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Experimental Performance of 4-Stroke Single Cylinder S.I Engine Operating on Gasoline-Alcohol Fuels Blends.

Presented by

Mr. Sohan V. Sarode

Assistant Professor

Department of Mechanical Engineering

Nagpur Institute of Technology, Nagpur

INTRODUCTION

The research on alternative fuels has become essential due to depletion of petroleum products and its major contribution for pollutants. Alternative fuels for both spark ignition (SI) and compression ignition (CI) engines have become very important owing to increased environmental protection concern, the need to reduce dependency on petroleum and even socioeconomic aspects.

Depletion of fossil fuels and environmental consideration has let engineers and scientists to anticipate the need to develop a clean, renewable and sustainable energy system. The energy crisis created an incentive to study and evaluate different alternative fuels in the SI engine these alternative fuels are fermented and distilled from biomasses, it can be considered as a renewable energy.

In this presentation we focused on the effects of various alternative fuel additions to gasoline in various concentrations on engine performance and it is examined by conducting both theoretical and experimental studies.

DIFFERENT TYPES OF BLEND FUELS :-

Gasoline

E10 (10% ethanol and 90% gasoline)

E20 (20% ethanol and 80% gasoline)

E30 (30% ethanol and 70% gasoline)

M10 (10% methanol and 90% gasoline)

M20 (20% methanol and 80% gasoline)

M30 (30% methanol and 70% gasoline)

Methanol (GR)

CAS No.67-56-1

Ethanol (GR)

CAS No.64-17-5

PROPERTIES OF ETHANOL AND METHANOL

The physical and chemical properties of Gasoline, Ethyl alcohol and Methyl alcohol are listed in the following table.

Sr.No.	Property	Gasoline	Ethanol	Methanol
1.	Chemical formula	mC_nH_{2n}	C_2H_5OH	CH_3OH
2.	Molecular weight(Kg/mol)	112	46	32
3.	Composition by wt. in% Carbon Hydrogen Oxygen	 84.0 16.0 Nil	 52.0 13.0 35.0	 37.5 12.5 50.0
4.	Specific gravity	0.7-0.75	0.794	0.796
5.	Boiling Point(^oC)	30.0	78.0	65.0
6.	Latent heat of vaporization(Kcal/kg)	70-100	204.0	264.0
7.	Lower Calorific value (Kcal/kg)	10,500	6,400	4,700
8.	Ignition limit A/F ratio	6.0-22.0	3.57-17	2.15-12.8

PROPERTIES OF ETHANOL AND METHANOL

The physical and chemical properties of Gasoline, Ethyl alcohol and Methyl alcohol are listed in the following table.

Property item	Test Fuel						
	Gasoline	E10	E20	E30	M10	M20	M30
Density Kg/m^3	767.8	776	778.2	779.4	769.2	770.7	773.4
Calorific value KJ/kg-k	44133	42447	40672	38673	41615	38233	36247
Stoichiometric A/F ratio	14.7	14.13	13.56	12.99	13.877	13.054	12.231
Research octane no.	84.8	88.3	93.4	98.9	88.2	94.4	98.4

Experimental setup

Schematic of Experimental setup

ENGINE SPECIFICATION:-

- Variable compression ratio petrol engine test rig.
- Single cylinder four stroke Air cooled.
- Electrical loading (Air heater 500W each)
- Air flow across Orifice (Orifice diameter =12mm)
- No. of Cylinder =1
- Bore = 70mm
- Stroke = 66.7mm
- Coefficient of discharge = 0.62

TESTING PARAMETERS

1.Effect of Brake power on Brake thermal efficiency at variable compression ratio.

2.Effect of Brake power on Brake specific fuel consumption at variable compression ratio.

3.Effect of Brake power on Volumetric efficiency at variable compression ratio.

4.Effect of Brake power on Exhaust gas temperature at variable compression ratio.

Observation Table

For E30 (Compression ratio 6:1), Speed=2000rpm				
Sr.no	Load (KW)	Manometric head (mm)	Time for 20cc fuel consumption.(sec)	Texg.(C)
1	0	39	84	573
2	0.5	52	75	576
3	1	65	67	578
4	1.5	77	62	580
5	2	86	59	582
6	2.5	93	57	584

Observation Table

For E30 (Compression ratio 8:1), Speed=2000rpm				
Sr.no	Load (KW)	Manometric head(mm)	Time for 20cc fuel consumption.(sec)	Texg.(C)
1	0	37.5	86	607
2	0.5	50.5	76	610
3	1	63	69	612
4	1.5	75	64	615
5	2	84.5	60	617
6	2.5	91.5	58	620

Observation Table

For E30 (Compression ratio 10:1), Speed=2000rpm				
Sr.no	Load (KW)	Manometric head(mm)	Time for 20cc fuel consumption.(sec)	Texg.(C)
1	0	36	88	613
2	0.5	49.5	78	616
3	1	61.5	71	618
4	1.5	72.5	66	621
5	2	83	62	625
6	2.5	89	60	628

For E30 (Compression ratio 6:1)

B.P (KW)	Mass flow rate of air (10^-3)	Mass flow rate of fuel (10^-3)	BMEP	BSFC	Brake thermal efficiency	Air/Fuel ratio	Volumetric efficiency
0	2.2713	0.1856	0.0000	0.0000	0.0000	12.2397	45.5737
0.5	2.6227	0.2078	1.1689	1.4964	6.2206	12.6189	52.6240
1	2.9323	0.2327	2.3377	0.8376	11.1142	12.6035	58.8354
1.5	3.1915	0.2514	3.5066	0.6034	15.4271	12.6939	64.0365
2	3.3729	0.2642	4.6754	0.4756	19.5742	12.7661	67.6755
2.5	3.5074	0.2735	5.8443	0.3938	23.6383	12.8255	70.3758

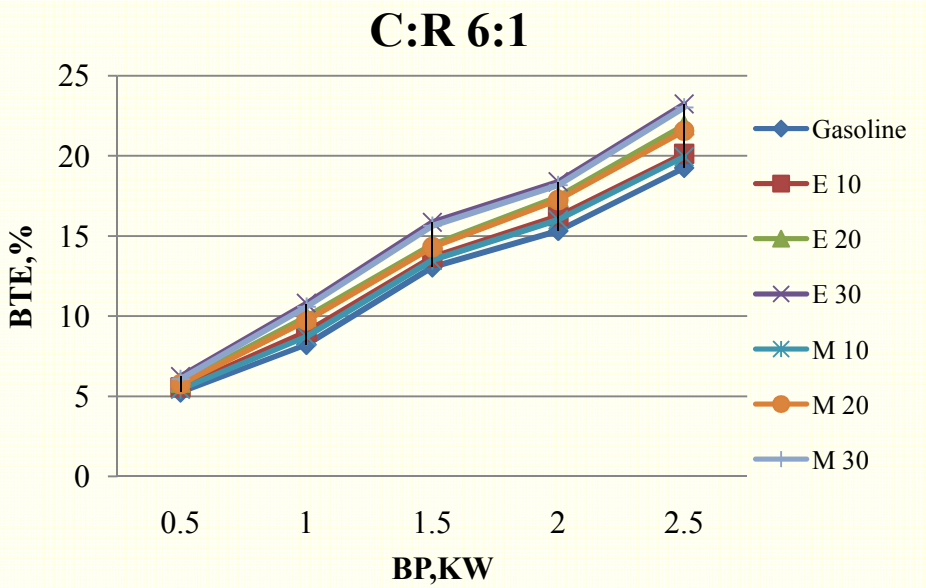
For E30 (Compression ratio 8:1)

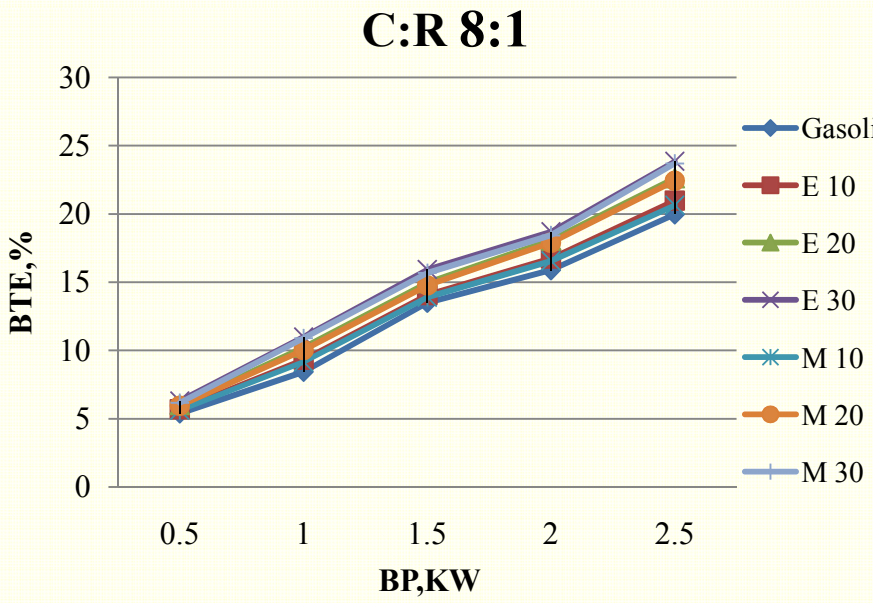
B.P (KW)	Mass flow rate of air (10^-3)	Mass flow rate of fuel (10^-3)	BMEP	BSFC	Brake thermal efficiency	Air/Fuel ratio	Volumetric efficiency
0	2.2272	0.1813	0.0000	0.0000	0.0000	12.2878	44.6887
0.5	2.5846	0.2051	1.1689	1.4768	6.3036	12.6014	51.8594
1	2.8868	0.2259	2.3377	0.8133	11.4459	12.7784	57.9232
1.5	3.1498	0.2436	3.5066	0.5846	15.9248	12.9321	63.1994
2	3.3433	0.2598	4.6754	0.4676	19.9060	12.8688	67.0827
2.5	3.4790	0.2688	5.8443	0.3870	24.0530	12.9448	69.8060

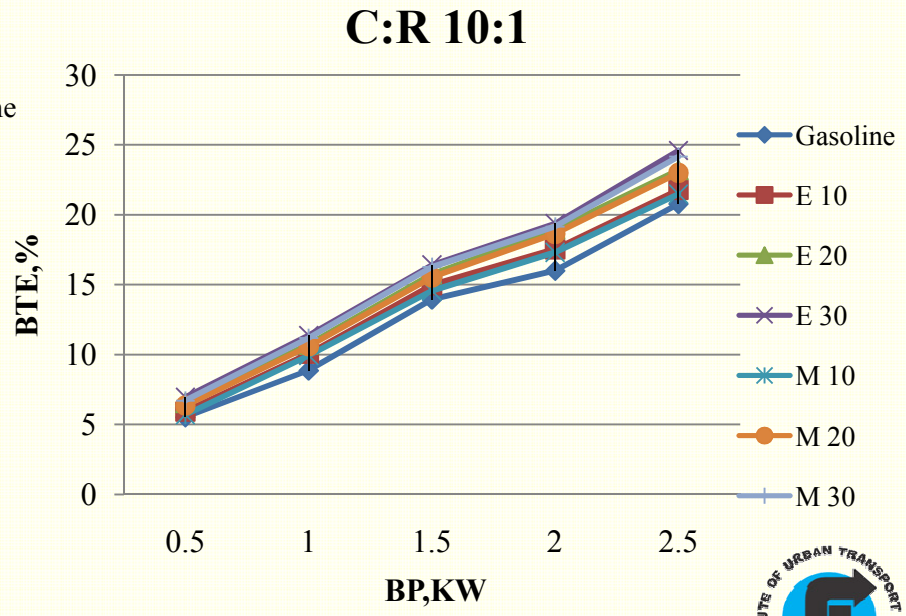
For E30 (Compression ratio 10:1)

B.P (KW)	Mass flow rate of air (10^-3)	Mass flow rate of fuel (10^-3)	BMEP	BSFC	Brake thermal efficiency	Air/Fuel ratio	Volumetric efficiency
0	2.1822	0.1771	0.0000	0.0000	0.0000	12.3195	43.7858
0.5	2.5589	0.1998	1.1689	1.4389	6.4694	12.8043	51.3434
1	2.8522	0.2195	2.3377	0.7904	11.7777	12.9913	57.2294
1.5	3.0968	0.2362	3.5066	0.5668	16.4224	13.1121	62.1371
2	3.3135	0.2514	4.6754	0.4526	20.5695	13.1792	66.4846
2.5	3.4312	0.2598	5.8443	0.3741	24.8824	13.2070	68.8457

Effect of Brake power on Brake thermal efficiency at variable compression ratio.



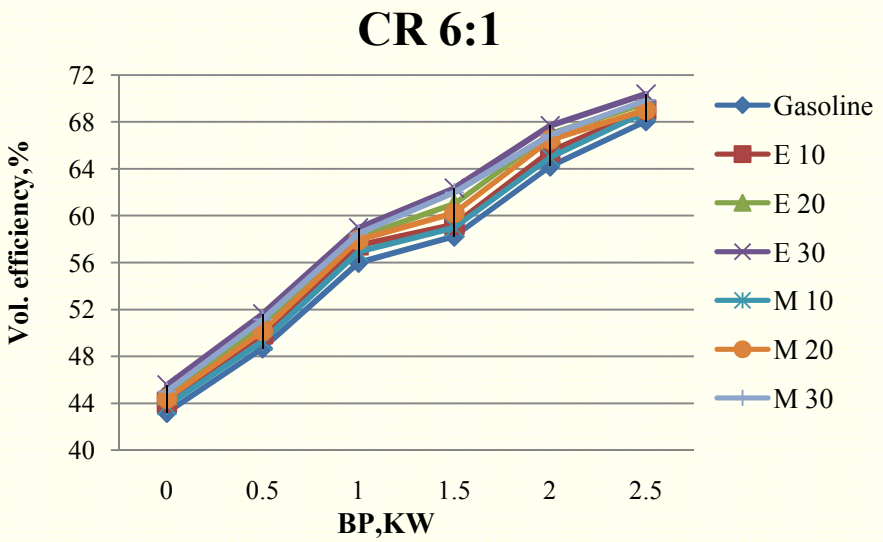


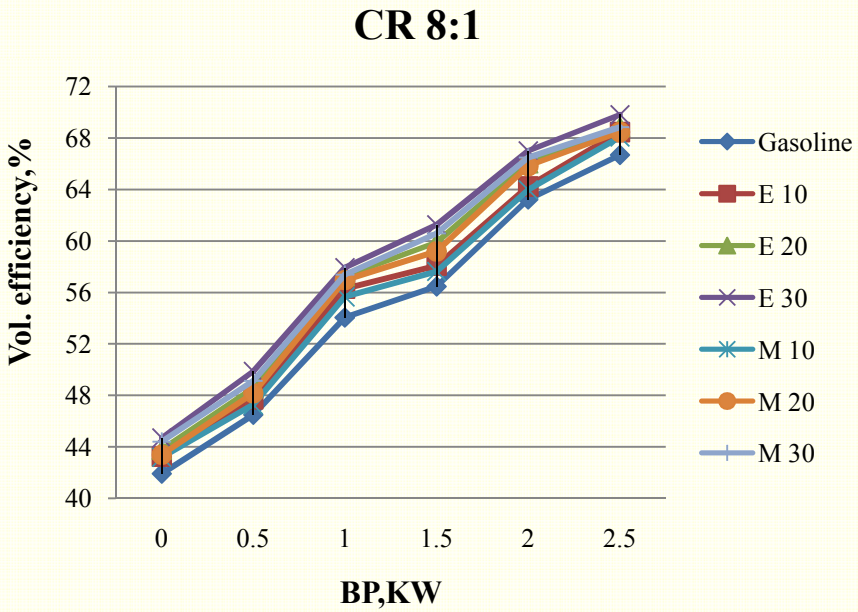


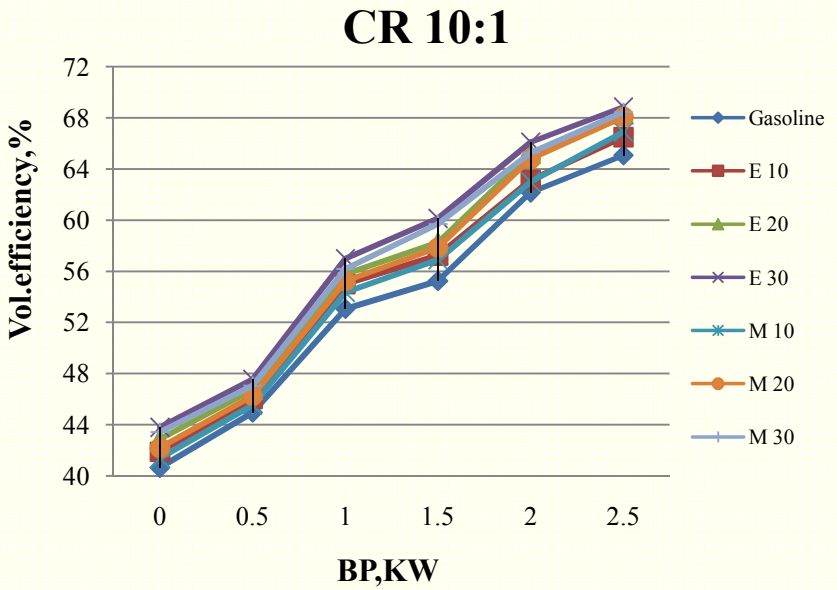
BRAKE THERMAL EFFICIENCY (BTE)

- As the load and compression ratio increased the BTE increased.
- High C.R resulted in increased temperature and pressure produced together with reduction in quantity of residuals.
- BTE also increased with increase in ethanol and methanol content.

Effect of Brake power on Volumetric efficiency at variable compression ratio.



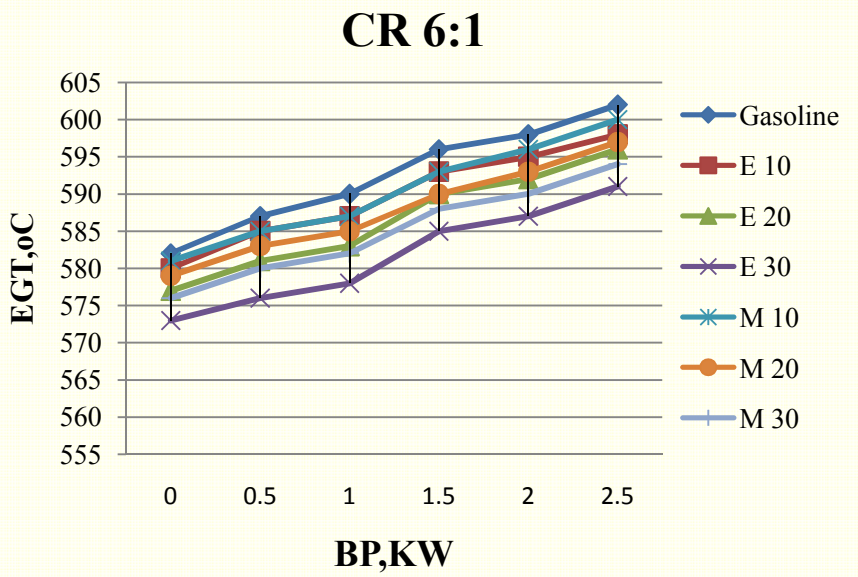


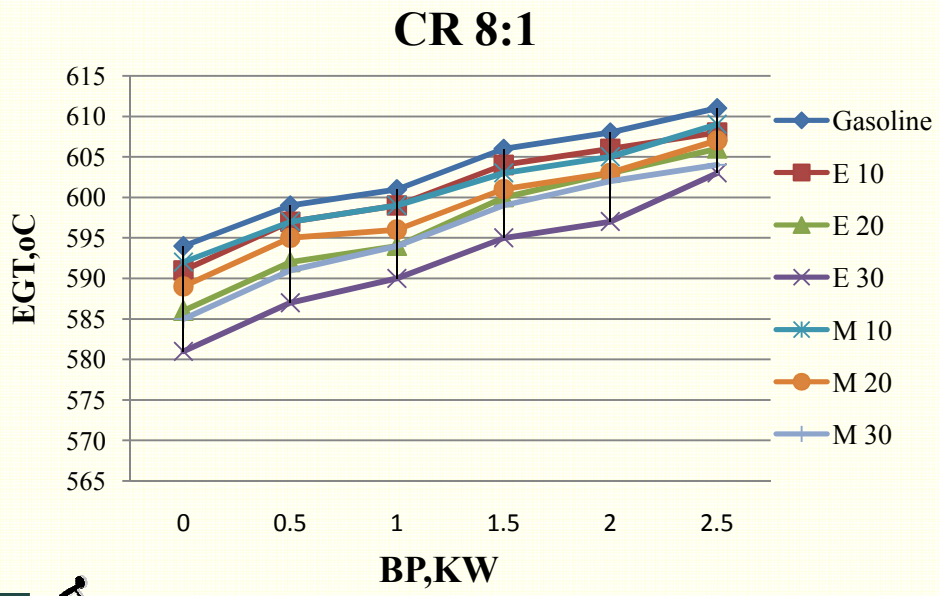


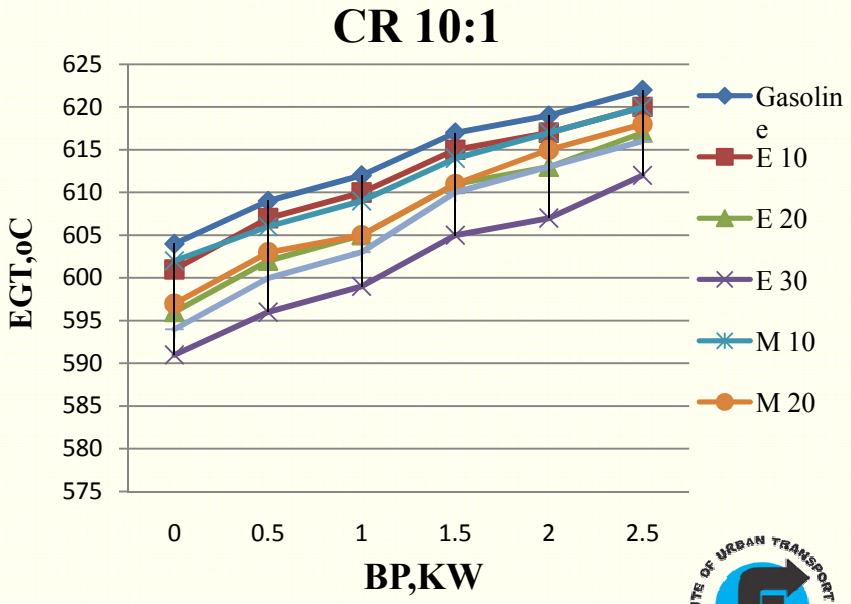
VOLUMETRIC EFFICIENCY (VE)

- Volumetric efficiency increased as the ethanol and methanol content increased.
- When the speed of the engine was increased, volumetric efficiency decreased.
- As the C.R increased the volumetric efficiency decreases.

Effect of Brake power on Exhaust gas temperature at variable compression ratio.



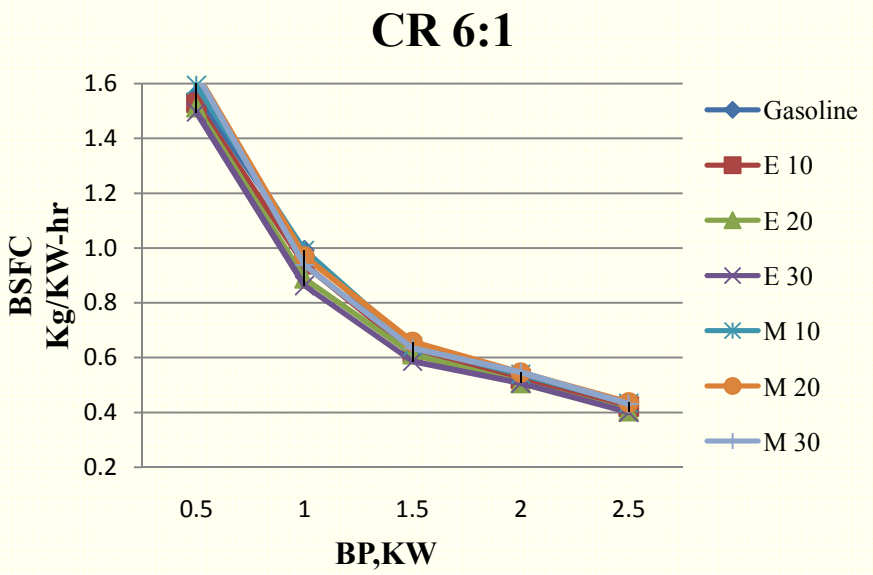


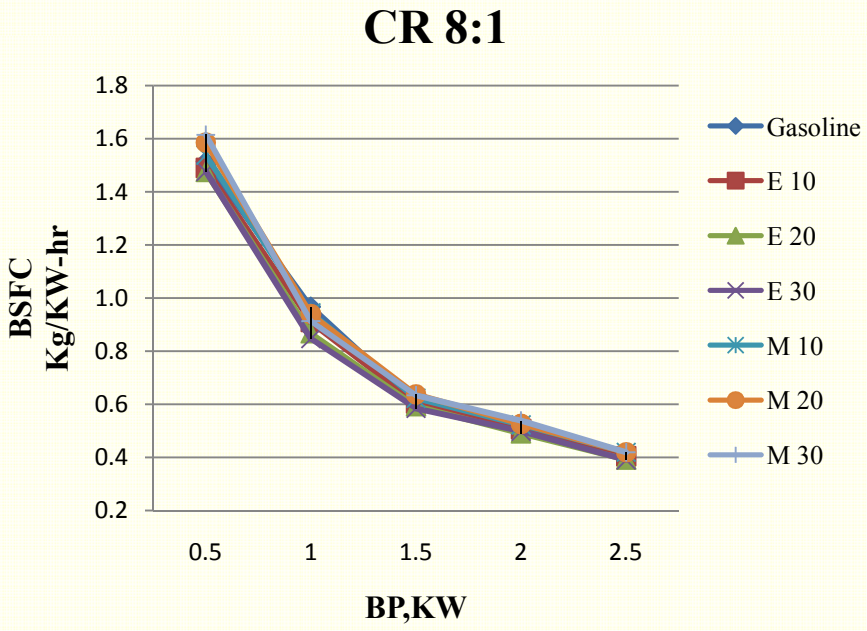


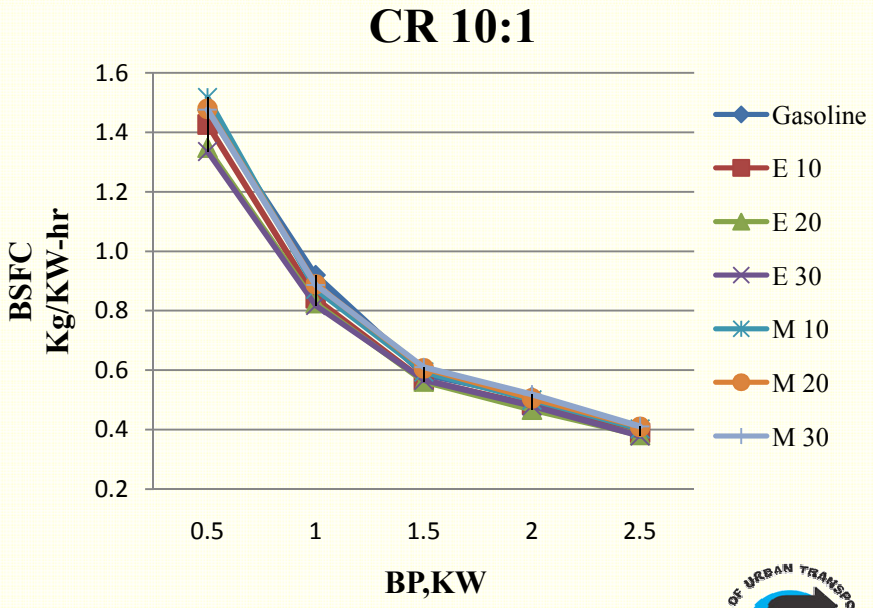
EXHAUST GAS TEMPERATURE(EGT)

- As the ethanol and methanol content increased, exhaust gas temperature decreased.
- As the load increased, temperature of exhaust gas increased due to more heat input to the engine.

Effect of Brake power on Break specific fuel consumption at variable compression ratio.







BRAKE SPECIFIC FUEL CONSUMPTION(BSFC)

- BSFC increased as the speed increases and decreased as the compression ratio and brake power increased.
- BSFC decreased with increase in ethanol and methanol content. Because increased alcohol content increased combustion rate as more oxygen was available which allowed complete combustion.

EFFECT OF C.R ON ENGINE PERFORMANCE

- BTE increased with increasing compression ratio and alcohol content.
- Volumetric efficiency decreased due to decrease in clearance volume.
- Minimum BSFC was obtained with ethanol blends compared to methanol blends.

CONCLUSION

- Adding ethanol and methanol to gasoline will lead to a leaner better combustion.
- Adding alcohol contents will led to an increase in engine BTE and decreases BSFC.
- Exhaust gas temperature tends to decrease depending on C.R.
- For fuels with low octane number like E10 detonation increases, due to poor combustion exhaust gas temperature increases.

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Thank You……..

Questions if any….