Data Article

Dataset for compression ignition engine fuelled with corn oil methyl ester biodiesel

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A B S T R A C T

The present data study deals with the experimental analysis of performance, emission and combustion characteristics of CI engine fuelled with corn oil methyl ester biodiesel blend as alternative fuel. A two-step transesterification process is used to produce the biodiesel. Furthermore, a characteristics study was carried out on the extracted corn oil methyl ester biodiesel blends over conventional fuel. Three different fuel blends namely B10, B20 and B30 were chosen and the performance, emission and combustion characteristics of these are compared to that of conventional diesel fuel. Eddy current dynamometer is used load the engine from no load to maximum load condition. Using AVL DiGAS 444 N gas analyser and AVL 346 smoke meter the emissions and smoke opacity of the fuel blends and diesel were measured respectively. The experimental performance, emission and combustion data's were presented.

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Lot of researchers have carried out different experiments on vegetable oil as an alternative fuel in compression ignition engine [1,2]. In the present data analysis various experiments were carried out on a single cylinder diesel engine fuelled with diesel, and blends of corn oil methyl ester biodiesel (B10, B20, and B30) to assess the engine performance and behavior over combustion and emission characteristics. The schematic diagram and experimental photograph of the test rig is shown in Figs. 1 and 2 respectively. Based on ASTM standards, the physio-chemical properties were measured. Three different blends of biodiesel namely B10, B20 and B30 were used in DI-CI diesel engine. The detailed specification of engine used in the present study is tabulated in Table 3. The variations on the brake thermal efficiency of the engine fuelled with diesel and biodiesel blends is shown in Fig. 3. Similarly, the data set for brake thermal efficiency produced by the experimental test rig for diesel and different blends of biodiesel at various loads is tabulated in Table 4. Fig. 4 shows the variations in the fuel consumption of diesel, B10, B20 and B30 biodiesel blends while Table 4 also shows the data’s of specific fuel consumption for diesel and different blends of biodiesel. Fig. 5 shows the variation of HC emission from prepared fuel blends and compared to that of conventional diesel. The data’s associated with emissions from engine in the form of hydrocarbons and NOx is tabulated in Table 5. Fig. 6 shows the variation of NOx for all loading condition of prepared fuel blends. It is seen that the formation of NOx is lower in biodiesel blends compared to that of conventional diesel fuel whereas, the unburnt hydrocarbons from the engine is higher with blends of biodiesel. Also, it is seen that the optimum biodiesel concentration obtained is B10 as the performance characteristics of the blend (B10) is almost similar to conventional diesel fuel. Similarly, the variations

Specifications Table

| Subject                  | IC Engine                                                                 |
|--------------------------|---------------------------------------------------------------------------|
| Specific subject area    | Biodiesel, performance, emission, combustion                               |
| Type of data             | Figures, Tables, Graphs                                                  |
| How data were acquired   | Using computerized Kirloskar 4 stroke, DI-CI diesel engine is used to measure the engine performance, cylinder pressure and heat release. AVL DiGAS 444 N gas analyser and AVL 346 smoke meter, the emissions and smoke opacity is measured. |
| Data format              | Raw and tabulated                                                        |
| Description of data collection | Using two stage tran esteri fication method, the pure corn oil is to produce biodiesel. Based on ASTM standards, the physio-chemical properties were measured. Three different blends of biodiesel namely B10, B20 and B30 were used in DI-CI diesel engine. |
| Data source location     | Sri Venkateswara College of Engineering, Sriperambadur, Tamil Nadu, India |
| Data accessibility       | With the article                                                         |
| Related research article | Liu, W., Lu, G., Yang, G., & Bi, Y. (2019). Improving oxidative stability of biodiesel by cis-trans isomerization of carbon-carbon double bonds in unsaturated fatty acid methyl esters. Fuel, 242, 133–139. Saravankumar, P. T., Suresh, V., Vijayan, V., & Godwin Antony, A. (2019). Ecological effect of corn oil biofuel with SiO2 nano-additives. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 1–8. |

Value of the Data

- The data set provided shows the applicability of corn oil methyl ester at different blending ratio with diesel fuel in internal combustion engine.
- The present data can be used to study the effect of blending biodiesel in different ratio and compare the fuel properties, combustion, emission and performance characteristics.
- Researchers working on alternative fuels can use the present data for the comparative analysis.
**Fig. 1.** Schematic diagram of experimental setup.

**Fig. 2.** Photograph of experimental test rig, dynamometer, smoke meter with gas analyser and computerized test rig.
**Table 1**  
Properties of diesel and biodiesel blends.

| Property                | Diesel | B100 | B10 | B20 | B30 |
|-------------------------|--------|------|-----|-----|-----|
| Density (kg/m³)         | 823    | 902  | 855 | 860 | 865 |
| Calorific value (kJ/kg) | 42000  | 36640| 41914|41328|40742|
| Kinematic viscosity (cSt)| 2.8   | 6.44 | 3.34| 3.65| 3.92|
| Flash point             | 56     | 145  | 40  | 44  | 49  |
| Fire point              | 64     | 156  | 51  | 54  | 60  |
| Specific gravity        | 0.825  | 0.904| 0.857|0.862|0.867|

**Table 2**  
Preparation of blends with diesel.

| Blend | Fuel quantity (liters) | COME (ml) | Diesel (ml) |
|-------|------------------------|-----------|-------------|
| B10   | 1                      | 100       | 900         |
| B20   | 1                      | 200       | 800         |
| B30   | 1                      | 300       | 700         |

**Table 3**  
Engine specification.

| Make               | Kirloskar |
|--------------------|-----------|
| Type               | single cylinder 4 stroke water cooled diesel engine |
| Bore diameter      | 87.5 mm   |
| Stroke length      | 110 mm    |
| Compression Ratio  | 17.5:1    |
| Combustion Chamber | Piston with hemispherical bowl |
| Maximum rated Speed| 1500 rpm  |
| Maximum operating Power | 5.2 kW    |

**Fig. 3.** Variation in brake thermal efficiency of prepared fuel blends at different load condition.
Table 4

Data’s for brake thermal efficiency for different biodiesel blends.

| Load (%) | BP (kW) | Brake Thermal Efficiency (%) | Brake Specific fuel Consumption (kg/kW-hr) |
|----------|---------|------------------------------|-------------------------------------------|
|          |         | Diesel | B10 | B20 | B30 | Diesel | B10 | B20 | B30 |
| 25 (%)   | 1.31    | 20.27  | 19.88 | 20.1 | 20.23 | 0.42 | 0.43 | 0.43 | 0.42 |
| 50 (%)   | 2.61    | 29.75  | 27.31 | 29.39 | 27.84 | 0.28 | 0.31 | 0.3  | 0.3  |
| 75 (%)   | 3.82    | 32.65  | 31.95 | 32.28 | 32.48 | 0.26 | 0.27 | 0.27 | 0.26 |
| 100 (%)  | 5.07    | 34.42  | 33.98 | 32.9  | 33.17 | 0.25 | 0.25 | 0.26 | 0.26 |

Fig. 4. Variation in brake specific fuel consumption of prepared fuel blends at different load condition.

Fig. 5. Variation in HC emissions of prepared fuel blends at different load condition.
Table 5
Emission data’s (HC and NOx) for diesel and different biodiesel blends.

| BP (kW) | HC emissions (ppm) | NOx emission (ppm) |
|---------|---------------------|---------------------|
|         | Diesel  | B10    | B20    | B30    | Diesel  | B10    | B20    | B30    |
| 1.31    | 7      | 6      | 8      | 10     | 430     | 425     | 422     | 419     |
| 2.61    | 9      | 9      | 11     | 12     | 1013    | 1029    | 993     | 987     |
| 3.82    | 11     | 10     | 12     | 13     | 1584    | 1505    | 1491    | 1465    |
| 5.07    | 12     | 11     | 14     | 16     | 1841    | 1837    | 1826    | 1799    |

Fig. 6. Variation in NOx of prepared fuel blends at different load condition.

Fig. 7. Variation in cylinder pressure developed inside the chamber for prepared fuel blends.
**Table 6**
Data’s of cylinder pressure developed using different blends of biodiesel.

| Crank angle (ºCA) | Cylinder pressure developed using different blends of biodiesel (bar) |
|-------------------|------------------------|-----------------|-----------------|------------------|
|                   | B10                    | B20             | B30             | Diesel           |
| -25               | 17.005625              | 16.715          | 17.101875       | 16.821875        |
| -24               | 17.775                 | 17.485          | 17.864375       | 17.57625         |
| -23               | 18.575                 | 18.284375       | 18.654375       | 18.365           |
| -22               | 19.405                 | 19.11125        | 19.471875       | 19.184375        |
| -21               | 20.26375               | 19.964375       | 20.3175         | 20.03125         |
| -20               | 21.146875              | 20.844375       | 21.1925         | 20.903125        |
| -19               | 22.05                  | 21.75125        | 22.0975         | 21.7975          |
| -18               | 22.975                 | 22.684375       | 23.0225         | 22.713125        |
| -17               | 23.9275                | 23.645          | 23.96875        | 23.650625        |
| -16               | 24.908125              | 24.633125       | 24.9875         | 24.61            |
| -15               | 25.910625              | 25.64125        | 25.998125       | 25.589375        |
| -14               | 26.92375               | 26.655625       | 27.020625       | 26.583125        |
| -13               | 27.93375               | 27.665          | 28.045625       | 27.578125        |
| -12               | 28.930625              | 28.665625       | 29.06625        | 28.55875         |
| -11               | 29.913125              | 29.661875       | 30.08625        | 29.516875        |
| -10               | 30.8975                | 30.675625       | 31.133125       | 30.455625        |
| -9                | 31.938125              | 31.77           | 32.286875       | 31.391125        |
| -8                | 33.15625               | 33.08           | 33.71           | 32.379375        |
| -7                | 34.758125              | 34.823125       | 35.6275         | 33.36235         |
| -6                | 37.00375               | 37.23625        | 38.2275         | 35.096875        |
| -5                | 40.084375              | 40.42125        | 41.525625       | 37.375625        |
| -4                | 43.9475                | 44.209375       | 45.3            | 40.613125        |
| -3                | 48.231875              | 48.209375       | 49.179375       | 44.755625        |
| -2                | 52.4325                | 52.035          | 52.830625       | 49.37125         |
| -1                | 56.184375              | 55.493125       | 56.0975         | 53.850625        |
| 0                 | 59.390625              | 58.56125        | 58.994375       | 57.750625        |
| 1                 | 62.12375               | 61.266875       | 61.56925        | 60.950625        |
| 2                 | 64.485625              | 63.646875       | 63.956875       | 63.545           |
| 3                 | 66.5475                | 65.745625       | 66.091875       | 65.683125        |
| 4                 | 68.356875              | 67.588125       | 67.989375       | 67.474375        |
| 5                 | 69.940625              | 69.170625       | 69.635625       | 68.9675          |
| 6                 | 71.29375               | 70.48125        | 71.015625       | 70.178125        |

(continued on next page)
in cylinder pressure and heat release for prepared fuel blends is shown in Figs. 7 and 8 respectively. The data associated with in cylinder pressure and net heat release rate are tabulated in Tables 6 and 7 respectively. It is observed from Fig. 7 that increasing the blend ratio of biodiesel decreased the cylinder pressure developed inside the cylinder. This is completely due to higher viscosity of fuel blend at higher blend ratio. Similarly, the rate of heat release is lower for biodiesel with higher blends as the caloric value of prepared biodiesel is lower as compared to that of diesel fuel (Fig. 8). The data set associated for different loads of engine on pressure developed and net heat release rate for diesel, B10, B20 and B30 are provided as a supplementary material.

| Crank angle (°) | Cylinder pressure developed using different blends of biodiesel (bar) |
|----------------|------------------------------------------------------------------|
|                | B10                  | B20                  | B30                  | Diesel                  |
| 7              | 72.38875             | 71.51625             | 72.103125            | 71.11375                |
| 8              | 73.1925              | 72.273125            | 72.880625            | 71.77875                |
| 9              | 73.680625            | 72.743125            | 73.350625            | 72.16875                |
| 10             | 73.84625             | 72.91875             | 73.521875            | 72.276875               |
| 11             | 73.69625             | 72.798125            | 73.401875            | 72.103125               |
| 12             | 73.2425              | 72.381875            | 72.999375            | 71.653125               |
| 13             | 72.503125            | 71.678125            | 72.326875            | 70.938125               |
| 14             | 71.506875            | 70.708125            | 71.401875            | 69.97625                |
| 15             | 70.288125            | 69.50375             | 70.245               | 68.79125                |
| 16             | 68.883125            | 68.105625            | 68.8825              | 67.413125               |
| 17             | 67.330625            | 66.559375            | 67.35125             | 65.878125               |
| 18             | 65.6675              | 64.908125            | 65.693125            | 64.22625                |
| 19             | 63.92375             | 63.18625             | 63.94625             | 62.46925                |
| 20             | 62.12375             | 61.4175              | 62.141875            | 60.718125               |
| 21             | 60.28625             | 59.616875            | 60.3025              | 58.91125                |
| 22             | 58.423125            | 57.793125            | 58.44125             | 57.08875                |
| 23             | 56.543125            | 55.951875            | 56.565               | 55.259375               |
| 24             | 54.655625            | 54.098125            | 54.679375            | 53.426875               |
| 25             | 52.768125            | 52.23625             | 52.79125             | 51.59375                |
| 26             | 50.88375             | 50.37                | 50.90875             | 49.765625               |
| 27             | 49.006875            | 48.505               | 49.04125             | 47.949375               |
| 28             | 47.148125            | 46.65125             | 47.198125            | 46.15125                |
| 29             | 45.320625            | 44.82375             | 45.368875            | 44.37875                |
| 30             | 43.534375            | 43.093975            | 43.61375             | 42.640625               |
| 31             | 41.795625            | 41.31                | 41.885               | 40.945                  |
| 32             | 40.10875             | 39.639375            | 40.205625            | 39.299375               |
| 33             | 38.475625            | 38.025625            | 38.578125            | 37.709375               |
| 34             | 36.895               | 36.465625            | 37.003125            | 36.176875               |
| 35             | 35.365625            | 34.95875             | 35.4825              | 34.7025                 |
| 36             | 33.89375             | 33.505625            | 34.020625            | 33.286875               |
| 37             | 32.47125             | 32.10625             | 32.620625            | 31.92875                |
| 38             | 31.1175              | 30.7625              | 31.283125            | 30.625625               |
| 39             | 29.83125             | 29.4775              | 30.006875            | 29.375625               |
| 40             | 28.609375            | 28.251875            | 28.788125            | 28.17875                |
| 41             | 27.44625             | 27.083125            | 27.621875            | 27.035625               |
| 42             | 26.33875             | 25.9675              | 26.504375            | 25.945625               |
| 43             | 25.284375            | 24.901875            | 25.434375            | 24.9075                 |
| 44             | 24.276875            | 23.88375             | 24.410625            | 23.918125               |
| 45             | 23.309375            | 22.910625            | 23.429375            | 22.971875               |
| 46             | 22.379375            | 21.98                | 22.486875            | 22.063125               |
| 47             | 21.48625             | 21.090625            | 21.583125            | 21.188125               |
| 48             | 20.62875             | 20.24375             | 20.720625            | 20.34625                |
| 49             | 19.805625            | 19.44                | 19.899375            | 19.53875                |
| 50             | 19.01625             | 18.67625             | 19.11625             | 18.766875               |
Table 7
Data’s of Net heat release for different blends of biodiesel.

| Crank angle (°) | Net HR dQn/dq for different blends of bio diesel (kJ/deg CA) |
|----------------|---------------------------------------------------------------|
|                | B10               | B20               | B30               | Diesel            |
| −25            | −1.38             | −1.2              | −1.79             | −1.47             |
| −24            | −1.56             | −1.42             | −1.94             | −1.57             |
| −23            | −1.76             | −1.6              | −2.06             | −1.74             |
| −22            | −2.02             | −1.8              | −2.15             | −1.98             |
| −21            | −2.26             | −1.95             | −2.19             | −2.21             |
| −20            | −2.36             | −1.97             | −2.19             | −2.36             |
| −19            | −2.32             | −1.9              | −2.13             | −2.41             |
| −18            | −2.2              | −1.84             | −2.06             | −2.35             |
| −17            | −2.15             | −1.9              | −2.1              | −2.28             |
| −16            | −2.28             | −2.12             | −2.25             | −2.3              |
| −15            | −2.55             | −2.41             | −2.42             | −2.48             |
| −14            | −2.79             | −2.57             | −2.47             | −2.79             |
| −13            | −2.83             | −2.47             | −2.35             | −2.96             |
| −12            | −2.52             | −2.01             | −1.85             | −2.86             |
| −11            | −1.43             | −0.63             | −0.12             | −2.48             |
| −10            | 1.43              | 2.78              | 4.25              | −1.43             |
| −9             | 7.49              | 9.62              | 12                | 1.33              |
| −8             | 16.94             | 19.49             | 21.77             | 7.67              |
| −7             | 28.61             | 29.62             | 30.06             | 18.33             |
| −6             | 37.18             | 35.05             | 33.7              | 31.82             |
| −5             | 39.56             | 34.37             | 32.14             | 41.89             |
| −4             | 34.52             | 30.11             | 28.15             | 44.25             |
| −3             | 28.9              | 26.84             | 24.46             | 38.41             |
| −2             | 25.1              | 25.02             | 23.24             | 31.24             |
| −1             | 22.97             | 23.27             | 22.85             | 26.2              |
| 0              | 22.77             | 22.94             | 23.3              | 23.24             |
| 1              | 22.46             | 23.12             | 23.97             | 22.84             |
| 2              | 23.65             | 23.82             | 24.12             | 22.74             |
| 3              | 24.58             | 24.3              | 25.16             | 23.35             |
| 4              | 25.76             | 24.73             | 25.67             | 23.63             |
| 5              | 26.33             | 25.43             | 25.88             | 24.35             |
| 6              | 26.55             | 25.97             | 26.07             | 25.01             |
| 7              | 26.56             | 26.33             | 26.43             | 25.41             |
| 8              | 26.5              | 26.46             | 26.61             | 25.64             |
| 9              | 26.44             | 26.46             | 26.73             | 25.68             |
| 10             | 26.07             | 26.11             | 26.64             | 25.56             |
| 11             | 25.64             | 25.61             | 26.38             | 25.24             |
| 12             | 25.21             | 25.01             | 26                | 24.88             |
| 13             | 24.86             | 24.46             | 25.46             | 24.39             |
| 14             | 24.55             | 24.06             | 24.88             | 23.92             |
| 15             | 24.31             | 23.89             | 24.4              | 23.48             |
| 16             | 24.18             | 23.88             | 24.11             | 23.27             |
| 17             | 24.05             | 23.86             | 23.94             | 23.2              |
| 18             | 23.89             | 23.8              | 23.81             | 23.12             |
| 19             | 23.59             | 23.59             | 23.62             | 22.99             |
| 20             | 23.11             | 23.19             | 23.26             | 22.7              |
| 21             | 22.54             | 22.62             | 22.68             | 22.23             |
| 22             | 21.91             | 21.85             | 21.91             | 21.63             |
| 23             | 21.11             | 20.9              | 21.05             | 20.83             |
| 24             | 20.07             | 19.79             | 20.18             | 19.9              |
| 25             | 18.96             | 18.59             | 19.26             | 18.95             |
| 26             | 17.92             | 17.43             | 18.33             | 17.95             |
| 27             | 17.05             | 16.47             | 17.43             | 16.98             |
| 28             | 16.24             | 15.74             | 16.56             | 15.99             |
| 29             | 15.46             | 15.1              | 15.71             | 15.19             |
| 30             | 14.66             | 14.42             | 14.86             | 14.44             |
| 31             | 13.78             | 13.68             | 13.96             | 13.72             |
| 32             | 12.8              | 12.83             | 13.06             | 13.07             |

(continued on next page)
2. Experimental design, materials, and methods

2.1. Materials and methods

2.1.1. Preparation and production of biodiesel

Initially, the crude oil is transesterified using NaOH to remove the soap content. A two stage acid and alkali based transesterification method is employed to produce the biodiesel as the moisture content and free fatty acid content has to be removed. During the acid based 200ml of crude corn oil is taken in a beaker and heated for 10 minutes to a temperature of 60°C and 60ml of methanol is added. In addition, 2ml of H_2SO_4 is added to the mixture and the mixture is stirred using magnetic stirrer for 1 hr at 50°C. Then the mixture is allowed to settle for 2 hrs. The mixture with two separated phases namely methanol formed in the bottom and water floating on the top surface is formed. After the acid based transesterification is done, the mixture is added with 50 ml methanol during the base catalyst transesterification. Again the mixture is heated to a temperature of 60°C and agitation is carried out at 1000 rpm. Solution of NaOH in methanol was added with the pre-treated oil at room temperature thus allowing the reaction for a period of 2 hrs. Using a separating funnel, the mixture was allowed to settle for almost 24 hrs and the lower glycerol layer is taken out.

2.1.2. Experimental setup and procedure

The engine used in the present study is a Kirloskar type single cylinder, vertical, water cooled four stroke diesel engine. Various industrial and agricultural sector use these stationary engine so as in the present study this engine is chosen and this engine can be operated even at higher cylinder pressures. Eddy current dynamometer is used to load the engine. Using AVL DiGAS 444 type gas analyser the pollutants such as carbon dioxide, carbon monoxide, NOx, HC were measured and the smoke opacity is measured using AVL 346 smoke meter.

Appendix A. Supplementary data

The supplementary documents on combustion and pressure data’s are provided in Supplementary materials.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.104683.
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.

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