FUEL CHARACTERISTICS OF CASSVA ETHANOL

J.T. SHERIFF
S.N.MOORTHY
S.C. DAS*
G.PADMAJA
S.EDISON

Central Tuber Crops Research Institute , Kerala, India
*College of Engineering, Trivandrm, Kerala, India

Demand and production of petrol in India

Demand	5000 lakh litres
Production	1840 lakh litres

Source: Ministry of Petroleum and Natural gas, GOI

Characteristics of fuel

	Petrol	Ethanol
Formula	C_8H_{18}	C2H5OH
Research octane Number	91-98	108
Motor octane Number	83-90	92
Cetane number	8-14	8
Calorific value, Kcal. Kg^{-}	10800	57449
Energy compared to Gasoline	100%	66%
Heat of Vapourisation, Kj.Kg-1	355	842
Specific Gravity	2-4	
Flash Gravity,^{0}F	-45	55
Density, Kg.m^{-3}	0.746	0.783

Advantages

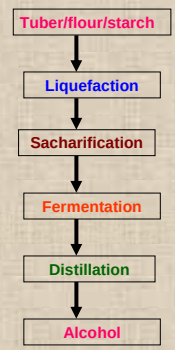
- Alcohol fuels can burn more efficiently
- Reduce pollution
- Has high octane rating
- Can substitute for gasoline and reduce oil imports

5% Ethanol Blended Gasoline

- **Requirement on all India Basis-500 million tonnes per annum**
- **Requirement in 8 States – 300 million tonnes per annum**
- **Requirement in UP & Maharashtra – 40 and 70 million tonnes per annum**

Sl. No.	Raw material	Yield of 98% alcohol
1	One tonne of cassava starch	450 litres
2.	One tonne of cassava flour	350 litres
3.	One tonne of cassava tuber	150 litres

Process flow chart for the production of cassva alcohol



Combustion properties of cassava alcohol

Calorific value of cassava alcohol	27.1125 MJ/kg
Calorific value of petrol (Cv)	43.054 MJ/kg
Calorific value of 10% cassava alcohol + 90% petrol (Cv)	41.456 MJ/Kg
Calorific value of 20% cassava alcohol + 80% petrol (Cv)	39.865 MJ/Kg

Specific Gravity of alcohol – 0.83

Specific gravity of petrol – 0.71

Boiling Point - 79°

Cassava alcohol 0% + 100% Petrol

W, Kg	Time	BP KW	TFC, Kg/h	SFC, Kg/Kwh	IP, KW	Q, KW	BTE	ME	ITE
0.0	20	0.000	1.278	0.00	3.000	15.284	0.00	0.000	19.628
1.4	19	0.773	1.345	1.741	3.773	16.089	4.803	20.483	23.450
4.0	15.5	2.208	1.649	0.747	5.208	19.722	11.196	42.396	26.408
5.8	11.5	3.202	3.223	0.694	6.202	26.581	12.045	51.625	23.331
7.4	11.0	4.085	2.324	0.569	7.085	27.789	14.696	57.656	25.496
8.7	10.5	4.502	2.434	0.507	7.802	29.113	16.496	61.550	26.801
11.5	10.0	6.348	2.556	0.403	9.348	30.568	20.797	67.908	30.581

W – Load Applied
Q – Input power
BP – Brake Power
BTE – Brake Thermal Efficiency
TFC – Total Fuel Consumption
ME – Mechanical Efficiency
IP – Indicated Power
ITE – Indicated Thermal Efficiency

Cassava **alcohol** 10% + 90% Petrol

W, Kg	Time	BP KW	TFC, Kg/h	SFC, Kg/Kwh	IP, KW	Q, KW	BTE	ME	ITE
0	17	0.000	1.529	0.00	3.000	17.606	0.00	0.000	17.038
1	16.5	0.552	1.575	2.854	3.552	18.141	3.043	15.541	19.579
2	14	1.104	1.857	1.682	4.104	21.381	5.163	26.901	19.195
3	13	1.656	1.999	1.207	4.656	23.026	7.192	35.567	20.221
5	10.5	2.760	2.475	0.897	5.760	28.506	9.681	47.917	20.205
6	10	3.312	2.599	0.785	6.312	29.933	11.065	52.471	21.087
7	9.5	3.864	2.736	0.708	6.864	31.509	12.263	56.294	21.784
8	9	4.416	2.888	0.654	7.416	33.259	13.277	59.547	22.298
9	9	4.968	2.888	0.581	7.968	33.259	14.937	62.349	23.957

W – Load Applied
Q – Input power
BP – Brake Power
BTE – Brake Thermal Efficiency
TFC – Total Fuel Consumption
ME – Mechanical Efficiency
IP – Indicated Power
ITE – Indicated Thermal Efficiency

Cassava alcohol 20% + 80% Petrol

W, Kg	Time	BP KW	TFC, Kg/h	SFC, Kg/Kwh	IP, KW	Q, KW	BTE	ME	ITE
0	17	0.000	1.554	0.00	3.000	17.212	0.00	0.000	17.429
3	11	1.659	2.402	1.451	4.656	26.601	6.225	35.567	17.503
5.5	10.5	3.036	2.517	0.829	6.036	27.666	10.894	50.298	21.660
7.5	10	4.140	2.642	0.638	7.140	29.261	14.149	57.983	24.401
9.5	9	5.244	2.936	0.560	8.244	32.512	16.129	63.610	25.357
11.0	7.5	6.348	3.523	0.555	9.348	39.015	16.271	67.908	23.960

W – Load Applied
Q – Input power
BP – Brake Power
BTE – Brake Thermal Efficiency
TFC – Total Fuel Consumption
ME – Mechanical Efficiency
IP – Indicated Power
ITE – Indicated Thermal Efficiency

Performance indices of petrol and alcohol blends

	Petrol	10% cassava alcohol + 90% petrol	20% cassava alcohol + 80% petrol
Brake Thermal Efficiency	20.7%	14.9%	16.2%
Indicated Thermal Efficiency	30.5%	24.0%	24.4%
Mechanical Efficiency	67.9%	62.3%	67.9%

Conclusions

- Calorific value of cassava alcohol is 27 MJ/Kg and it increased with the percentage of petrol incorporated.
- TFC & SFC increased as the percentage of cassava alcohol increased in the fuel blend.
- BTE , ME & ITE were high for petrol and less for the blends.

THANK YOU