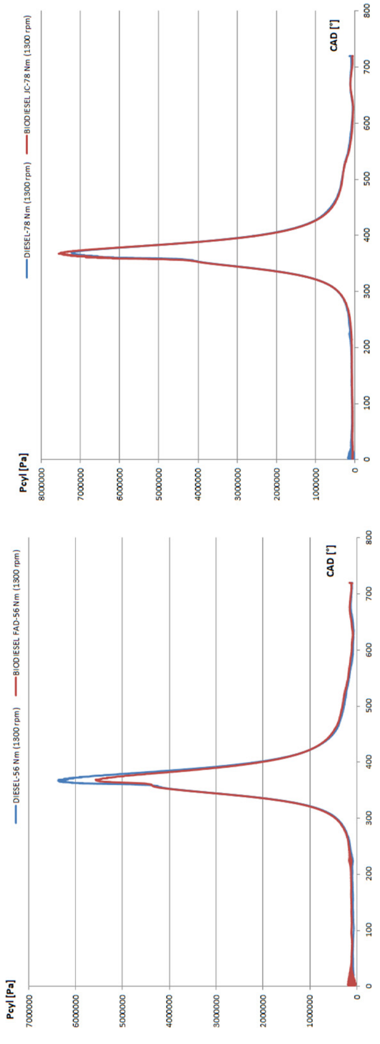

Fig.1. In-cylinder pressure of FAD and JC biodiesel compared to diesel fuel at selected loads.

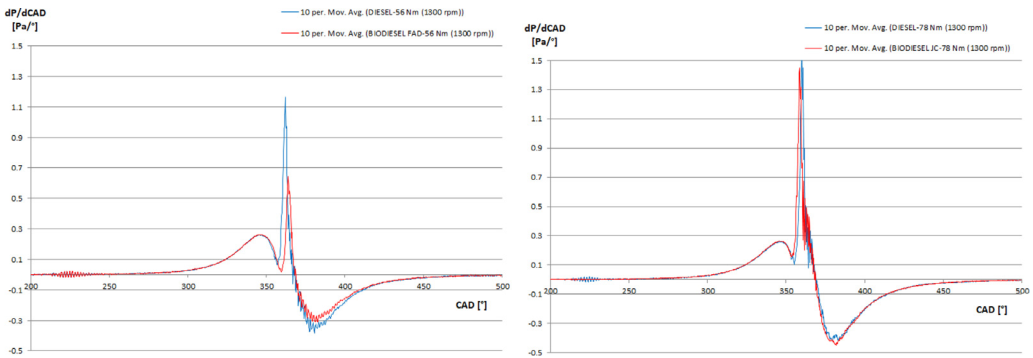

Fig.2. Rate of in-cylinder pressure rise of FAD and JC biodiesel compared to diesel fuel at selected loads.

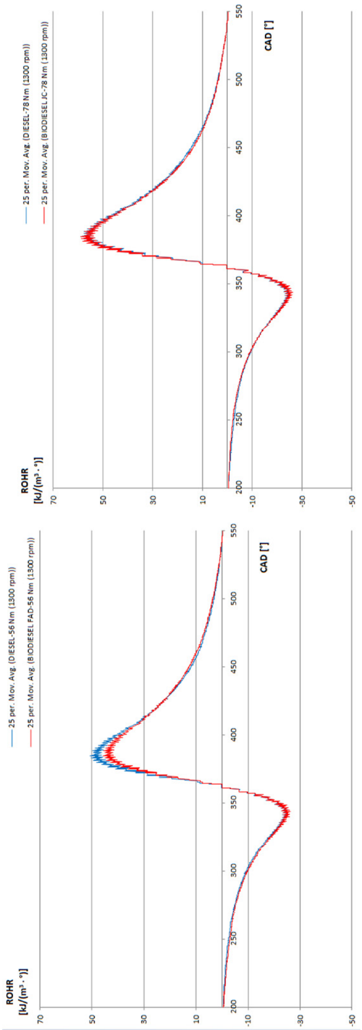

Fig.3. Rate of heat released of FAD and JC biodiesel compared to diesel fuel at selected loads.

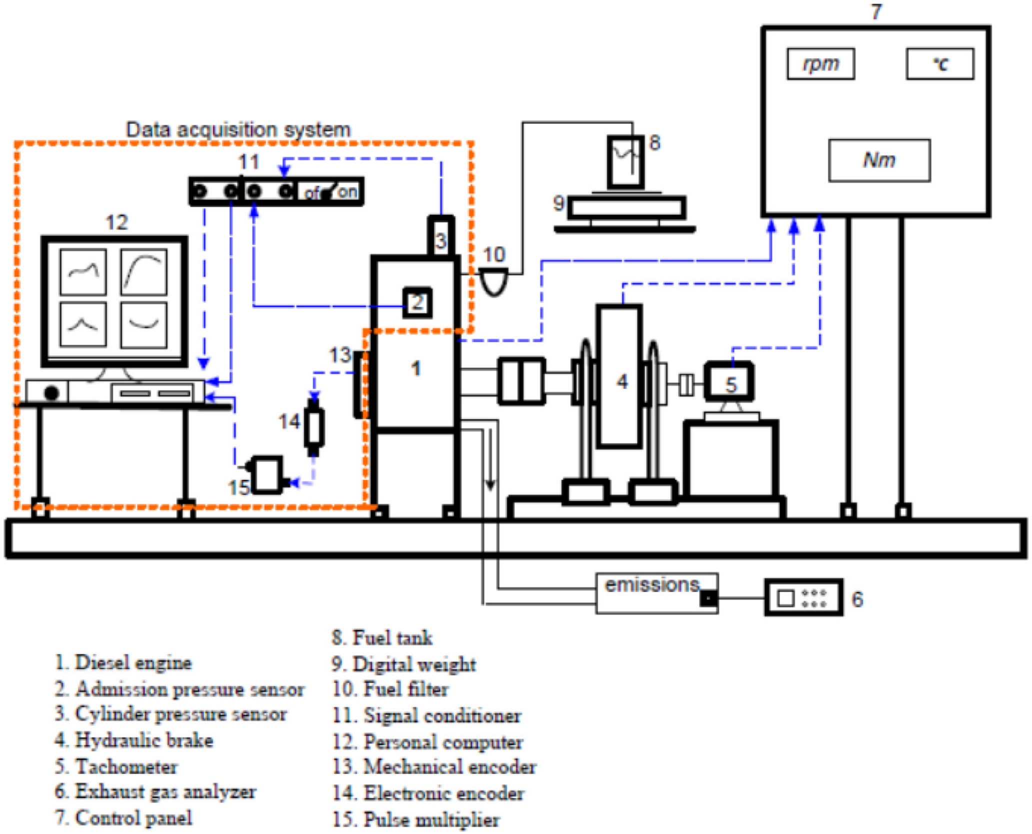

Fig.4. Schematic diagram of the engine bench setup.

Table 2
Summary of device specifications and their accuracy.

Item	Device	Accuracy
Torque	Load cell	0.1 Nm
Engine speed	Tachometer	6 rpm
CAD	Encoder mechanic Kistler 2614A1, Encoder electric Kistler 2614A2, Pulse multiplier Kistler 2614B4	1 CAD
Intake pressure	Kistler 4075A10	3000 Pa
Cylinder pressure	Kistler 6067C	1%

Table 3
Differences in ignition delay time in comparison between fuels.

Pair of fuels	Experimental conditions	Pair of ID values (diesel/BD)	ID differences
Diesel and FAD biodiesel	56 Nm–1300 rpm	20/22	2
	56 Nm–1500 rpm	20/21	1
	56 Nm–1700 rpm	25/26	1
Diesel and JC biodiesel	78 Nm–1300 rpm	19/19	0
	78 Nm–1500 rpm	20/17	−3
	78 Nm–1700 rpm	25/23	−2

angle position, with a resolution of 0.2 CAD. The system is composed by a mechanical encoder, an electric encoder and a pulse multiplier.

The experiments are conducted at selected fixed torque values and different engine speeds (1300, 1500 and 1700 rpm). Concerning engine load, the experiments corresponding to biodiesel of *Jatropha curcas* were performed at 78 Nm and 56 Nm for biodiesel of FAD. The accuracy and device specifications used in this research are shown in Table 2.

The signals of the cylinder gas pressure are recorded for every 0.2 CAD increment in crank angle over 100 completed cycles. For assessment of the ignition delay, behaviour of cylinder pressure and its first derivative is analysed. The start of injection is assumed taking into account the manufacturer specifications. The uncertainty assumed on ignition delay measurements is 0.2 CAD. The cylinder pressure, volume and their first derivate are used to calculate the rate of heat release [3] and the ignition delay is estimated by in-cylinder behaviour of the first derivate of pressure [4, 5].

The determination of ignition delay (ID) differences when the engine is fuelled with biodiesel as a substitute of diesel fuel is in Table 3 shown. Nevertheless, a deeper analysis can be afforded using the database.

Transparency document: Supplementary material

Supplementary full data associated with this article can be found in the online version at https://data.mendeley.com/datasets/yfp368tf32/1 [6].

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that have, or could be perceived to have, influenced the work reported in this article.

CRediT authorship contribution statement

Ramón Piloto-Rodríguez: Conceptualization, Investigation, Writing - review & editing, Supervision. **Marianela Ortiz-Alvarez:** Data curation, Writing - review & editing. **Jesús Suárez-**

Hernández: Resources, Project administration. **Indira Tobío-Pérez:** Investigation, Resources. **Eliezer Ahmed Melo-Espinosa:** Investigation. **Yosvany Díaz:** Investigation, Resources. **José Angel Sotolongo:** Resources, Project administration.

Acknowledgments

The authors wish to express their thanks to the International Project GEF-PNUD Bioenergía. Tecnologías energéticas limpias para las áreas rurales de Cuba, because of their greater support to this research, which was performed under project.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dib.2020.105799.

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