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Combustion Heat Release Models of Biodiesel

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Format of Presentation:

- Aims and Objectives of the Study
- Experimental Setup
- Fuel Manufacture Process
- Results and discussions
- Conclusions and Recommendation for Future Work

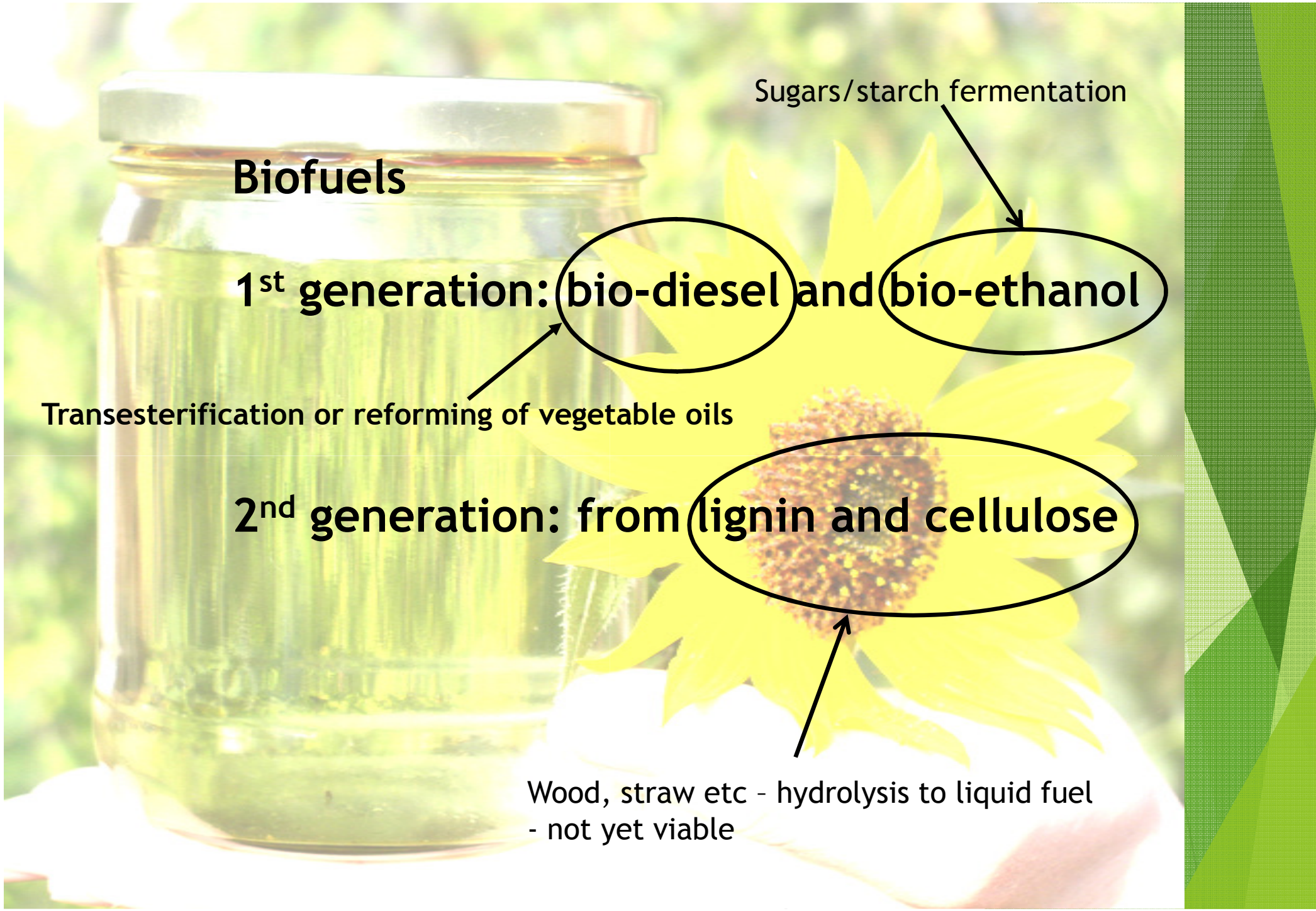
Aims of the Study:

- To investigate the viability of using biodiesel as an alternative, or additive, to basic diesel fuel.
- To be evaluated the engine performance along with emission characteristics for an engine running with biodiesel and traditional fuels.

Objectives of the Study

To find an immediate alternative energy solution through an investigation of combustion heat release processes of different biodiesel blends, which does not involve a drastic overhaul of the world's engine structure.

Obtaining one of solutions, which can reduce the global green house gas emissions over the petroleum, while a similar output in performance and efficiency.

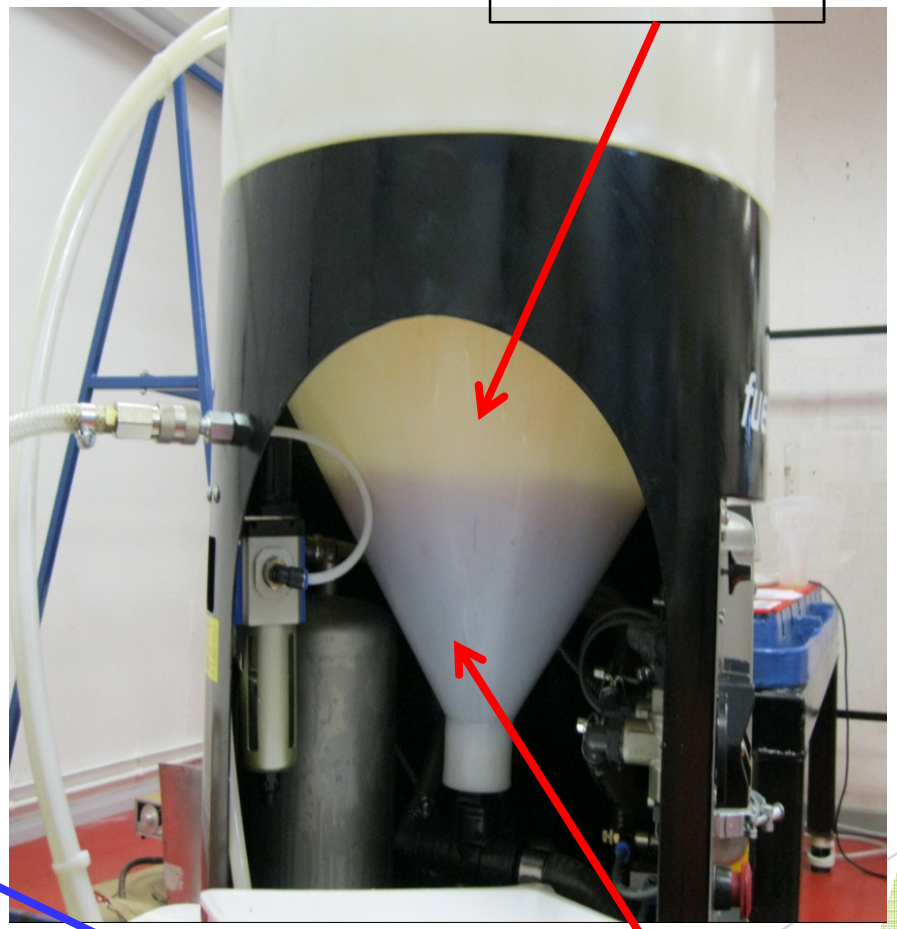

Biofuels
Sugars/starch fermentation
1st generation: bio-diesel and bio-ethanol
Transesterification or reforming of vegetable oils
2nd generation: from lignin and cellulose
Wood, straw etc – hydrolysis to liquid fuel
- not yet viable

Experimental setup

- Biodiesel production process
- Testing fuel properties
- Engine testing

el Pod - Basic Unit for Manufacture of Bio-Diesel – ansesterification Process





Oil, M, and NaOH

Bio-Diesel

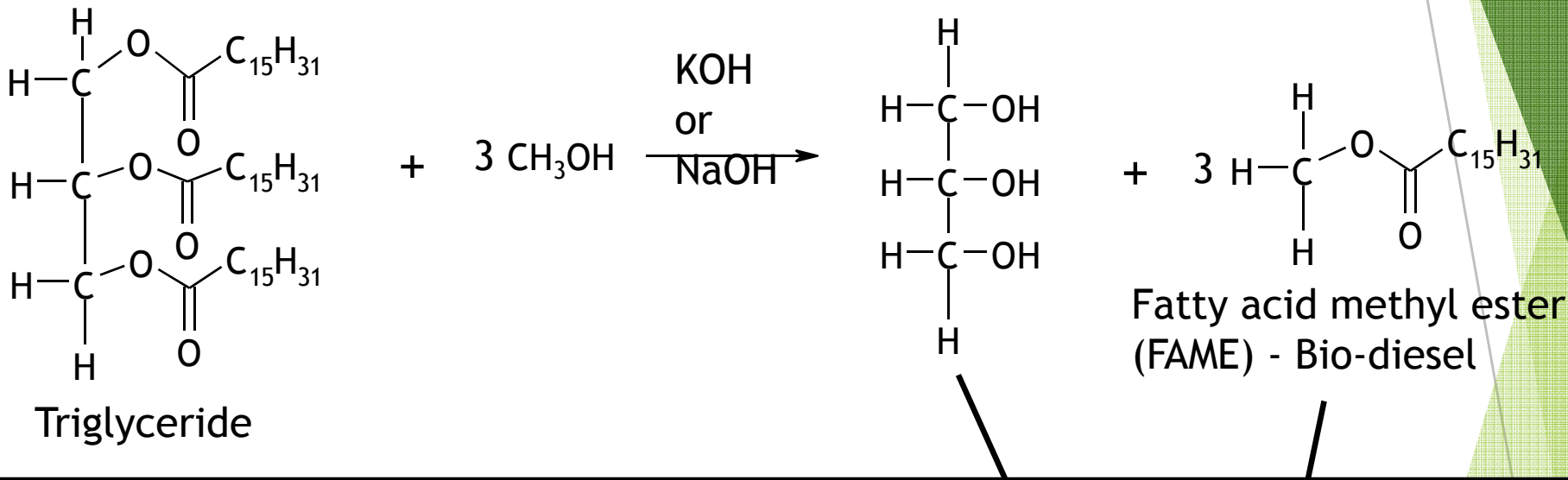
ixture of Methanol and NaOH

Vegetable oil

Glycerol

Conversion of vegetable oils to bio-diesel

Major process: triglyceride to methyl esters



Triglyceride

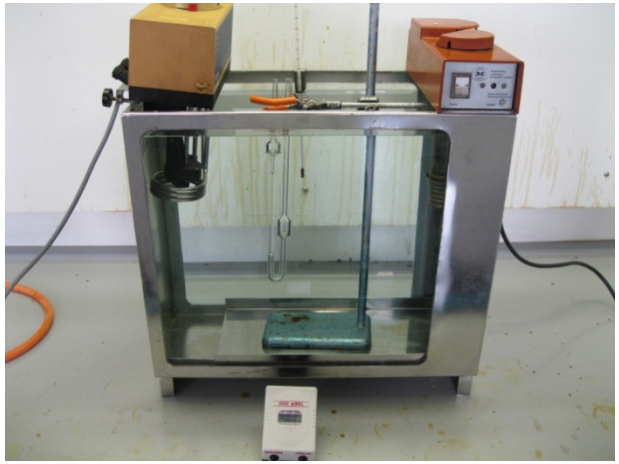
Fatty acid methyl ester (FAME) - Bio-diesel

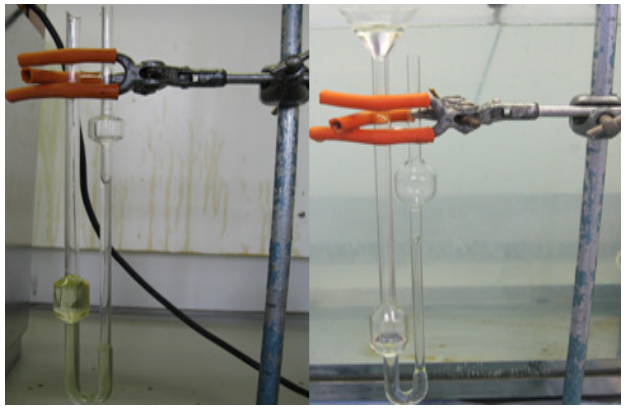
KOH + Free Fatty Acids = Soap





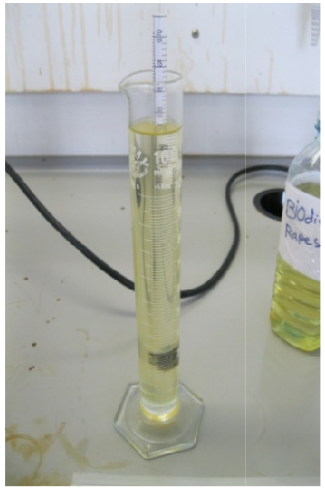
U-tube viscometer is used to measure kinematic viscosity.





U-tube viscometer B size and U-tube viscometer D size

Hydrometer is used to measure density.



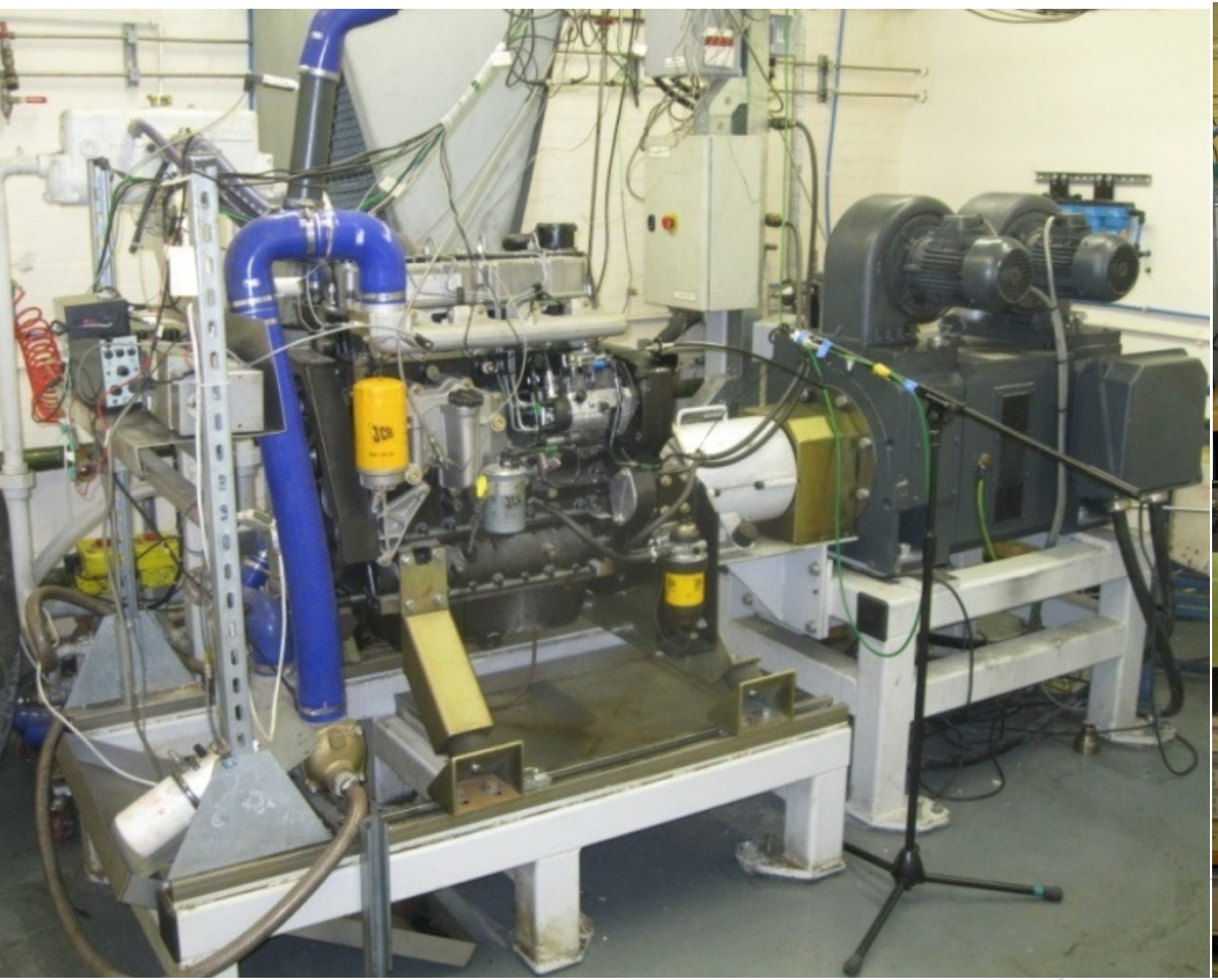
Hydrometer for Oil and Petroleum

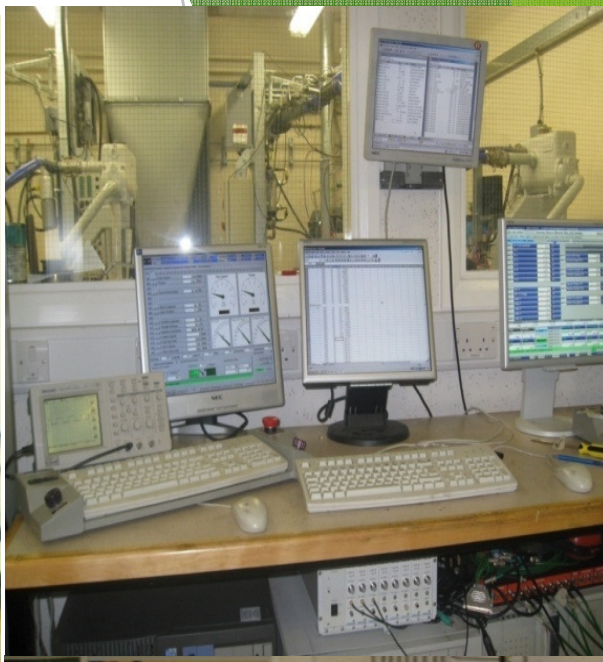
A bomb calorimeter is used to test calorific values samples.





dy State Engine Test Rig – Schenk dynamometer fitted with JCB 444 TCA 74 kW engine







Results and Discussions

The average yield of biodiesel was found to be 49 L, which is about 98% by volume from the vegetable oils. The average amount of glycerol obtained as a by-product from 50 L of vegetable oils was 8 L.

Vegetable oils

Biodiesel fuels

Standard Diesel

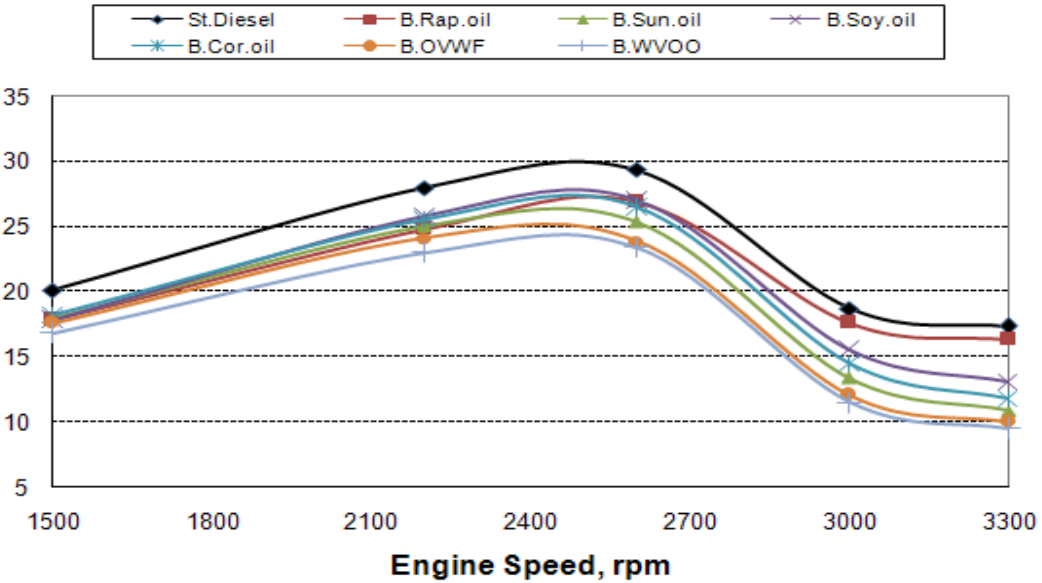
Fuels	Kinematic Viscosity At 40°C (mm^2/s)	Calorific Value (MJ/kg)	Cloud Point (°C)	Pour Point (°C)	Flash Point (°C)	Density (kg/m^3) At 15°C
Corn oil	39.3	37.37	-1.1	-40.0	277	920
Rapeseed oil	37.98	37.37	-3.9	-6.7	246	910
Soybean oil	35.28	36.75	-3.9	-12.2	254	915
Sunflower oil	33.72	37.26	7.2	-15.0	274	920
Waste oil	41.7	37.16	0	-39.7	279	910
Corn Biodiesel	4.78	37.45	0	-10	167	880
Rapeseed Biodiesel	4.47	37.70	-1	-11	163	880
Soybean Biodiesel	5.23	37.34	1	-7	178	885
Sunflower Biodiesel	4.53	37.00	1	-6	173	885
Waste oil Biodiesel	5.58	37.90	2	-7	179	885
Diesel	2.4	42.54	-5	-17	76	845

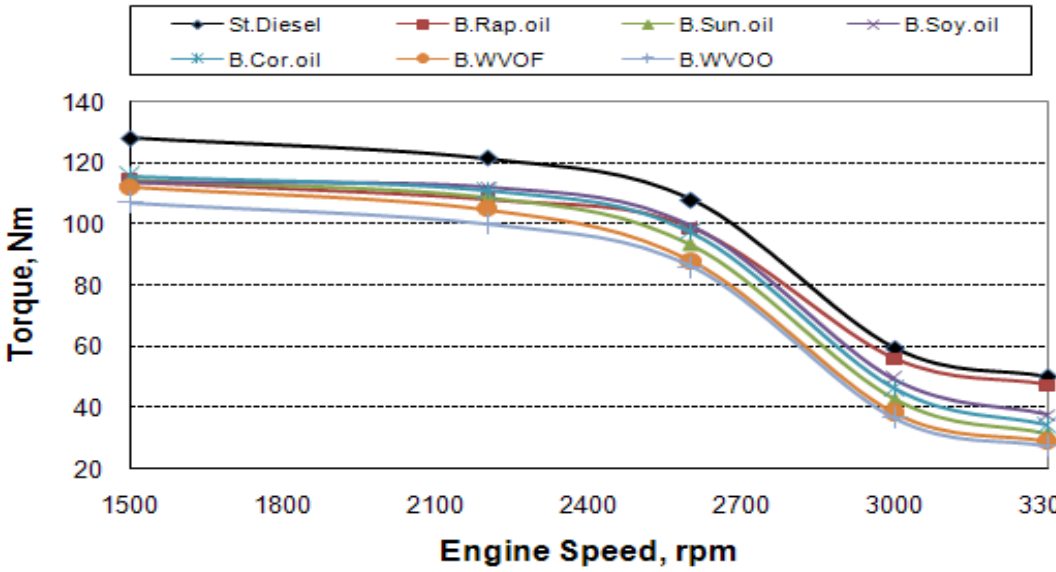
Before

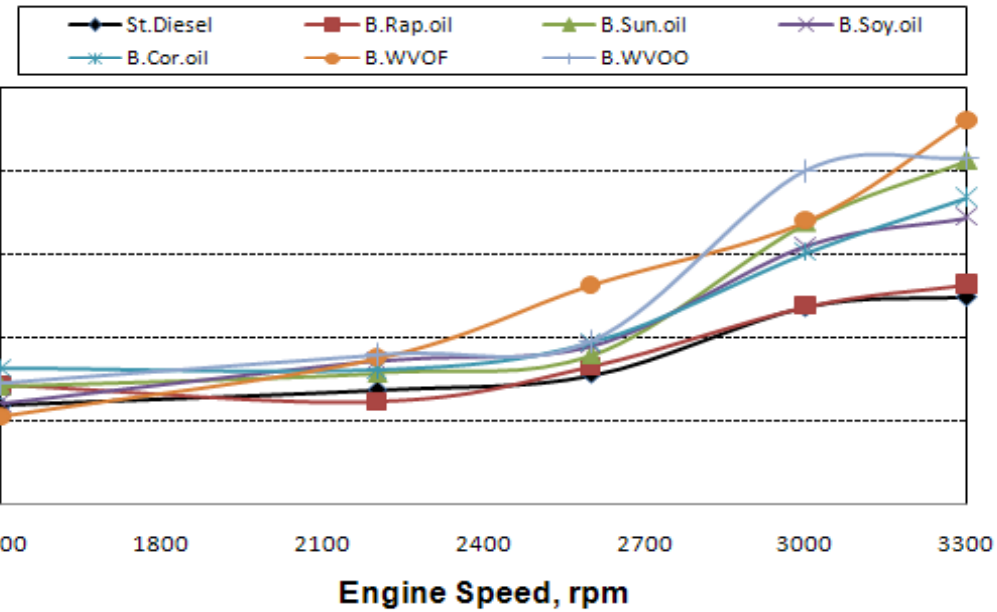
After

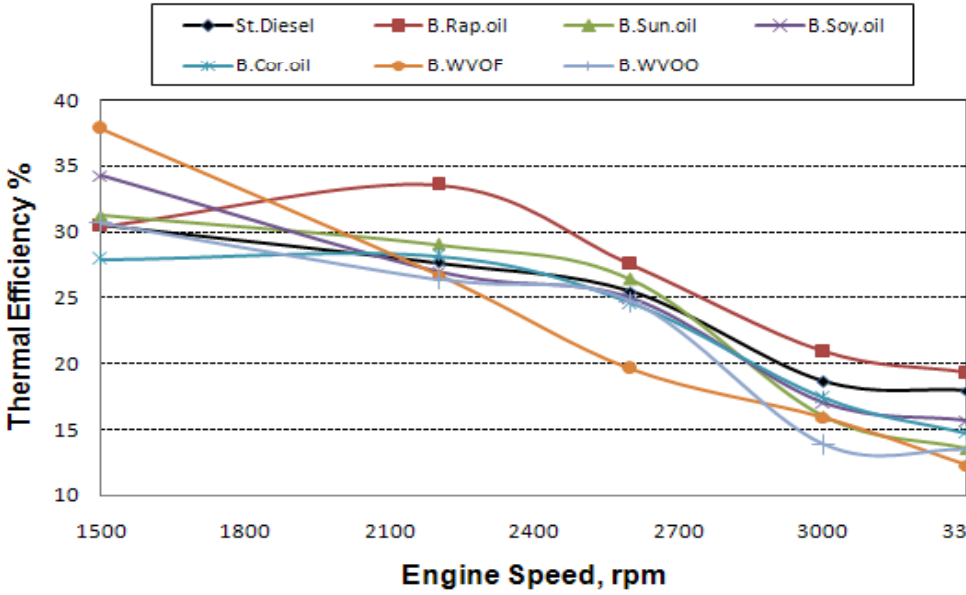
American Society for Testing and Materials (ASTM) Standards of maximum allowed quantities in diesel and bio-diesel.

Property	Diesel	Bio-diesel
Standard	ASTM D975	ASTM D6751
Composition	HC[a] (C10-C21)	FAME[b] (C12-C22)
Kinematic viscosity (mm^2/s) at 40 °C	1.9-4.1	1.9-6.0
Boiling point (°C)	188-343	182-338
Flash point (°C)	60-80	100-170
Cloud point (°C)	-15 to 5	-3 to 12
Pour point (°C)	-35 to -15	-15 to 16
Water (vol %)	0.05	0.05
Carbon (wt %)	87	77
Hydrogen (wt %)	13	12
Oxygen (wt %)	0	11
Sulphur (wt %)	0.05	0.05
Cetane number (ignition quality)	40-55	48-60
Stoichiometric air/fuel ratio (AFR)	15	13.8
HFRR[c] (µm)	685	314
BOCLE[d] scuff (g)	3600	>7000

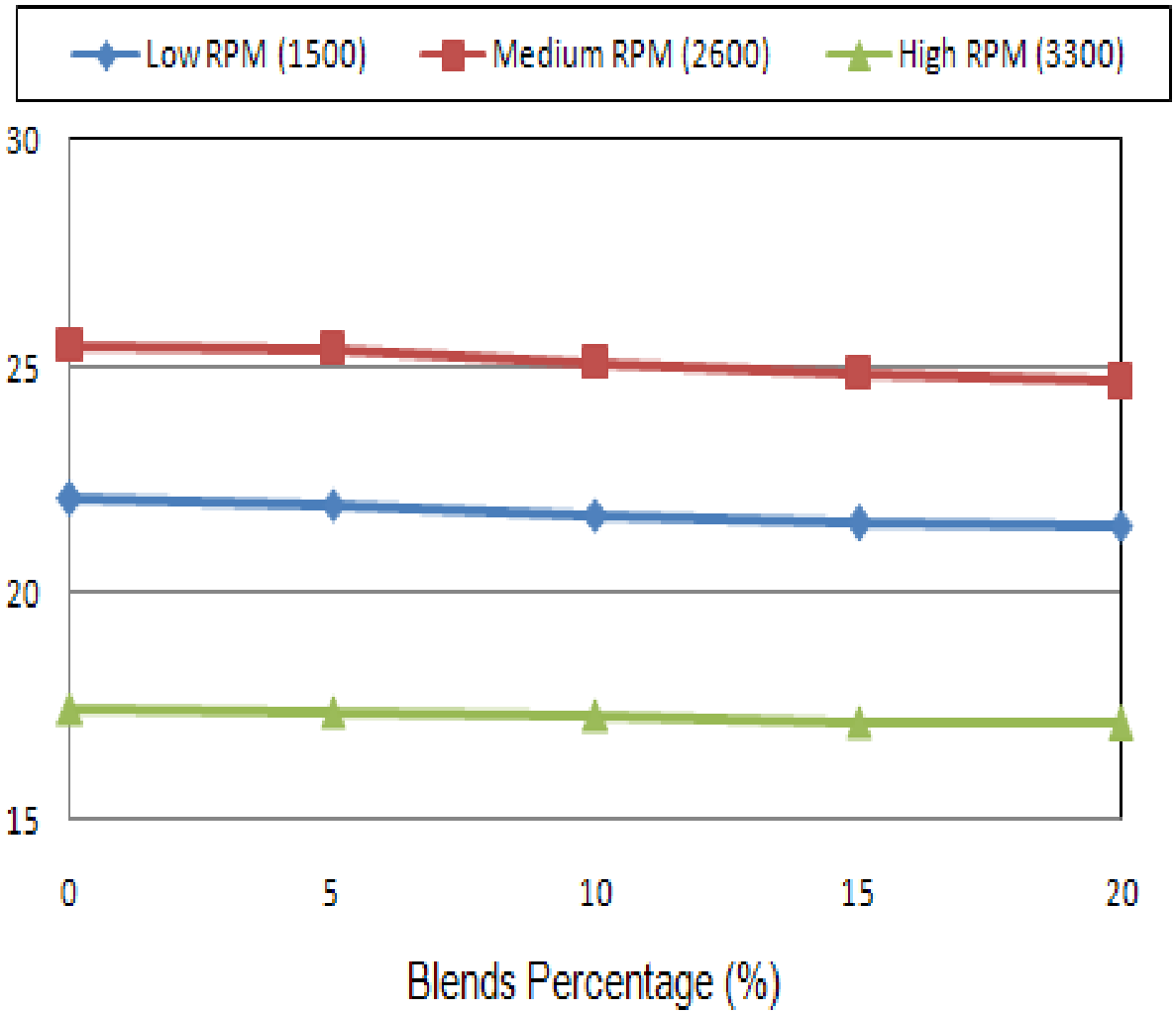


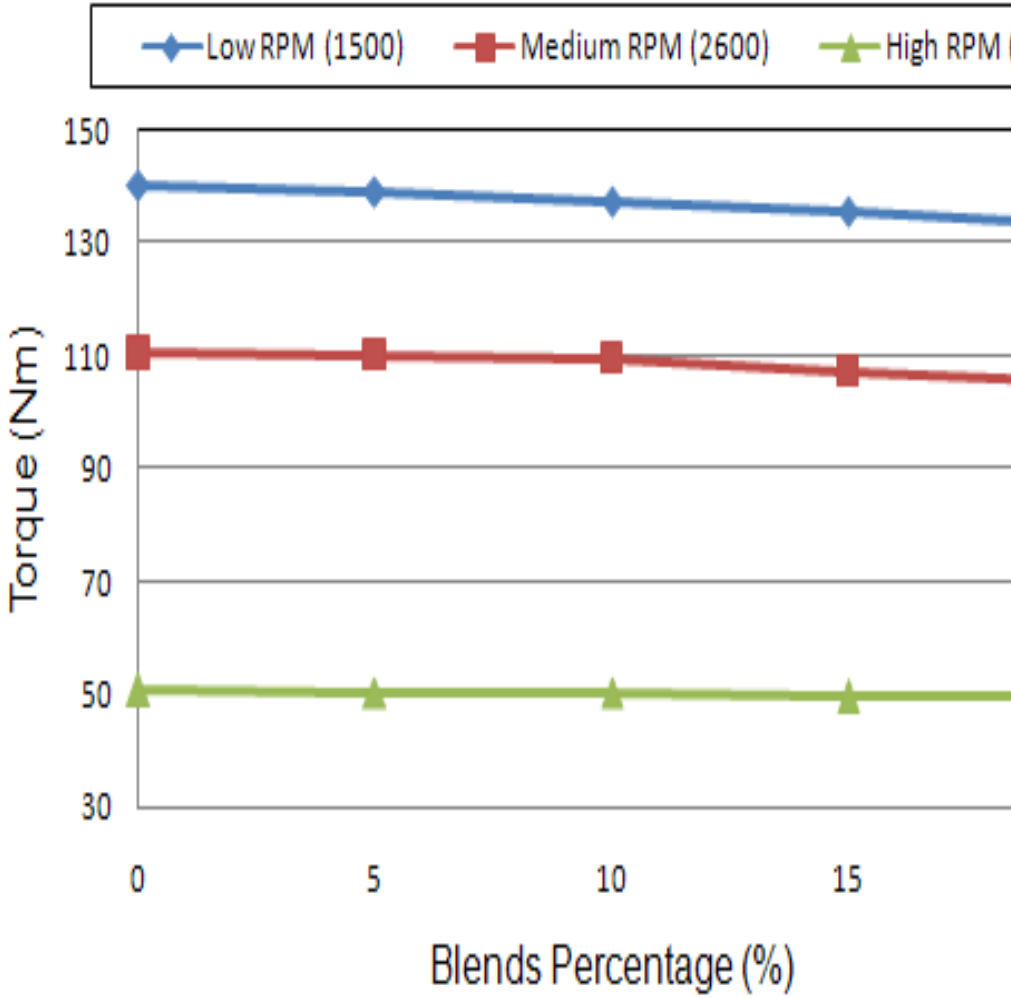




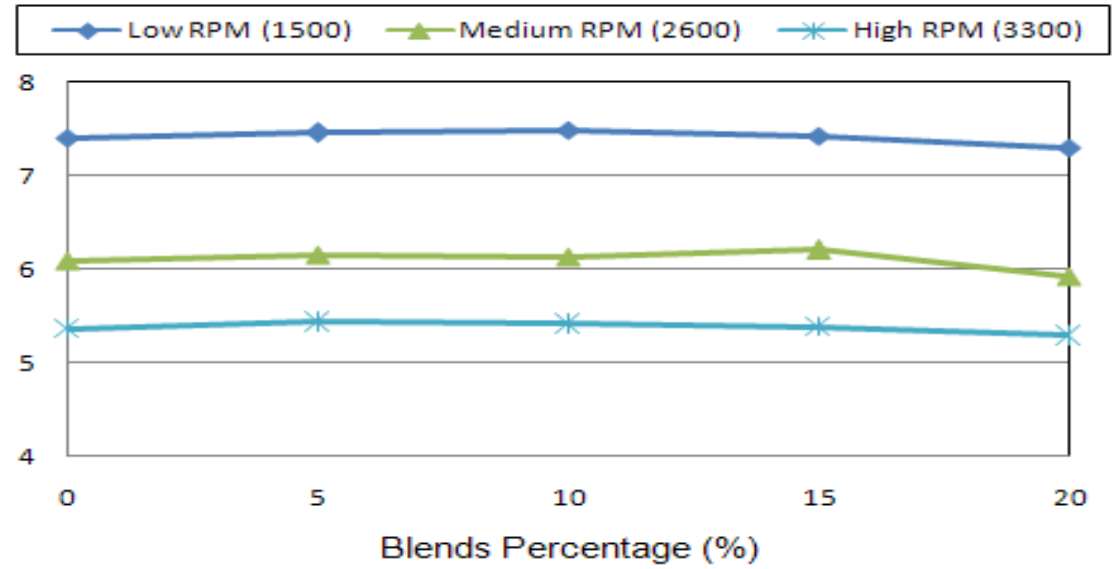


Variation of Engine performance with the engine speed, at full load

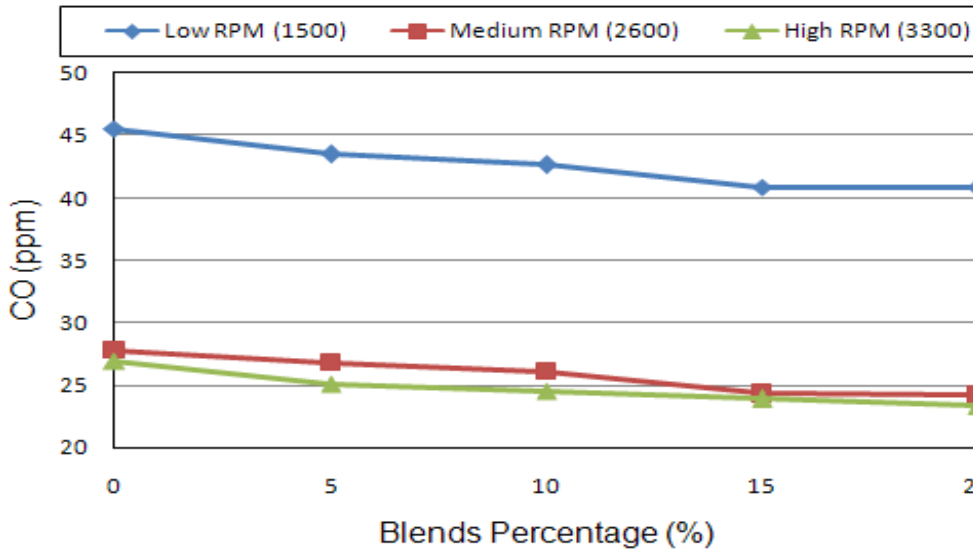


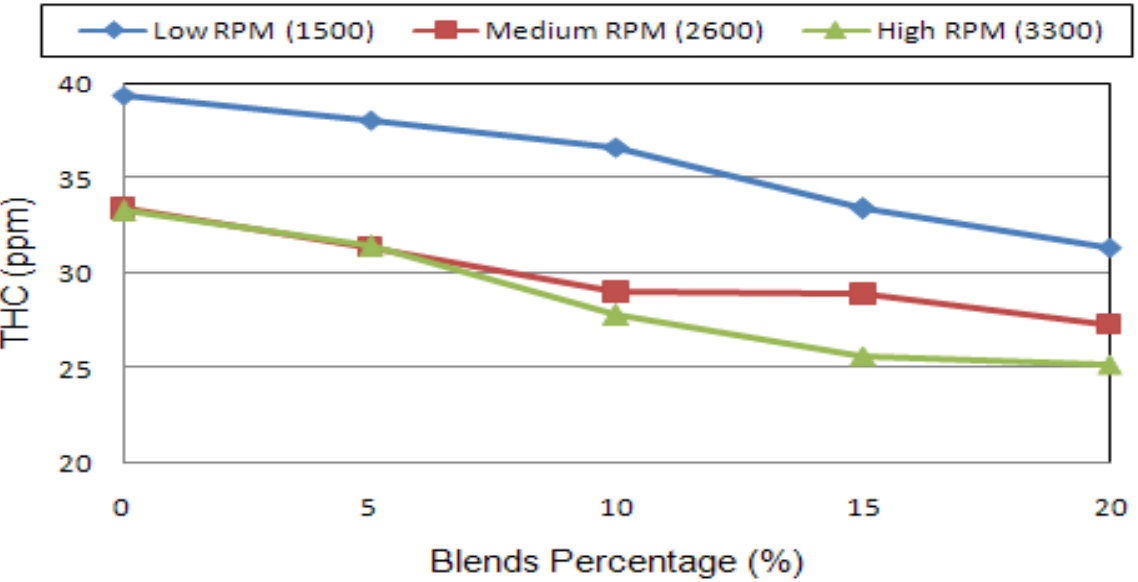


Variation of the brake power and the brake torque with the different biodiesel blends percentage, at full load

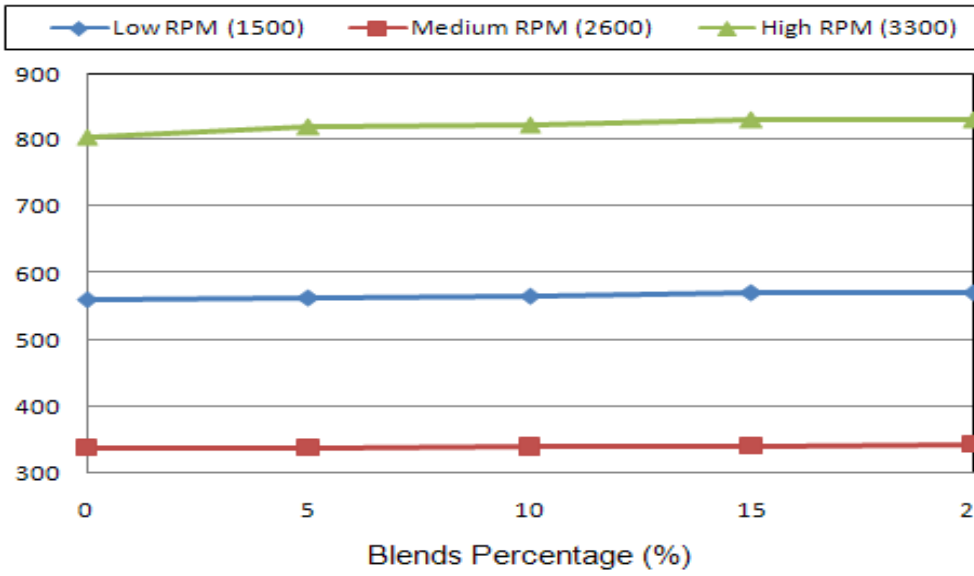


carbon monoxide



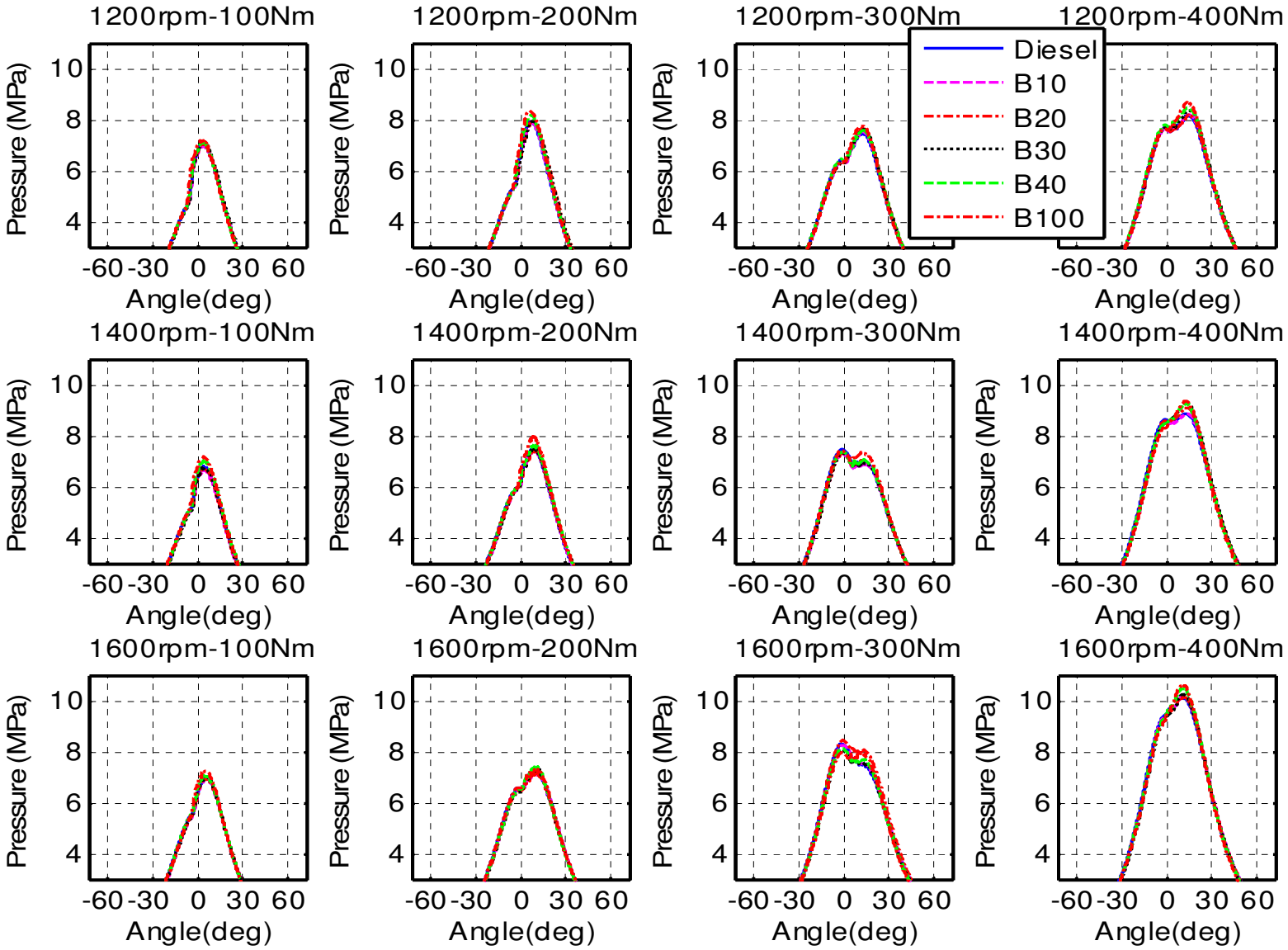


oxide of nitrogen



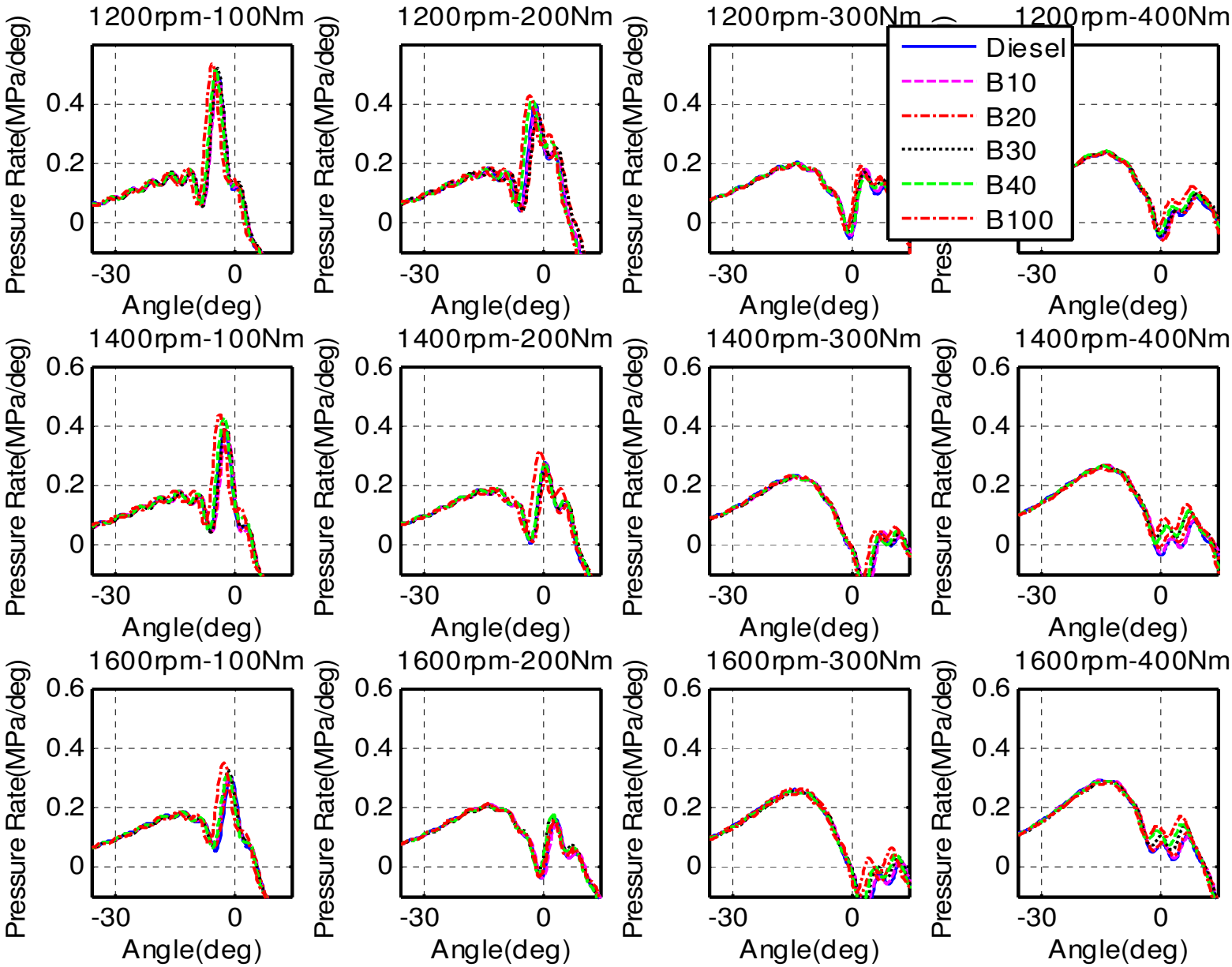
Variation of different gas emissions with biodiesel blends percentage

Cylinder pressure profile comparisons

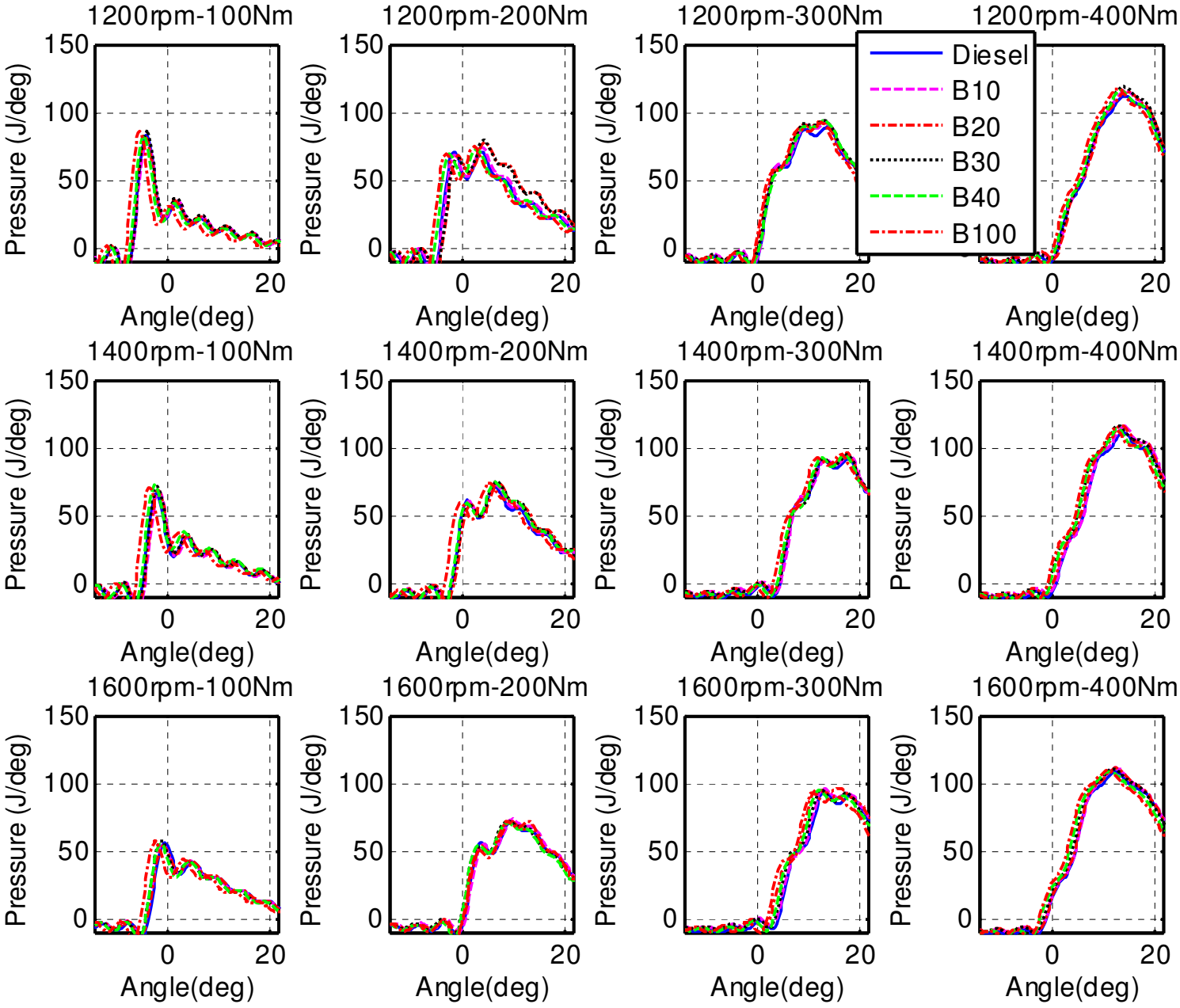


Variation of in-cylinder pressure for different fuels at different engine speeds and loads

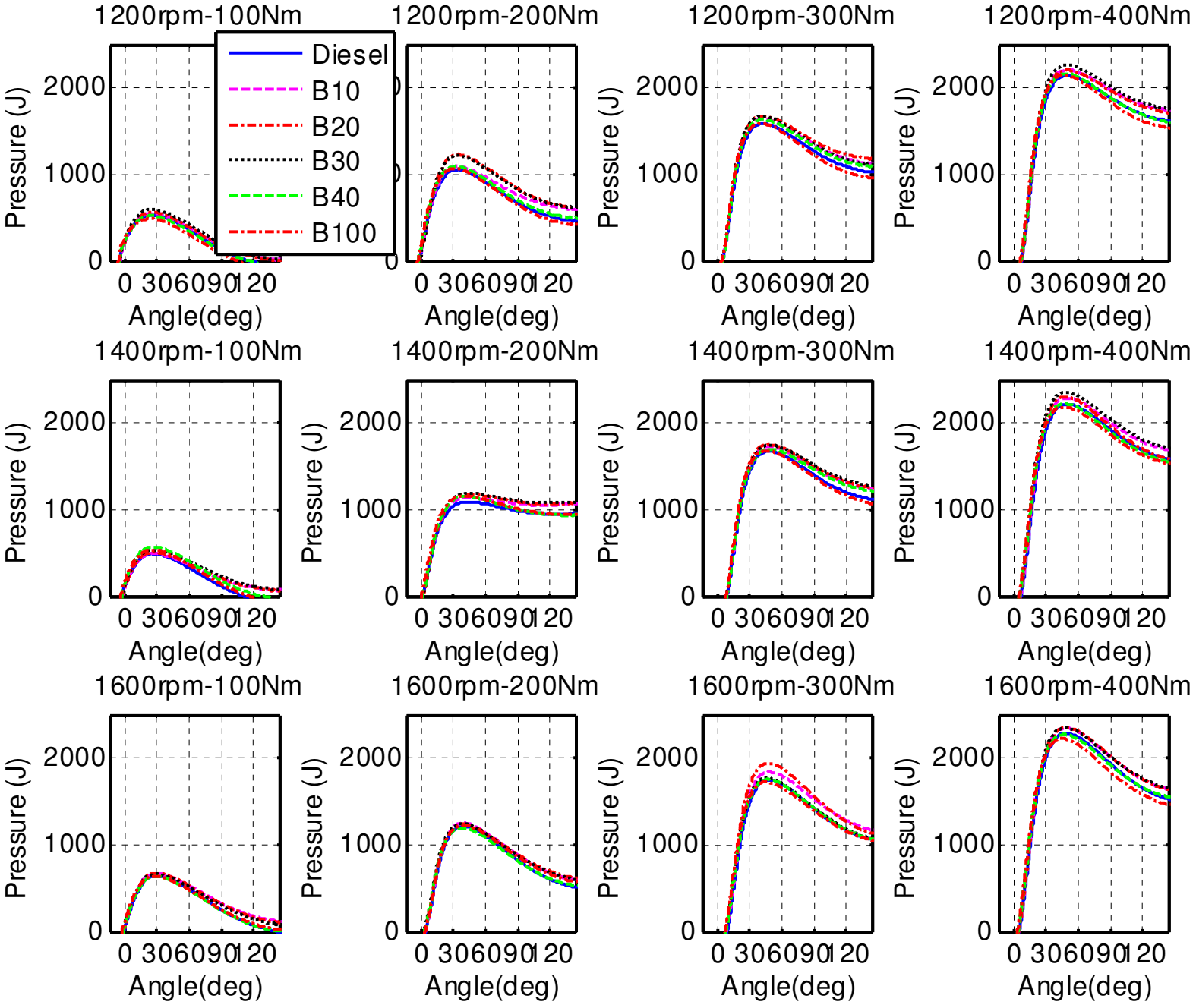
mparison of the rate of Cylinder pressure rise



Comparison of heat release rate



parison of Cumulative heat release



nclusions:

The “Fulpod” processor was used for the production of biodiesel from vegetable oils by using t ransesterification process.

After esterification of vegetable oils, the kinematic viscosity was reduced from 40 mm2/s to 5 mm2/s.

Thus, any type of vegetable oils biodiesel can be used as an alternate and nonconventional fue un all types of CI engine.

By running biodiesel fuel, the experiential data shown, decreased in almost all of the emission (CO, THC and CO_2) except for NOx.

The study has shown that no matter what type of feedstock is used there will be very similar decreases in emissions and performance of the engine.

The combustion profile for biodiesel fuel that is very similar to that of the baseline diesel fuel and a similar torque is demanded from the engine.

commendation for Future Work

uture work should be conducted on actual road vehicles, to see the mpact of driving a car in varying weather conditions, how the driver ffects the emissions, efficiency and performance of the oil.

nvestigation and characterization of combustion for mixture of biodiesel vith ethanol or methanol and evaluate the engine performance and xhaust gas emissions.

tudies to optimize and characterize biodiesel production from canola oil nd jatropha oil.

Thank you very much for your attention …


Any questions?