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Performance of Indiesel Fuel and the Blend of Aviation Turbine Fuel in the Diesel Engine

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Abstract: ***The performance of the Engine is tested with the Indiesel fuel with the blends of the Aviation Turbine Fuel up to the 40%. The distillation properties, performance, and emissions are observed. This paper will project the output of the engine performance.***

Keywords: Indiesel, Aviation Turbine Fuel, Distillation, Power output, emissions.

I. INTRODUCTION

The Internal Combustion engine under test is selected. The Indiesel fuel is blended with dopant Aviation Turbine Fuel with different proportions up to 40% of Aviation Turbine Fuel. The calorific values of the samples are tested. The distillation parameters of density, flash point, Kinematic viscosity are tested and results are recorded. The performance is tested at different loads. The results are recorded. Finally the emission of gases through the tail pipe is observed.

II. MATERIALS

2.1 MATERIALS: Indiesel, Aviation Turbine Fuel. Smoke Analyser, Distillation equipment.

2.2 Testing equipment: Diesel IC Engine with the power 3.50 kW @ 1500 rpm, single Cylinder, Four stroke, Constant Speed, Water Cooled, Diesel Engine, with Cylinder Bore 87.50(mm), Stroke Length 110.00(mm), Connecting Rod length 234.00(mm), Compression Ratio 18.00, Swept volume 661.45 (cc).

2.3 The Combustion Parameters are Specific Gas Const (kJ/kgK) : 1.00, Air Density (kg/m^3) : 1.17, Adiabatic Index :1.41, Polytrophic Index : 0.99, Number Of Cycles : 10, Cylinder Pressure Reference : 6, Smoothing 2, TDC Reference : 0

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2.4 Performance Parameters : Orifice Diameter (mm) : 20.00, Orifice Coefficient of discharge : 0.60, Dynamometer Arm Length (mm) : 185, Fuel Pipe dia (mm) : 12.40, Ambient Temp. (^{O}C) : 27, Pulses Per revolution : 360,

III. LITERATURE REVIEW

Kinematic Viscosity varies for the similar Petroleum fuels. Fiber Optic technique is used to find the Gasoline adulteration[1]. A attempt is made to depict the adulteration through the Data Pre Processing in Gasoline[2]. Fractional distillation process is employed to find the adulteration with superior kerosene to the Gasoline[3]. Gasoline is blended with the bio fuels like Soya bean (15PRS, 20 PRS) and Mustard oil (15 PRM, 20 PRM). volumetric &mechanical Efficiencies are evaluated[4]. The ethanol blended Gasoline fuels and their use in the SI engines is narrated for climate changes and energy[5]. The flame height, combustion quality is lowered with the Diesel blends when compared with the Kerosene with the change in pressure[6]. The attempt is made to find the fuel adulteration through Multivariate Analysis[7]. Gasoline with hydrous ethanol can be used for power generation or other with low emissions[8]. Acetone is used to detect the adulteration[9]. With the increase in Kerosene blends there is substantial increase in the tail pipe emissions of carbon monoxide, un burnt hydrocarbon, particulate matters and specific fuel consumption[10].

LPFG (Long period fiber grating sensor) Technique can detect 10% contamination in Gasoline when compared with the conventional technique to the tune of 20 %[11]. At specific wavelengths, different blends of kerosene exhibit imitation fuel samples, show linear variations of the synchronous emission intensity[12]. Adulteration is calculated in terms of resistance and capacitance. Practical calculations is done with LCR meter[13]. This paper presented the emissions due to mixture of fuels with kerosene. The harmful gases like carbon monoxide, hydro carbons and expanded knocking tendency[14]. In addition to the statutory authorities, there shall be the responsibility of user to reduce the usage of harmful emissions due to the adulteration of fuels[15]. The ill effects of the use of Benzene in Gasoline is described[16]. Ultrasonic propagation velocity will help in finding the adulteration and need the practical measurements like distillation may give good results[17].

Diesel emissions with white spirit are tested. It is found an enhancement of the nitrogen oxide emissions, unburned hydrocarbons, and Particulate Matter[18]. The fuel with increased blend of Kerosene yielded maximum power output, lower carbon monoxide emissions[19].

IV.RESULT AND DISCUSSION

4.1: The results of the Distillation:

S.No.	Colour	Density	Sulphur (ppm)	Flash Point	Kinematic Viscosity (cst)
1	Yellow	814.2	85	67.5	2.913
2	Yellow	812	107	66	2.856
3	Yellow	809.7	163	59	2.532
4	Yellow	807.6	273	57.5	2.499
5	Yellow	808.4	187	65	2.657

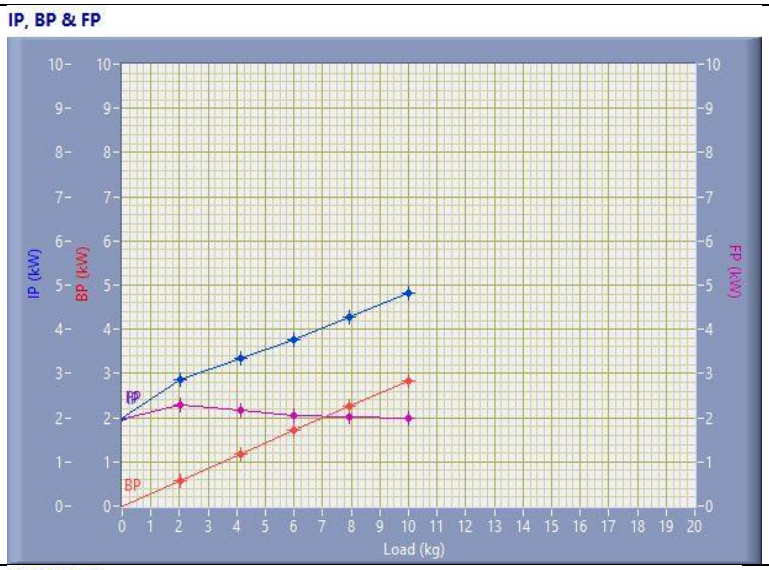
4.2: The results of the Smoke and its composition.

Sample	Load	CO(Vol)	HC(ppm)	CO_2 (Vol)	O_2(Vol)	NO(ppm)	Smoke(%)
1	0	0.17	21	1.20	19.07	6	32.3
	2	0.08	15	1.80	18.20	105	48.9
	4	0.05	14	2.10	17.85	222	61
	6	0.04	16	2.40	17.44	368	73
	8	0.04	18	3.00	16.60	584	86.4
	10	0.03	15	3.10	16.41	710	94.3
2	0	0.01	13	1.30	18.93	38	32
	2	0.08	15	1.90	18.20	109	44
	4	0.06	16	2.30	17.53	228	55.5
	6	0.04	17	2.40	17.48	352	66.3
	8	0.03	14	2.70	17.10	509	78.9
	10	0.03	14	3.5	16.03	745	80.04
3	0	0.11	13	1.60	18.66	47	28
	2	0.08	10	1.9	18.26	112	37.5
	4	0.05	13	2.2	17.73	239	44
	6	0.06	15	2.5	17.41	367	53
	8	0.03	13	3.0	16.76	559	71.5
	10	0.03	13	3.0	16.68	663	85
4	0	0.11	15	1.5	18.69	52	30.8
	2	0.07	14	1.7	18.42	104	37.2
	4	0.04	15	2.0	18.05	203	47.3
	6	0.03	20	2.4	17.36	360	58.2
	8	0.03	18	2.6	17.13	476	74.3
	10	0.03	19	3.40	16.04	740	83.6
5	0	0.12	18	1.70	18.43	54	21.1
	2	0.08	14	1.80	18.41	103	28.3
	4	0.05	16	2.20	17.72	225	34.8
	6	0.03	15	2.20	17.72	333	42.6
	8	0.03	14	2.70	17.17	502	46.5
	10	0.03	13	3.00	16.78	653	73.5

4.3 Engine performance at different composition of blend and with its respective Calorific Value:

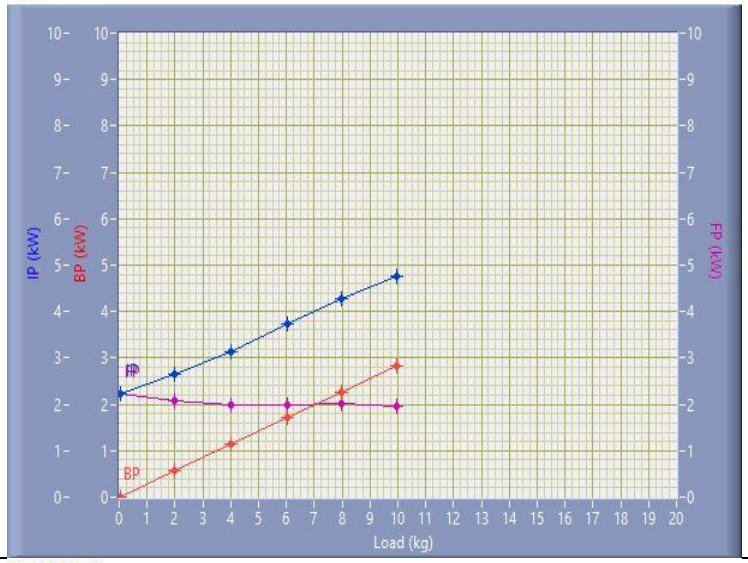
4.3.1.IP, BP & FP :: (Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431)

Speed (rpm)	Load (kg)	IP (kW)	BP (kW)	FP (kW)
1537	-0.08	1.94	-0.02	1.97
1526	2.01	2.86	0.58	2.28
1515	4.13	3.35	1.19	2.16
1510	6.00	3.78	1.72	2.06
1500	7.94	4.27	2.26	2.01
1491	10.01	4.82	2.84	1.98



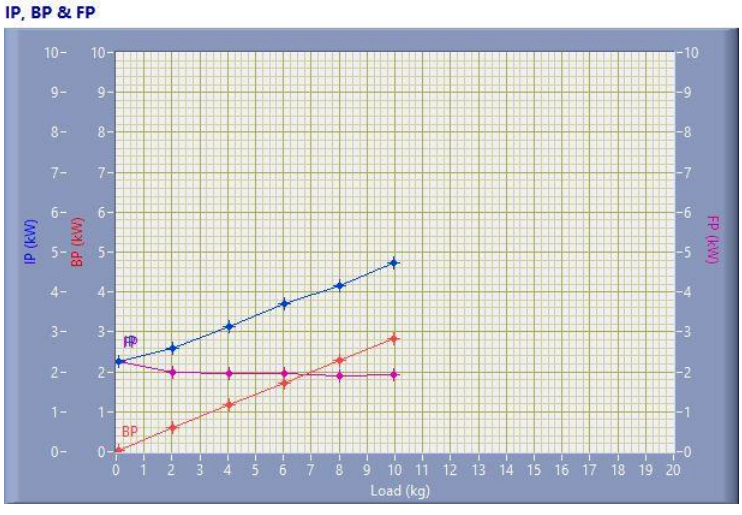
4.3.2.IP, BP & FP :: (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Speed (rpm)	Load (kg)	IP (kW)	BP (kW)	FP (kW)
1529	0.03	2.23	0.01	2.22
1523	1.98	2.66	0.57	2.08
1516	4.00	3.15	1.15	1.99
1507	6.04	3.72	1.73	1.99
1498	7.99	4.29	2.27	2.01
1489	9.98	4.77	2.82	1.95



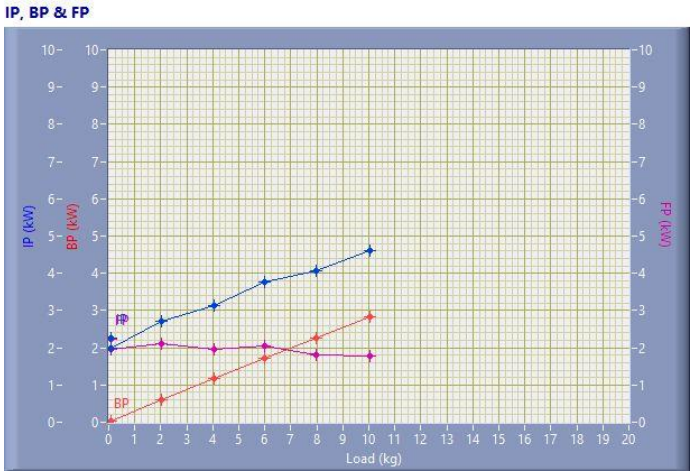
4.3.3.IP, BP & FP :: (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Speed (rpm)	Load (kg)	IP (kW)	BP (kW)	FP (kW)
1528	0.07	2.27	0.02	2.24
1520	2.04	2.58	0.59	1.99
1514	4.06	3.14	1.17	1.97
1507	6.03	3.69	1.73	1.96
1499	8.01	4.17	2.28	1.88
1490	9.97	4.74	2.82	1.92



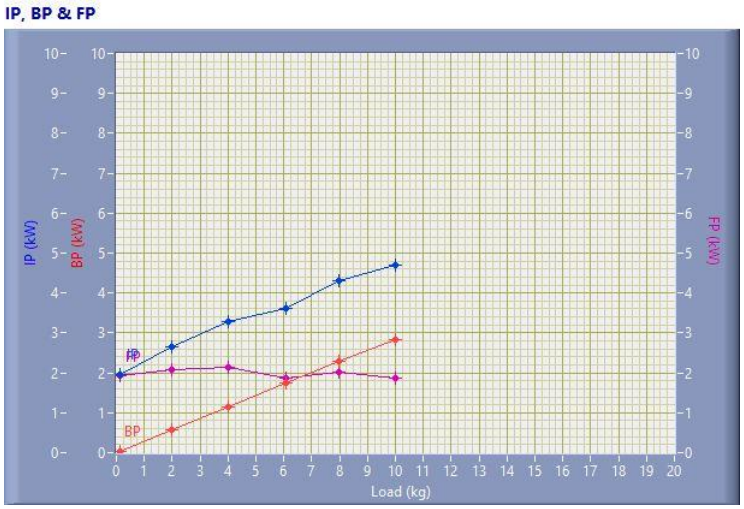
4.3.4. IP, BP & FP (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

Speed (rpm)	Load (kg)	IP (kW)	BP (kW)	FP (kW)
1528	0.07	2.26	0.02	2.24
1531	0.10	1.98	0.03	1.95
1520	2.04	2.71	0.59	2.12
1516	4.06	3.14	1.17	1.97
1504	6.00	3.75	1.71	2.04
1496	7.95	4.06	2.26	1.80
1493	10.02	4.62	2.84	1.77



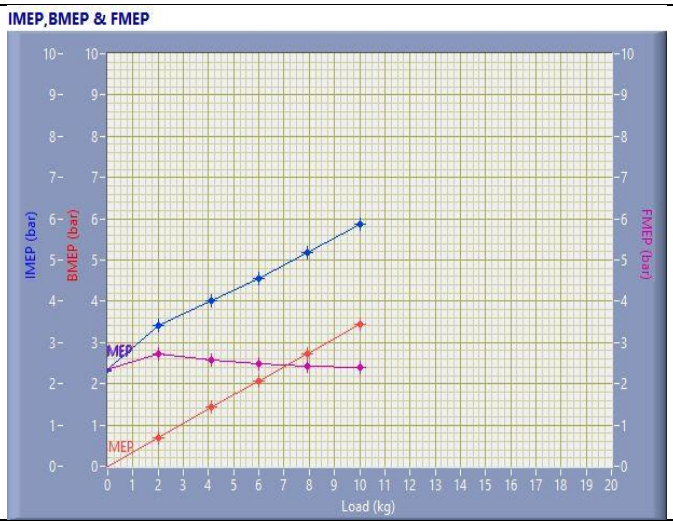
4.3.5. IP, BP & FP (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Speed (rpm)	Load (kg)	IP (kW)	BP (kW)	FP (kW)
1531	0.14	1.96	0.04	1.92
1523	2.00	2.65	0.58	2.07
1514	3.99	3.29	1.15	2.15
1508	6.06	3.60	1.74	1.86
1500	7.98	4.30	2.28	2.02
1494	10.02	4.71	2.84	1.86



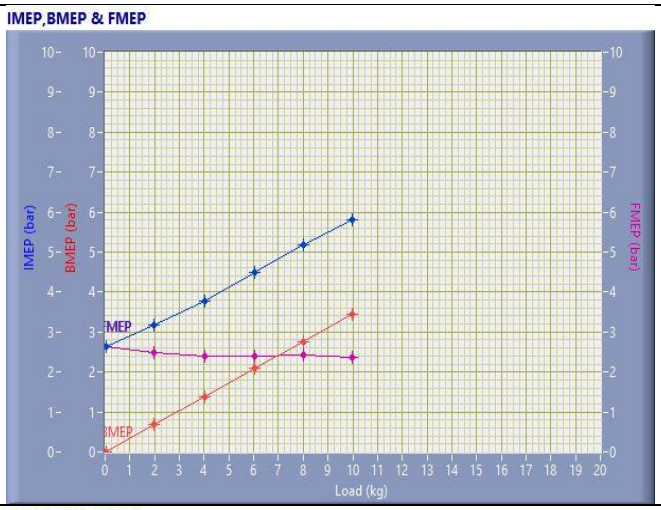
4.4.1.IMEP,BMEP & FMEP :: (Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431)

Speed (rpm)	Load (kg)	IMEP (bar)	BMEP (bar)	FMEP (bar)
1537	-0.08	2.29	-0.03	2.32
1526	2.01	3.41	0.69	2.71
1515	4.13	4.01	1.42	2.59
1510	6.00	4.54	2.07	2.47
1500	7.94	5.17	2.74	2.43
1491	10.01	5.86	3.45	2.41



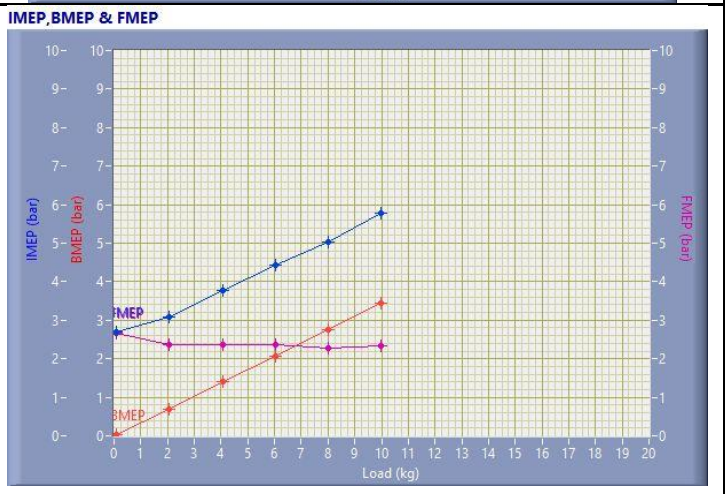
4.4.2. IMEP,BMEP & FMEP :: (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Speed (rpm)	Load (kg)	IMEP (bar)	BMEP (bar)	FMEP (bar)
1529	0.03	2.65	0.01	2.64
1523	1.98	3.17	0.68	2.48
1516	4.00	3.77	1.38	2.38
1507	6.04	4.48	2.08	2.40
1498	7.99	5.19	2.75	2.44
1489	9.98	5.81	3.44	2.37



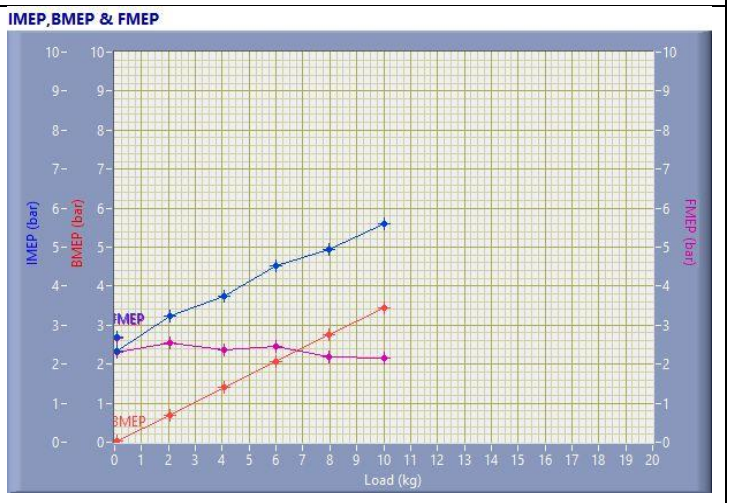
4.4.3. IMEP,BMEP & FMEP :: (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Speed (rpm)	Load (kg)	IMEP (bar)	BMEP (bar)	FMEP (bar)
1528	0.07	2.69	0.03	2.67
1520	2.04	3.08	0.70	2.37
1514	4.06	3.76	1.40	2.36
1507	6.03	4.44	2.08	2.36
1499	8.01	5.04	2.76	2.28
1490	9.97	5.78	3.44	2.34



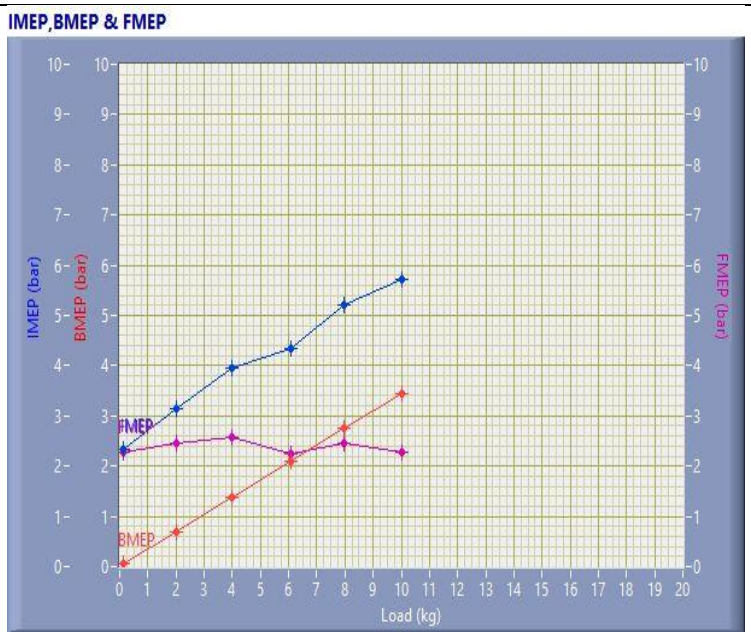
4.4.4. IMEP,BMEP & FMEP :: (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

Speed (rpm)	Load (kg)	IMEP (bar)	BMEP (bar)	FMEP (bar)
1528	0.07	2.68	0.03	2.66
1531	0.10	2.35	0.03	2.31
1520	2.04	3.23	0.70	2.53
1516	4.06	3.75	1.40	2.35
1504	6.00	4.53	2.07	2.46
1496	7.95	4.93	2.74	2.18
1493	10.02	5.61	3.46	2.15



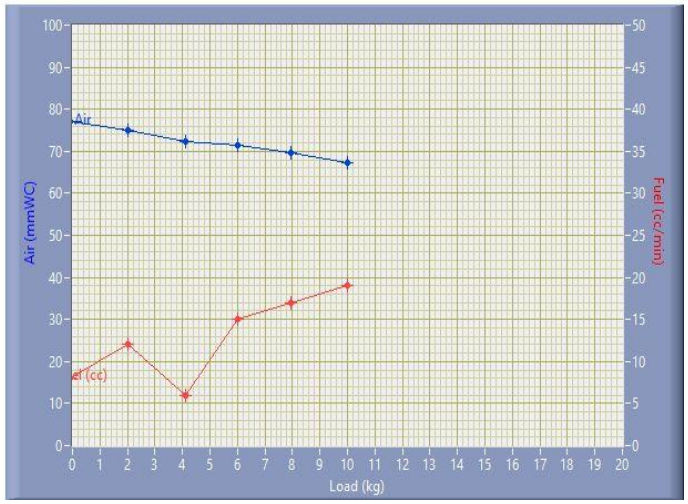
4.4.5. IMEP,BMEP & FMEP :: (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Speed (rpm)	Load (kg)	IMEP (bar)	BMEP (bar)	FMEP(bar)
1531	0.14	2.33	0.05	2.28
1523	2.00	3.16	0.69	2.47
1514	3.99	3.95	1.38	2.57
1508	6.06	4.33	2.09	2.24
1500	7.98	5.20	2.75	2.44
1494	10.02	5.72	3.45	2.26



4.5.1. Air & Fuel Flow :: Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431

Speed (rpm)	Load (kg)	Air (mmWC)	Fuel (cc/min)
1537	-0.08	77.13	8.00
1526	2.01	74.86	12.00
1515	4.13	72.28	6.00
1510	6.00	71.36	15.00
1500	7.94	69.57	17.00
1491	10.01	67.13	19.00

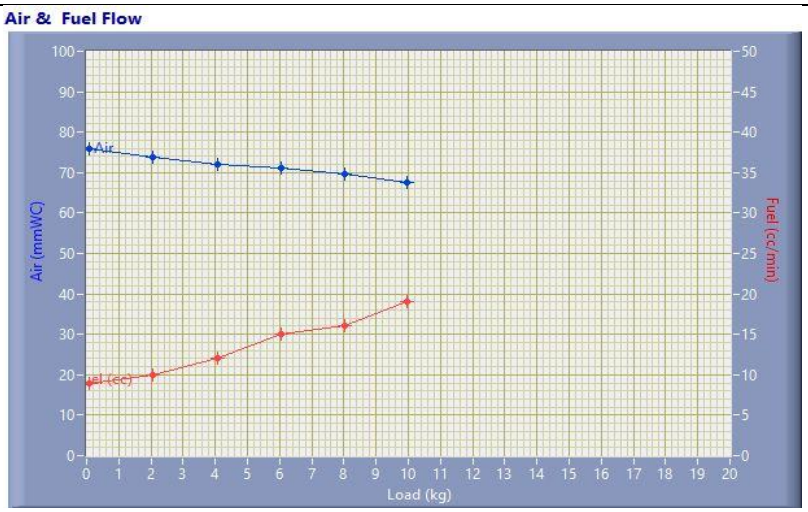


4.5.2. Air & Fuel Flow (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Speed (rpm)	Load (kg)	Air (mmWC)	Fuel (cc/min)
1529	0.03	76.00	9.00
1523	1.98	74.60	10.00
1516	4.00	72.76	12.00
1507	6.04	71.15	15.00
1498	7.99	69.05	16.00
1489	9.98	67.23	19.00

4.5.3. Air & Fuel Flow (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Speed (rpm)	Load (kg)	Air (mmWC)	Fuel (cc/min)
1528	0.07	75.82	9.00
1520	2.04	73.68	10.00
1514	4.06	72.15	12.00
1507	6.03	71.03	15.00
1499	8.01	69.56	16.00
1490	9.97	67.65	19.00



4.5.4. Air & Fuel Flow (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

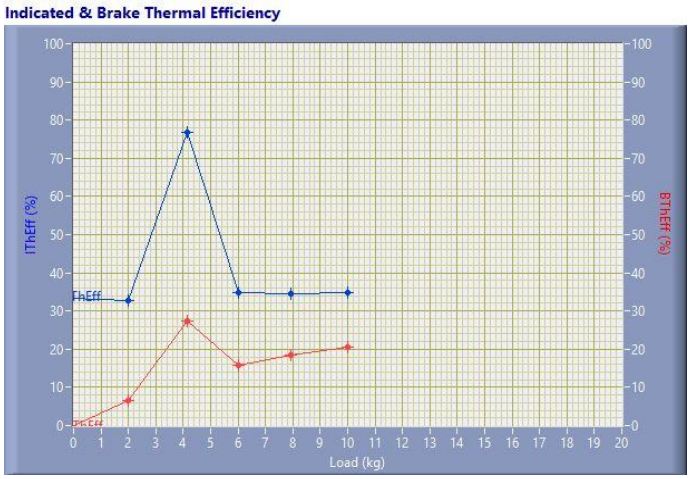
Speed (rpm)	Load (kg)	Air (mmWC)	Fuel (cc/min)
1528	0.07	75.38	0.00
1531	0.10	75.68	9.00
1520	2.04	74.38	11.00
1516	4.06	72.56	12.00
1504	6.00	71.37	14.00
1496	7.95	69.43	16.00
1493	10.02	67.61	19.00

4.5.5. Air & Fuel Flow (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Speed (rpm)	Load (kg)	Air (mmWC)	Fuel (cc/min)
1531	0.14	74.89	9.00
1523	2.00	74.03	11.00
1514	3.99	73.13	13.00
1508	6.06	70.97	14.00
1500	7.98	69.95	17.00
1494	10.02	67.50	19.00

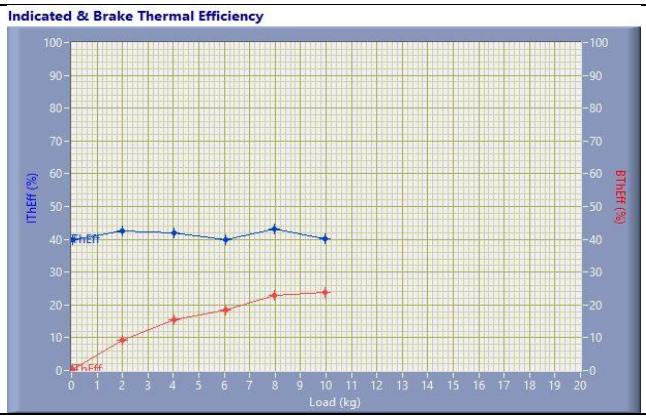
4.6.1. Indicated & Brake Thermal Efficiency::Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431

Speed (rpm)	Load (kg)	IThEff (%)	BThEff (%)
1537	-0.08	33.48	-0.42
1526	2.01	32.89	6.69
1515	4.13	76.87	27.29
1510	6.00	34.72	15.82
1500	7.94	34.65	18.33
1491	10.01	34.92	20.57



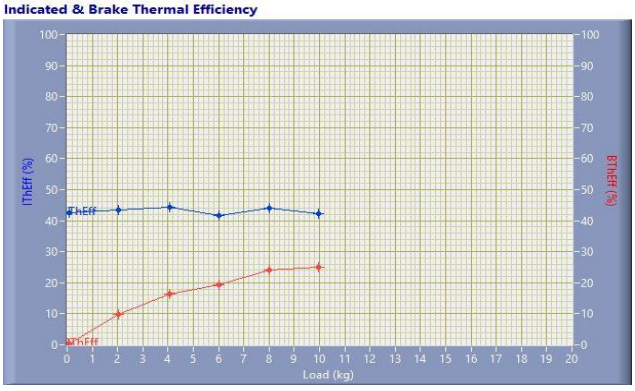
4.6.2. Indicated & Brake Thermal Efficiency (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Speed (rpm)	Load (kg)	IThEff (%)	BThEff (%)
1529	0.03	39.81	0.17
1523	1.98	42.69	9.22
1516	4.00	42.10	15.44
1507	6.04	39.82	18.52
1498	7.99	43.01	22.82
1489	9.98	40.32	23.86



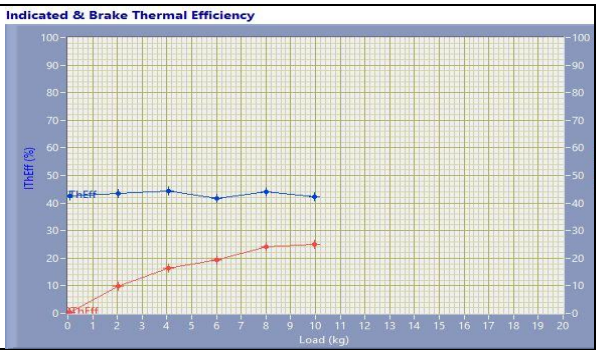
4.6.3. Indicated & Brake Thermal Efficiency (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Speed (rpm)	Load (kg)	IThEff (%)	BThEff (%)
1528	0.07	42.55	0.40
1520	2.04	43.56	9.94
1514	4.06	44.22	16.45
1507	6.03	41.58	19.46
1499	8.01	44.01	24.11
1490	9.97	42.19	25.10



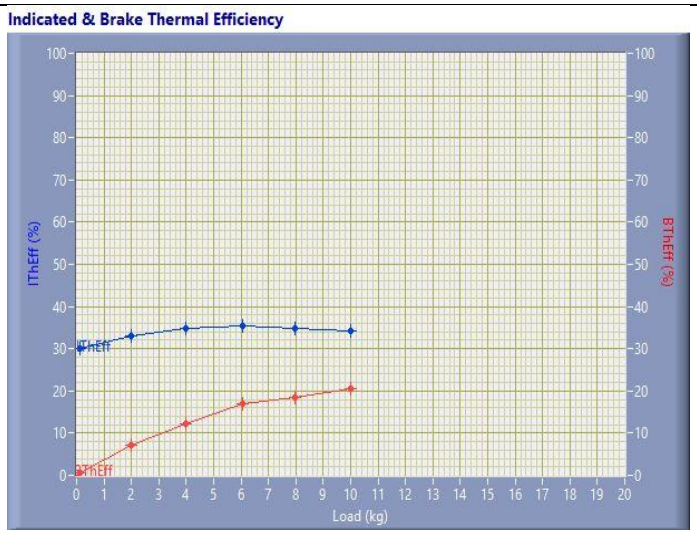
4.6.4. Indicated & Brake Thermal Efficiency (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

Speed (rpm)	Load (kg)	IThEff (%)	BThEff (%)
1528	0.07	0.00	0.00
1531	0.10	27.63	0.40
1520	2.04	30.91	6.72
1516	4.06	32.82	12.24
1504	6.00	33.65	15.37
1496	7.95	31.87	17.74
1493	10.02	30.50	18.79



4.6.5. Indicated & Brake Thermal Efficiency (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Speed (rpm)	Load (kg)	IThEff (%)	BThEff (%)
1531	0.14	30.05	0.61
1523	2.00	33.18	7.25
1514	3.99	34.92	12.18
1508	6.06	35.43	17.10
1500	7.98	34.84	18.45
1494	10.02	34.14	20.63

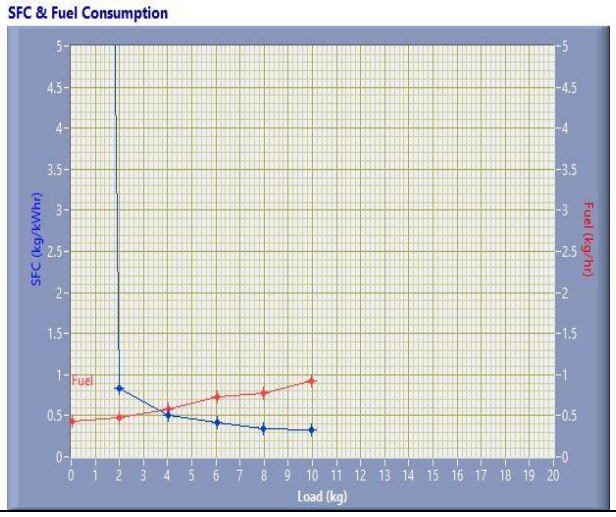


4.7.1. SFC & Fuel Consumption :: Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431

Speed (rpm)	Load (kg)	SFC (kg/kWh)	Fuel (kg/h)
1537	-0.08	0.00	0.39
1526	2.01	1.01	0.59
1515	4.13	0.25	0.29
1510	6.00	0.43	0.73
1500	7.94	0.37	0.83
1491	10.01	0.33	0.93

4.7.2. SFC & Fuel Consumption (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Speed (rpm)	Load (kg)	SFC (kg/kWh)	Fuel (kg/h)
1529	0.03	46.36	0.43
1523	1.98	0.84	0.48
1516	4.00	0.50	0.58
1507	6.04	0.42	0.72
1498	7.99	0.34	0.77
1489	9.98	0.32	0.92
1529	0.03	46.36	0.43

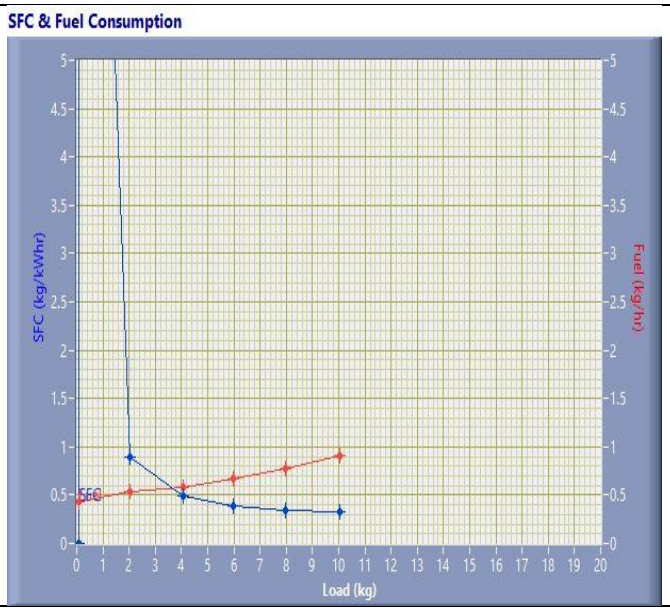


4.7.3. SFC & Fuel Consumption (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Speed (rpm)	Load (kg)	SFC (kg/kWh)	Fuel (kg/h)
1528	0.07	20.22	0.43
1520	2.04	0.82	0.48
1514	4.06	0.49	0.58
1507	6.03	0.42	0.72
1499	8.01	0.34	0.77
1490	9.97	0.32	0.91

4.7.4. SFC & Fuel Consumption (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

Speed (rpm)	Load (kg)	SFC (kg/kWh)	Fuel (kg/h)
1528	0.07	0.00	0.00
1531	0.10	15.01	0.43
1520	2.04	0.90	0.53
1516	4.06	0.49	0.58
1504	6.00	0.39	0.67
1496	7.95	0.34	0.77
1493	10.02	0.32	0.91

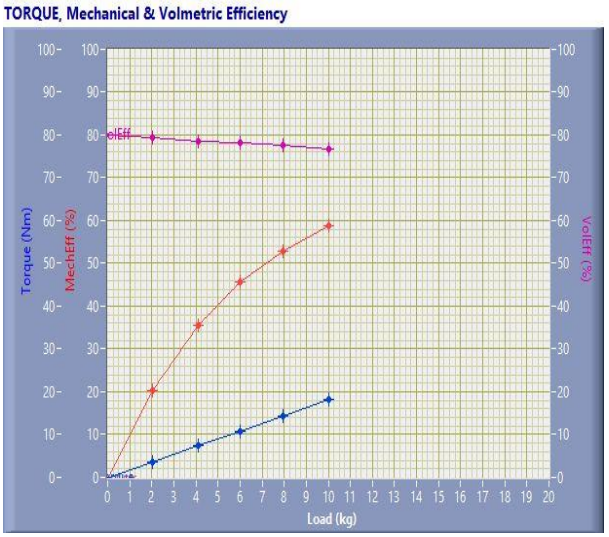


4.7.5. SFC & Fuel Consumption (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Speed (rpm)	Load (kg)	SFC (kg/kWh)	Fuel (kg/h)
1531	0.14	10.95	0.43
1523	2.00	0.92	0.53
1514	3.99	0.55	0.63
1508	6.06	0.39	0.67
1500	7.98	0.36	0.82
1494	10.02	0.32	0.92

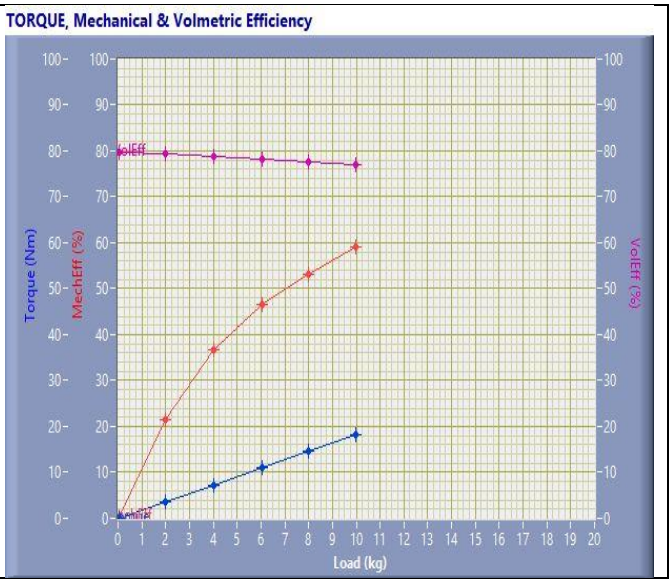
4.8.1. TORQUE, Mechanical & Volmertic Efficiency:: Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431

Speed (rpm)	Load (Kg)	Torque (Nm)	Mech Eff. (%)	Vol Eff. (%)
1537	-0.08	-0.15	-1.26	79.88
1526	2.01	3.65	20.35	79.27
1515	4.13	7.49	35.50	78.46
1510	6.00	10.89	45.56	78.21
1500	7.94	14.40	52.92	77.74
1491	10.01	18.17	58.91	76.83



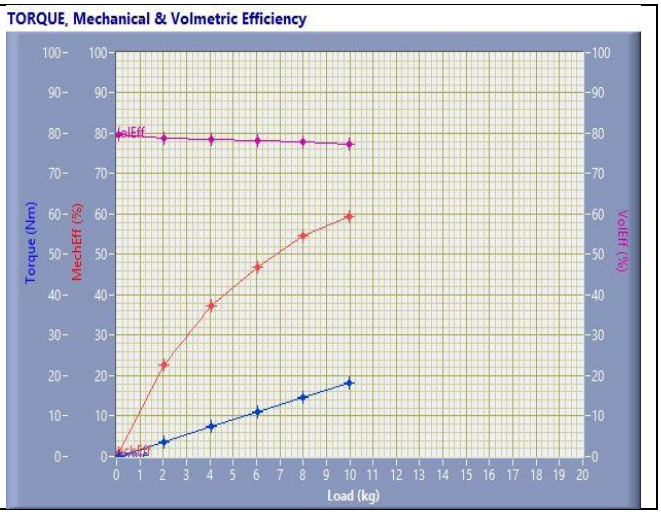
4.8.2. TORQUE, Mechanical & Volmertic Efficiency :: (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Speed (rpm)	Load (Kg)	Torque (Nm)	Mech Eff. (%)	Vol Eff. (%)
1529	0.03	0.06	0.42	79.71
1523	1.98	3.60	21.59	79.28
1516	4.00	7.27	36.67	78.66
1507	6.04	10.97	46.52	78.25
1498	7.99	14.50	53.06	77.55
1489	9.98	18.11	59.18	76.98



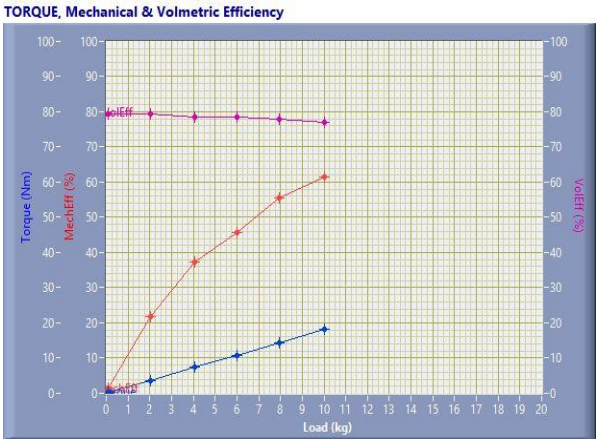
4.8.3. TORQUE, Mechanical & Volmertic Efficiency:: (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Speed (rpm)	Load (Kg)	Torque (Nm)	Mech Eff. (%)	Vol Eff. (%)
1528	0.07	0.13	0.95	79.67
1520	2.04	3.70	22.82	78.95
1514	4.06	7.37	37.20	78.44
1507	6.03	10.95	46.81	78.19
1499	8.01	14.54	54.77	77.79
1490	9.97	18.09	59.50	77.17



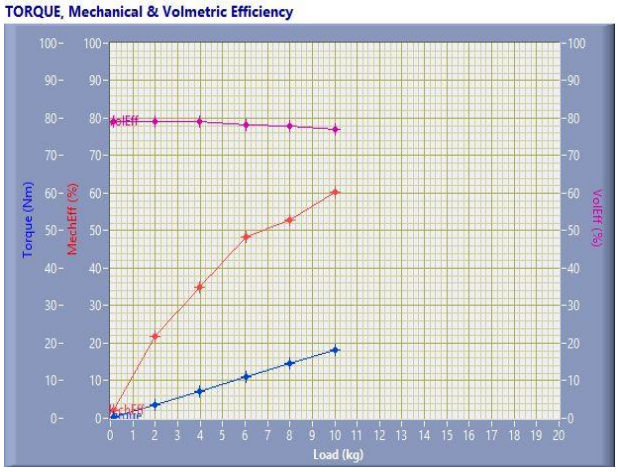
4.8.4. TORQUE, Mechanical & Volmertic Efficiency (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

Speed (rpm)	Load (Kg)	Torque (Nm)	Mech Eff. (%)	Vol Eff. (%)
1528	0.07	0.13	0.93	79.43
1531	0.10	0.18	1.45	79.44
1520	2.04	3.70	21.74	79.33
1516	4.06	7.37	37.30	78.56
1504	6.00	10.88	45.67	78.53
1496	7.95	14.44	55.67	77.87
1493	10.02	18.19	61.61	77.00



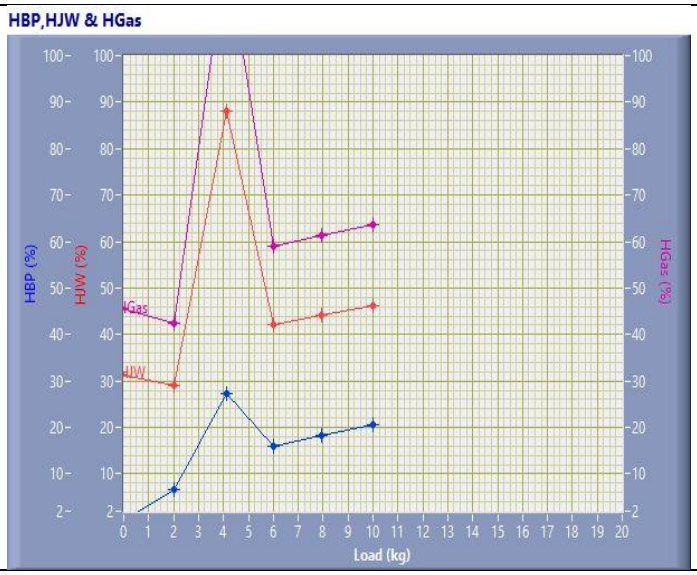
4.8.5. TORQUE, Mechanical & Volmertic Efficiency (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Speed (rpm)	Load (Kg)	Torque (Nm)	Mech Eff. (%)	Vol Eff. (%)
1531	0.14	0.25	2.02	79.02
1523	2.00	3.63	21.84	78.98
1514	3.99	7.25	34.88	78.96
1508	6.06	11.00	48.25	78.10
1500	7.98	14.49	52.96	77.95
1494	10.02	18.18	60.43	76.88



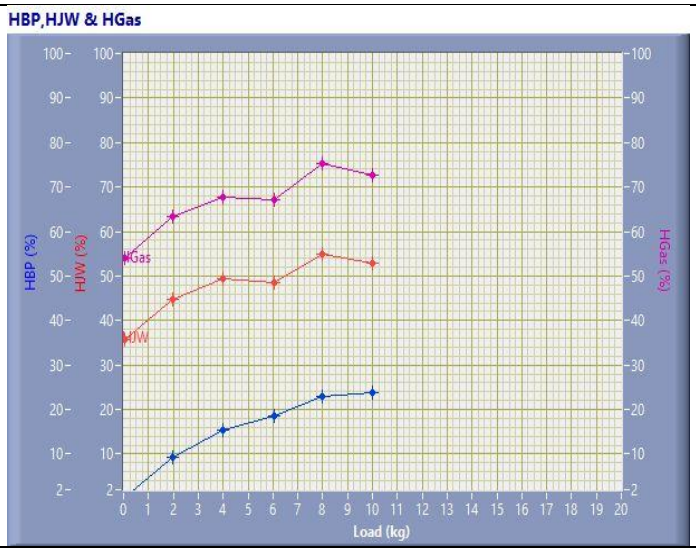
4.9.1. HBP,HJW & HGas :: Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431

Speed (rpm)	Load (kg)	HBP (%)	HJW (%)	HGas (%)	HRad (%)
1537	-0.08	-0.42	31.83	14.08	54.51
1526	2.01	6.69	22.30	13.35	57.66
1515	4.13	27.29	60.73	34.95	0.00
1510	6.00	15.82	26.34	16.74	41.11
1500	7.94	18.33	25.89	17.02	38.75
1491	10.01	20.57	25.56	17.39	36.48



4.9.2. HBP,HJW & HGas (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Speed (rpm)	Load (kg)	HBP (%)	HJW (%)	HGas (%)	HRad (%)
1529	0.03	0.17	35.64	18.16	46.03
1523	1.98	9.22	35.50	18.77	36.51
1516	4.00	15.44	33.83	18.46	32.27
1507	6.04	18.52	29.90	18.62	32.96
1498	7.99	22.82	32.11	20.45	24.62
1489	9.98	23.86	28.96	19.75	27.42

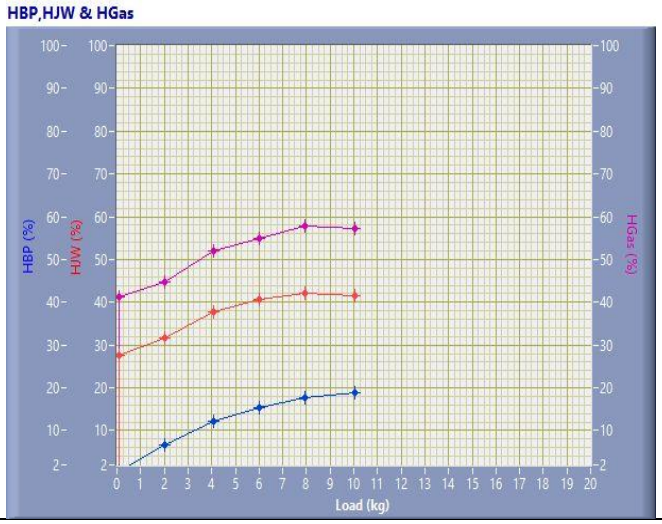


4.9.3. HBP,HJW & HGas (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Speed (rpm)	Load (kg)	HBP (%)	HJW (%)	HGas (%)	HRad (%)
1528	0.07	0.40	38.81	19.84	40.94
1520	2.04	9.94	37.12	19.91	33.03
1514	4.06	16.45	35.33	20.79	27.43
1507	6.03	19.46	32.77	19.71	28.06
1499	8.01	24.11	33.45	21.33	21.12
1490	9.97	25.10	30.22	20.58	24.09

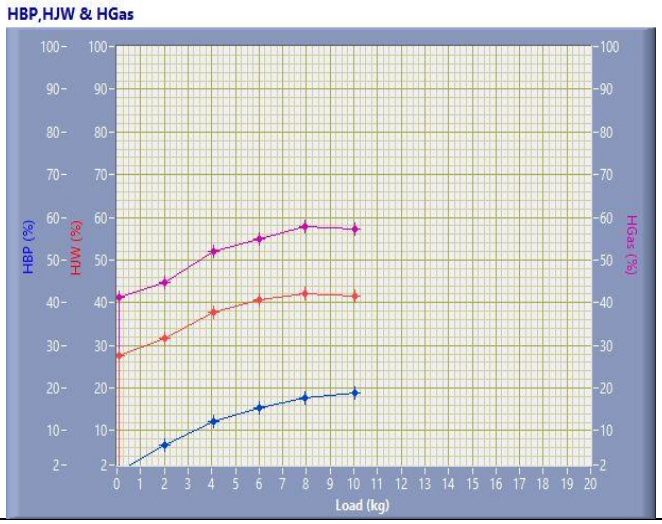
4.9.4. HBP,HJW & HGas (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

Speed (rpm)	Load (kg)	HBP (%)	HJW (%)	HGas (%)	HRad (%)
1528	0.07	0.00	0.00	0.00	100.00
1531	0.10	0.40	27.14	13.70	58.76
1520	2.04	6.72	24.85	13.18	55.25
1516	4.06	12.24	25.45	14.20	48.11
1504	6.00	15.37	25.32	14.38	44.93
1496	7.95	17.74	24.40	15.81	42.05
1493	10.02	18.79	22.75	15.58	42.88



4.9.5. HBP,HJW & HGas (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Speed (rpm)	Load (kg)	HBP (%)	HJW (%)	HGas (%)	HRad (%)
1531	0.14	0.61	30.64	15.00	53.76
1523	2.00	7.25	27.58	14.34	50.84
1514	3.99	12.18	26.24	14.46	47.12
1508	6.06	17.10	27.06	15.48	40.37
1500	7.98	18.45	25.41	15.60	40.54
1494	10.02	20.63	25.01	16.61	37.74



5.1.1. Observation Data (Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431)

Speed (rpm)	Load (kg)	Comp Ratio	T1 (^0C)	T2 (℃)	T3 (^{0}C)	T4 (^0C)	T5 (^0C)	T6 (℃)
1537	-0.08	18.00	28.49	34.84	28.48	29.23	119.29	87.49
1526	2.01	18.00	28.42	35.10	28.41	29.85	159.24	108.75
1515	4.13	18.00	28.52	37.61	28.52	31.55	195.40	136.30
1510	6.00	18.00	28.59	38.45	28.58	32.32	220.51	152.15
1500	7.94	18.00	28.66	39.65	28.66	33.74	252.04	172.64
1491	10.01	18.00	28.71	40.83	28.71	34.96	287.51	194.00

5.1.2. Observation Data (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Speed (rpm)	Load (kg)	Comp Ratio	T1 (^0C)	T2 (℃)	T3 (^{0}C)	T4 (^0C)	T5 (^0C)	T6 (℃)
1529	0.03	18.00	28.72	35.59	28.72	30.12	142.59	105.30
1523	1.98	18.00	28.70	36.30	28.70	30.44	160.69	114.41
1516	4.00	18.00	28.72	37.42	28.73	31.18	186.18	130.38
1507	6.04	18.00	28.75	38.36	28.75	32.18	215.04	148.71
1498	7.99	18.00	28.79	39.80	28.79	33.31	246.64	168.88
1489	9.98	18.00	28.85	40.64	28.86	34.52	280.90	189.70

5.1.3 Observation Data (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Speed (rpm)	Load (kg)	Comp Ratio	T1 (^0C)	T2 (℃)	T3 (^{0}C)	T4 (^0C)	T5 (^0C)	T6 (℃)
1528	0.07	18.00	28.80	35.91	28.80	30.79	139.51	102.07
1520	2.04	18.00	28.80	36.36	28.81	31.13	158.29	112.46
1514	4.06	18.00	28.81	37.44	28.81	31.92	183.82	128.43
1507	6.03	18.00	28.84	38.84	28.82	33.06	213.35	147.30
1499	8.01	18.00	28.88	39.78	28.88	34.27	243.87	167.02
1490	9.97	18.00	28.91	40.60	28.90	35.65	277.64	187.91

5.1.4 (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

Speed (rpm)	Load (kg)	Comp Ratio	T1 (^0C)	T2 (℃)	T3 (^{0}C)	T4 (^0C)	T5 (^0C)	T6 (℃)
1528	0.07	18.00	28.90	35.47	28.90	29.81	138.89	101.16
1531	0.10	18.00	28.89	35.59	28.90	29.85	138.75	101.35
1520	2.04	18.00	28.90	36.39	28.90	30.27	159.10	113.05
1516	4.06	18.00	28.91	37.29	28.91	31.02	183.82	129.26
1504	6.00	18.00	28.96	38.67	28.95	31.96	213.25	148.08
1496	7.95	18.00	28.99	39.68	28.99	33.13	243.60	168.05
1493	10.02	18.00	29.06	40.91	29.07	34.48	282.42	192.19

5.1.5 Observation Data (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Speed (rpm)	Load (kg)	Comp Ratio	T1 (^0C)	T2 (℃)	T3 (^{0}C)	T4 (^0C)	T5 (^0C)	T6 (℃)
1531	0.14	18.00	29.05	35.94	29.05	30.06	139.03	101.56
1523	2.00	18.00	29.04	36.61	29.05	30.49	158.23	112.84
1514	3.99	18.00	29.07	37.58	29.07	31.25	183.84	129.07
1508	6.06	18.00	29.10	38.55	29.10	31.97	210.06	145.47
1500	7.98	18.00	29.14	39.92	29.13	32.90	239.84	164.82
1494	10.02	18.00	29.15	41.02	29.16	34.19	275.36	186.54

5.2.1. Observation Data (Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431)

Air (mmWC)	Fuel (cc/min)	WaterFlow Engine (lph)	WaterFlow Cal (lph)
77.13	8.00	250	150
74.86	12.00	250	150
72.28	6.00	250	150
71.36	15.00	250	150
69.57	17.00	250	150
67.13	19.00	250	150

5.2.2. Observation Data (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Air (mmWC)	Fuel (cc/min)	Water Flow Engine (lph)	Water Flow Cal (lph)
76.00	9.00	250	150
74.60	10.00	250	150
72.76	12.00	250	150
71.15	15.00	250	150
69.05	16.00	250	150
67.23	19.00	250	150

5.2.3. Observation Data (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Air (mmWC)	Fuel (cc/min)	WaterFlow Engine (lph)	WaterFlow Cal (lph)
75.82	9.00	250	150
73.68	10.00	250	150
72.15	12.00	250	150
71.03	15.00	250	150

69.56	16.00	250	150
67.65	19.00	250	150

5.2.4. Observation Data (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

Air (mmWC)	Fuel (cc/min)	WaterFlow Engine (lph)	WaterFlow Cal (lph)
75.38	0.00	250	150
75.68	9.00	250	150
74.38	11.00	250	150
72.56	12.00	250	150
71.37	14.00	250	150
69.43	16.00	250	150
67.61	19.00	250	150

5.2.5. Observation Data (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Air (mmWC)	Fuel (cc/min)	WaterFlow Engine (lph)	WaterFlow Cal (lph)
74.89	9.00	250	150
74.03	11.00	250	150
73.13	13.00	250	150
70.97	14.00	250	150
69.95	17.00	250	150
67.50	19.00	250	150

5.3.1. Result Data (Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431)

Torque (Nm)	BP (kW)	FP (kW)	IP (kW)	BMEP (bar)	IMEP (bar)	BTHE (%)	ITHE (%)	Mech Eff. (%)
-0.15	-0.02	1.97	1.94	-0.03	2.29	-0.42	33.48	-1.26
3.65	0.58	2.28	2.86	0.69	3.41	6.69	32.89	20.35
7.49	1.19	2.16	3.35	1.42	4.01	27.29	76.87	35.50
10.89	1.72	2.06	3.78	2.07	4.54	15.82	34.72	45.56
14.40	2.26	2.01	4.27	2.74	5.17	18.33	34.65	52.92
18.17	2.84	1.98	4.82	3.45	5.86	20.57	34.92	58.91

5.3.2. Result Data (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Torque (Nm)	BP (kW)	FP (kW)	IP (kW)	BMEP (bar)	IMEP (bar)	BTHE (%)	ITHE (%)	Mech Eff. (%)
0.06	0.01	2.22	2.23	0.01	2.65	0.17	39.81	0.42
3.60	0.57	2.08	2.66	0.68	3.17	9.22	42.69	21.59
7.27	1.15	1.99	3.15	1.38	3.77	15.44	42.10	36.67
10.97	1.73	1.99	3.72	2.08	4.48	18.52	39.82	46.52
14.50	2.27	2.01	4.29	2.75	5.19	22.82	43.01	53.06
18.11	2.82	1.95	4.77	3.44	5.81	23.86	40.32	59.18

5.3.3. Result Data (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Torque (Nm)	BP (kW)	FP (kW)	IP (kW)	BMEP (bar)	IMEP (bar)	BTHE (%)	ITHE (%)	Mech Eff. (%)
0.13	0.02	2.24	2.27	0.03	2.69	0.40	42.55	0.95
3.70	0.59	1.99	2.58	0.70	3.08	9.94	43.56	22.82
7.37	1.17	1.97	3.14	1.40	3.76	16.45	44.22	37.20
10.95	1.73	1.96	3.69	2.08	4.44	19.46	41.58	46.81
14.54	2.28	1.88	4.17	2.76	5.04	24.11	44.01	54.77
18.09	2.82	1.92	4.74	3.44	5.78	25.10	42.19	59.50

5.3.4. Result Data (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

Torque (Nm)	BP (kW)	FP (kW)	IP (kW)	BMEP (bar)	IMEP (bar)	BTHE (%)	ITHE (%)	Mech Eff. (%)
0.13	0.02	2.24	2.26	0.03	2.68	0.00	0.00	0.93
0.18	0.03	1.95	1.98	0.03	2.35	0.40	27.63	1.45
3.70	0.59	2.12	2.71	0.70	3.23	6.72	30.91	21.74
7.37	1.17	1.97	3.14	1.40	3.75	12.24	32.82	37.30
10.88	1.71	2.04	3.75	2.07	4.53	15.37	33.65	45.67
14.44	2.26	1.80	4.06	2.74	4.93	17.74	31.87	55.67
18.19	2.84	1.77	4.62	3.46	5.61	18.79	30.50	61.61

5.3.5. Result Data (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Torque (Nm)	BP (kW)	FP (kW)	IP (kW)	BMEP (bar)	IMEP (bar)	BTHE (%)	ITHE (%)	Mech Eff. (%)
0.25	0.04	1.92	1.96	0.05	2.33	0.61	30.05	2.02
3.63	0.58	2.07	2.65	0.69	3.16	7.25	33.18	21.84
7.25	1.15	2.15	3.29	1.38	3.95	12.18	34.92	34.88
11.00	1.74	1.86	3.60	2.09	4.33	17.10	35.43	48.25
14.49	2.28	2.02	4.30	2.75	5.20	18.45	34.84	52.96
18.18	2.84	1.86	4.71	3.45	5.72	20.63	34.14	60.43

5.4.1. Result Data (Fuel Density (Kg/m^3) : 815, Calorific Value Of Fuel (kj/kg) : 53431)

Air Flow (kg/h)	Fuel Flow (kg/h)	SFC (kg/kWh)	Vol Eff. (%)	A/F Ratio	HBP (%)	HJW (%)	HGas (%)	HRad (%)
28.60	0.39	0.00	79.88	73.11	-0.42	31.83	14.08	54.51
28.18	0.59	1.01	79.27	48.02	6.69	22.30	13.35	57.66
27.69	0.29	0.25	78.46	94.37	27.29	60.73	34.95	0.00
27.51	0.73	0.43	78.21	37.51	15.82	26.34	16.74	41.11
27.16	0.83	0.37	77.74	32.67	18.33	25.89	17.02	38.75
26.68	0.93	0.33	76.83	28.72	20.57	25.56	17.39	36.48

5.4.2. Result Data (Fuel Density (Kg/m^3) : 804, Calorific Value Of Fuel (kj/kg) : 46476)

Air Flow (kg/h)	Fuel Flow (kg/h)	SFC (kg/kWh)	Vol Eff. (%)	A/F Ratio	HBP (%)	HJW (%)	HGas (%)	HRad (%)
28.39	0.43	46.36	79.71	65.39	0.17	35.64	18.16	46.03
28.13	0.48	0.84	79.28	58.31	9.22	35.50	18.77	36.51
27.78	0.58	0.50	78.66	47.99	15.44	33.83	18.46	32.27
27.47	0.72	0.42	78.25	37.96	18.52	29.90	18.62	32.96
27.06	0.77	0.34	77.55	35.06	22.82	32.11	20.45	24.62
26.70	0.92	0.32	76.98	29.13	23.86	28.96	19.75	27.42

5.4.3. Result Data (Fuel Density (Kg/m^3) : 802, Calorific Value Of Fuel (kj/kg) : 44271)

Air Flow (kg/h)	Fuel Flow (kg/h)	SFC (kg/kWh)	Vol Eff. (%)	A/F Ratio	HBP (%)	HJW (%)	HGas (%)	HRad (%)
28.36	0.43	20.22	79.67	65.48	0.40	38.81	19.84	40.94
27.95	0.48	0.82	78.95	58.09	9.94	37.12	19.91	33.03
27.66	0.58	0.49	78.44	47.91	16.45	35.33	20.79	27.43
27.45	0.72	0.42	78.19	38.03	19.46	32.77	19.71	28.06
27.16	0.77	0.34	77.79	35.28	24.11	33.45	21.33	21.12
26.79	0.91	0.32	77.17	29.30	25.10	30.22	20.58	24.09

5.4.4. Result Data (Fuel Density (Kg/m^3) : 801, Calorific Value Of Fuel (kj/kg) : 59671)

Air Flow (kg/h)	Fuel Flow (kg/h)	SFC (kg/kWh)	Vol Eff. (%)	A/F Ratio	HBP (%)	HJW (%)	HGas (%)	HRad (%)
28.27	0.00	0.00	79.43	0.00	0.00	0.00	0.00	100.00
28.33	0.43	15.01	79.44	65.50	0.40	27.14	13.70	58.76
28.09	0.53	0.90	79.33	53.13	6.72	24.85	13.18	55.25
27.74	0.58	0.49	78.56	48.10	12.24	25.45	14.20	48.11
27.51	0.67	0.39	78.53	40.89	15.37	25.32	14.38	44.93

27.14	0.77	0.34	77.87	35.29	17.74	24.40	15.81	42.05
26.78	0.91	0.32	77.00	29.32	18.79	22.75	15.58	42.88

5.4.5. Result Data (Fuel Density (Kg/m^3) : 803, Calorific Value Of Fuel (kj/kg) : 54223)

Air Flow (kg/h)	Fuel Flow (kg/h)	SFC (kg/kWh)	Vol Eff. (%)	A/F Ratio	HBP (%)	HJW (%)	H Gas (%)	H Rad (%)
28.18	0.43	10.95	79.02	64.99	0.61	30.64	15.00	53.76
28.02	0.53	0.92	78.98	52.87	7.25	27.58	14.34	50.84
27.85	0.63	0.55	78.96	44.46	12.18	26.24	14.46	47.12
27.44	0.67	0.39	78.10	40.67	17.10	27.06	15.48	40.37
27.24	0.82	0.36	77.95	33.25	18.45	25.41	15.60	40.54
26.76	0.92	0.32	76.88	29.23	20.63	25.01	16.61	37.74

V.CONCLUSION

The Density of the blend samples are decreased. The content of the Sulphur is increased and Kinematic Viscosity decreased. There is substantial increase in the gases of Carbon monoxide, Nitrogen Oxide and increase in the engine performance with the increase of Aviation Turbine Fuel blend with the Indiesel. The specific fuel consumption, Air to Fuel Ratio, volumetric efficiency is reduced to some extent.

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