Specifications of the test engine are as follows:

Parameter	Specification
Model	Eicher 320D49
Engine type	Direct Injection diesel-fueled, mechanical injector type, in-line three-cylinder
Aspiration	Naturally Aspirated
Number of strokes	4
Number of cylinders	3
Rated speed (rpm)	2000
Bore X Stroke (mm x mm)	108 x 120
Displacement (cc)	3298
Compression ratio	18.5
Rated power (hp)	49
Idling speed	750rpm
Total lubrication oil capacity (l)	9.5
Cooling system	Water-cooled
Fuel injection timing	23^{o} BTDC
Connecting rod length (mm)	208
Piston pin offset (mm)	0.5
Firing order	1-2-3

Specifications of the eddy current dynometer attached with the engine are as follows:

Parameter	Specification
Maximum Power	200 HP @3500-8000 rpm
Maximum Torque	420Nm @ 1500-3500 rpm
Maximum excitation current	6 A DC
Coil resistance	12-15 Ω
Coil to dynamometer casing resistance	500 MΩ
Maximum permissible weight for calibration	42 kg
Dynamometer constant	7026
Cooling water pressure	1-1.2 bar
Cooling water temperature	<40˚C
Cooling water flow	100 lpm

Prior Research Work

To mitigate the dependence on fossil based resources and to cope up with more stringent emission norms, adaptability of alternative fuels in internal combustion engines is the need of the era. Similar to Alcohols as alternative fuel for SI engines, ethers are found to be an excellent replacement for conventional diesel in CI engines. The simplest form of ether is Dimethyl Ether (DME) with molecular formula CH_3OCH_3. With no C-C bond in DME, the exhaust is soot free and NO_x can be reduced to a great extent by incorporating exhaust gas recirculation. As DME is in gaseous state at atmospheric condition, initial experiments are carried out with ether having higher position in the series, Diethyl Ether($C_2H_5OC_2H_5$), which is a liquid in normal condition.

DEE is blended with diesel ranging from 15% v/v basis to 45%, beyond which the engine became unstable due to its inherent property of high volatility and low lubricity. The test are being performed without any significant structural changes in the engine, hence full load cannot be achieved due to lower calorific value of DEE compared to diesel. Three different types of emissions were analyzed from the engine exhaust gas, namely regulated emissions(CO, HC, NO_x) by Horiba Gas Analyzer(EXSA-1500), unregulated emissions(formaldehyde, SO_2, formic acid) by Fourior Transform Infrared Spectroscopy(FTIR) and Particulate Matter by Engine Exhaust Particle Sizer(EEPS).

Maintaining the same power output, it is found that NO_x and CO emission gets reduced with DEE blends compared to conventional diesel whereas HC emission increases. Unregulated emissions such as n-pentane, n-octane, iso-butene, sulphur dioxide, formic acid, formaldehyde though in very low concentration, slightly increases compared to that of conventional diesel, which gets decreased as load increases. A second main constituent of diesel exhaust is particulate matter. Particulates are formed due to partial combustion of charge and burning of lubricants entering in the combustion chamber through piston rings. Particle Number Concentration, Particle Mass Concentration, Total particle Number are found to be lower at low load conditions and comparable at high loads conditions with that of conventional diesel.

Current Research Work

To incorporate DME as a fuel and to perform similar tests, the fuel injection system of the engine is being modified for the adaptability with liquefied Dimethyl Ether as fuel. Distinct properties of DME compared to diesel are high vapour pressure, almost half calorific value, high rate of atomization and low lubricity. Modifying parts and parameters include low pressure line of fuel injection system, feed pump, fuel injection timing, Injection angle, nozzle diameter, adding additives to liquefied DME, etc.