|| Volume 5 || Issue 8 || August 2020 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH
AND ENGINEERING TRENDS

PERFORMANCE TEST ON IC ENGINE BY USING SOAP NUTS AS BIODIESEL

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Abstract: : Biodiesel was prepared from Soapnut oil through transesterification process and it was blended with diesel in two concentration ratios of 20% and 30%. Later the performance and exhaust emissions of a Cl engine were experimentally investigated when the engine was fuelled with biodiesel-diesel blends. The experimental data was compared with baseline diesel. The important findings are as follows: BSFC for biodiesel blends is comparable to diesel fuel at different loads. BTE is optimum for biodiesel blends at 830. All blends showed good ITE as compared to diesel. Bio-diesel has shown highest mechanical efficiency compared to diesel. Biodiesel-diesel blends is the least contributor of CO and CO2 emissions when compared to Diesel. Overall, the optimum is found to be regarding blend wise 830 is considered to be better in getting mechanical efficiency.B20 gives the low emissions.

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I INTRODUCTION

The most efficient prime movers commonly available today are the diesel engines. They move a large portion of world's goods, power much of the world's equipment, drive agriculture and rural sector and generate electricity more economically than any other device in their size range. The magnitude of present fuel crisis is going to worsen in future because of significant increase in fuel consumption rate over the last few decades in transportation and rural agriculture sectors in our country, a better design of the engine, using alternate fuels or effective fuel formation can considerably improve the engine performance and reduce harmful exhaust emissions. This in turn will lead to better break thermal efficiencies and lower environmental pollution.Diesel engines achieve their high performance and excellent fuel economy by compressing air at high pressures, then injecting a small amount of fuel into this highly compressed air. High particulate matter (PM) and oxides of nitrogen (NOx) emissions remains a challenge of technical issues for the diesel engine today. The new areas of technical issues for the diesel engine today. The new areas of technology including fuels post combustion emission control devices to assist in future emission standards. The use of fuel additives was a cost-effective method, it results in reduction of particles with sizes under 2.5 µm. A maximum drop of freezing point about was measured 15 ºc with organic based manganese, and the optimum rate of dosage was determined as 54.2 µmol Mn/L, equivalent to 700 ppm. The trend on the fall of freezing point when subjected to metal additive dosage was subjected to metal additive dosage was significant. To improve the quality of diesel fuel, various metal additives are doped with diesel for reaching more complete fuel combustion and reducing the amount of exhaust gases. The principle of this additive action consists of a catalytic effect on the combustion of hydrocarbons. Use of transition (or) noble metals in the form of fuel additives lower the soot ignition temperature.

II MATERIALS

Blends:

Blends of biodiesel and conventional hydrocarbon-based diesel are products most commonly distributed for using in the retail diesel fuel market place. Much of the world uses a system known as the "B" factor to state the amount of diesel in any fuel mix.

- 100% biodiesel is referred to as B100.
- 20% biodiesel, 80%diesel is labelled B20.
- 5% biodiesel, 95% diesel is labelled B5.
- 2% biodiesel, 98% diesel is labelled B2.

Blends of 20% biodiesel and lower can be used in diesel equipment with no, or only minor modifications, all through certain manufacturers do not extended warranty coverage if equipment is damaged by these blends. The B6 to B20 blends are covered by the ASTM (American Society for Testing and Materials).

ASTM International develops specifications for a wide variety of products, including conventional diesel fuel (ASTM D975). This specification allows for biodiesel concentrations of up to 5% (B5) to be called diesel fuel, with no separate labelling required at the pump. Low-level biodiesel blends, such as B5, are ASTM approved for safe operation in any compression-ignition engine designed to be operated on petroleum diesel. This can include light-duty and heavy-duty diesel cars and trucks, tractors, boats, and electrical generators

Biodiesel:

Biodiesel is an alternative fuel prepared from renewable biological sources such as vegetable oils both (edible and non-edible oil) and animal fats. The biodiesel has some rewards as compared to petroleum diesel. The most important advantages of biodiesel are higher flash point, biodegradability, improved cetane number and reduced exhaust emissions. Practically the higher viscosity of vegetable oils (30-200 Centistokes) as associated to that to Diesel (5.8- 6.4 Centistokes) leads to unfavourable pumping, inefficient mixing of fuel with the air contributes to the incomplete combustion, high flash point result in increased inferior coking and carbon deposit formation. Due to these problems, vegetable oil wants to be modified to bring the combustion associated properties closer to those of Diesel oil. The fuel modification is majorly aimed at reducing the viscosity and increasing the volatility.

One of the major promising processes to transform from vegetable oil to methyl ester is the Transesterification in which alcohol reacts with triglycerides of free fatty acids (vegetable oil) in the presence of catalyst like NaOH/KOH. Jatropha vegetable oil is one of the leading non-edible sources existing in India. The vegetable oil used for biodiesel production might contain free fatty acids which will improve specification reaction as a side reaction during the transesterification process.

All countries are at currently heavily dependent on petroleum fuels for agricultural machinery and transportation. The fact that a few nations together to prepared the bulk of petroleum has led to high price variation and uncertainties in supply for the engrossing nations. This in turn has led them to search for alternative fuels that they themselves can produce. Among the alternatives being treated are methanol, ethanol, vegetable oils and biogas.

Vegetable oils have some of features that make them attractive as substitute for Diesel. Vegetable oil has the characteristics compatible with the Compression Ignition engine systems. Vegetable oils are also mixing with diesel fuel in any proportion and can be used as extenders. India majorly depends on import of petroleum crude and almost two third of its requirement is met through imports. Moreover, the gases released by petrol, diesel driven vehicles have an opposing effect on the environment and human health.

The significant advantages of using the Biodiesel are its renewability, biodegradability, better quality exhaust gas emission, also it does not contribute to an increase in the level of carbon dioxide in the atmosphere. The major sources for biodiesel are both edible and non-edible oils can be reached from such as edible oils like Peanut oil, Palm oil, Sunflower oil, Seasame oil, Soyabeen oil etc., and the non-edible oils like Jatropha Curcas, PongamiaPinnata, Calophyllum inophyllum, Mahau, etc. Hence, it is assumed that non-edible oils can be one of the solutions to meet the world energy demand and decrease the dependency on the edible oils.

Soapnut:

Sap Indus is a genus of about five to twelve species of shrubs and small trees in the Lychee family, Sapindaceae, native to warm temperate to tropical regions in both the Old World and New World. The genus includes both deciduous and evergreen species. Members of the genus are commonly known as soapberries or soapnut because the fruit pulp is used to make soap. The generic name is derived from the Latin words sapo, meaning "soap", and indicus, meaning "of India".

Fig. 1: Soapnut Tree

The drupes (soapnut) contain saponins which are a natural surfactant. They have been used for washing by ancient people in Asia as well as Native Americans

Production of Soapnut Oil:

The production of Soapnut oil was carried out in the following order:

Fig. 2: Production of Oil

Additives:

Compounds added to diesel fuels to improve performance, such as cetane number improvers, metal deactivators, corrosion inhibitors, antioxidants, rust inhibitors, and dispersants.

Isopropyl alcohol(C_3H_8O):

Isopropyl alcohol (IUPAC name propan-2-ol; commonly called isopropanol) is a compound with the chemical formula C_3H_8O. It is a colourless, flammable chemical compound with a strong odor. As an isopropyl group linked to a hydroxyl group, it is the simplest example of a secondary alcohol, where the alcohol carbon atom is attached to two other carbon atoms. It is a structural isomer of 1-propanol. It is manufactured for a wide variety of industrial and household uses, and is a common ingredient in chemicals such as antiseptics, disinfectants and detergents.

Fig.3

Isopropyl alcohol dissolves a wide range of non-polar compounds. It also evaporates quickly, leaves nearly zero oil traces, compared to ethanol, and is relatively non-toxic, compared to alternative solvents. Thus, it is used widely as a solvent and as a cleaning fluid, especially for dissolving oils. Together with ethanol, n-butanol, and methanol, it belongs to the group of alcohol solvents, about 6.4 million tonnes of which were utilized worldwide in 2011.

Blends Used:

The following types of blends are used in the performance test B60 and B80 where B60 is the 60% of biodiesel and 40% of neat diesel and in B80 80% is biodiesel and 20% is conventional diesel and an additive isopropyl alcohol of 10% is blended with B20.

Fig. 4: Biodiesel Blends.

III EXPERMATION

PART – 1

Observation data for Conventional Diesel under 0-100 % load.

- Cylinder Bore 87.50(mm)
- Stroke Length 110.00(mm)
- Compression Ratio 17.50
- Swept volume 661.45 (cc)
- Area of piston (A) = 0.36 m^2
- Dynamometer Arm Length (mm): 185
- Calorific value (CV) = 42500 KJ/Kg
- Density (ρ) = 840 Kg/m^3

Observation table:

Table 1: Observation table conventional diesel

Load (Kg)	Speed (RPM)	Indicated Mean Effective Pressure (Pim) (bar)	Applied Force (N)	Air flow (mmWC)	Fuel flow (cc/min)
0.01	1571.00	2.15	0.09806	95.86	7.00
4.50	1504.00	3.62	44.1299	86.11	11.00
9.01	1488.00	4.92	88.3579	82.28	16.00
13.50	1474.00	6.33	132.3897	79.00	21.00
18.02	1463.00	7.63	176.7158	75.66	26.00

Torque (Nm)	BP (kW)	FP (kW)	IP (kW)	BMEP (bar)	IMEP (bar)	BTHE (%)	ITHE (%)	Mech Eff. (%)
0.02	0.00	1.86	1.86	0.00	2.15	0.09	44.63	0.19
8.17	1.29	1.72	3.00	1.55	3.62	19.66	45.89	42.84
16.35	2.55	1.49	4.04	3.11	4.92	26.76	42.41	63.10
24.50	3.78	1.36	5.14	4.65	6.33	30.27	41.16	73.54
32.70	5.01	1.15	6.16	6.21	7.63	32.39	39.80	81.38

Table 3: Result table for conventional diesel

Air Flow (kg/h)	Fuel Flow (kg/h)	SFC (kg/kWh)	Vol Eff. (%)	A/F Ratio	HBP (%)	HJW (%)	HGas (%)	HRad (%)
31.88	0.35	98.47	87.13	90.38	0.09	23.71	22.02	54.18
30.22	0.55	0.43	86.26	54.51	19.66	22.65	20.29	37.41
29.54	0.81	0.32	85.22	36.63	26.76	20.71	18.53	34.00
28.95	1.06	0.28	84.30	27.35	30.27	19.90	18.07	31.76
28.33	1.31	0.26	83.12	21.62	32.39	22.44	19.58	25.60

A. Graphs:

- Fig5 Break power, Indicated power& Friction power:

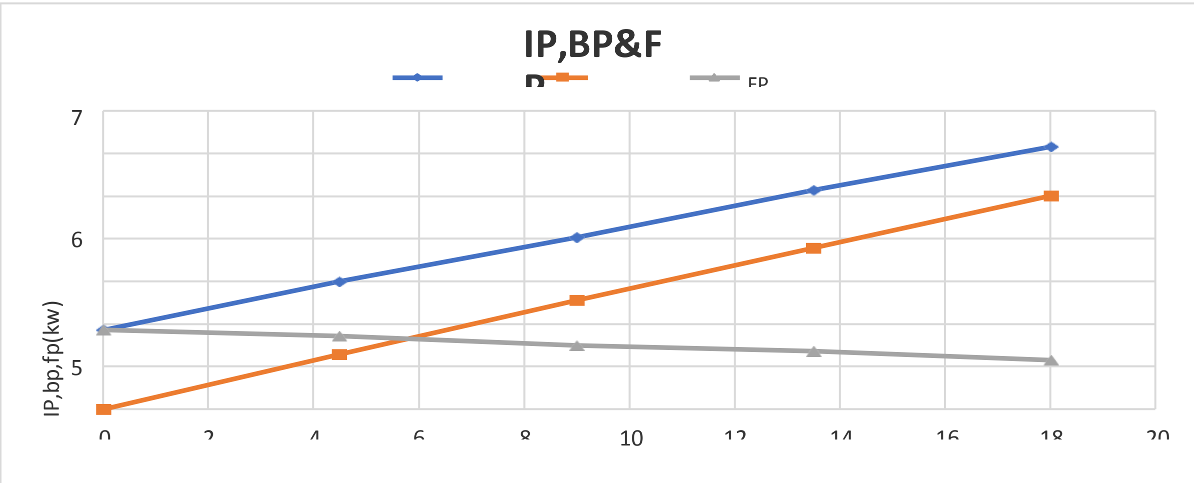
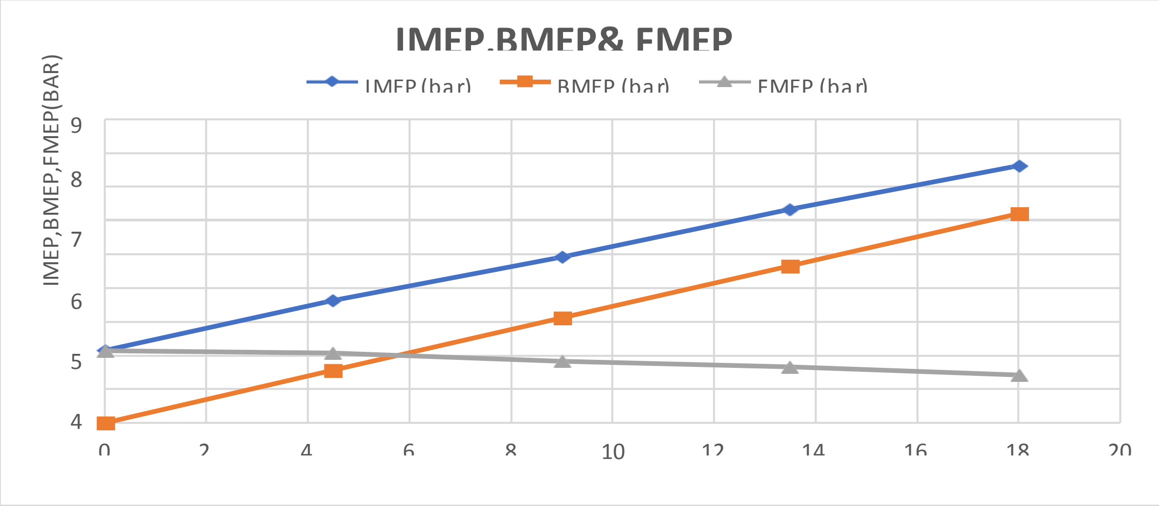


Fig.6: Indicated MEP, Break MEP & Friction MEP



- Fig. 7: SFC & Fuel consumption:

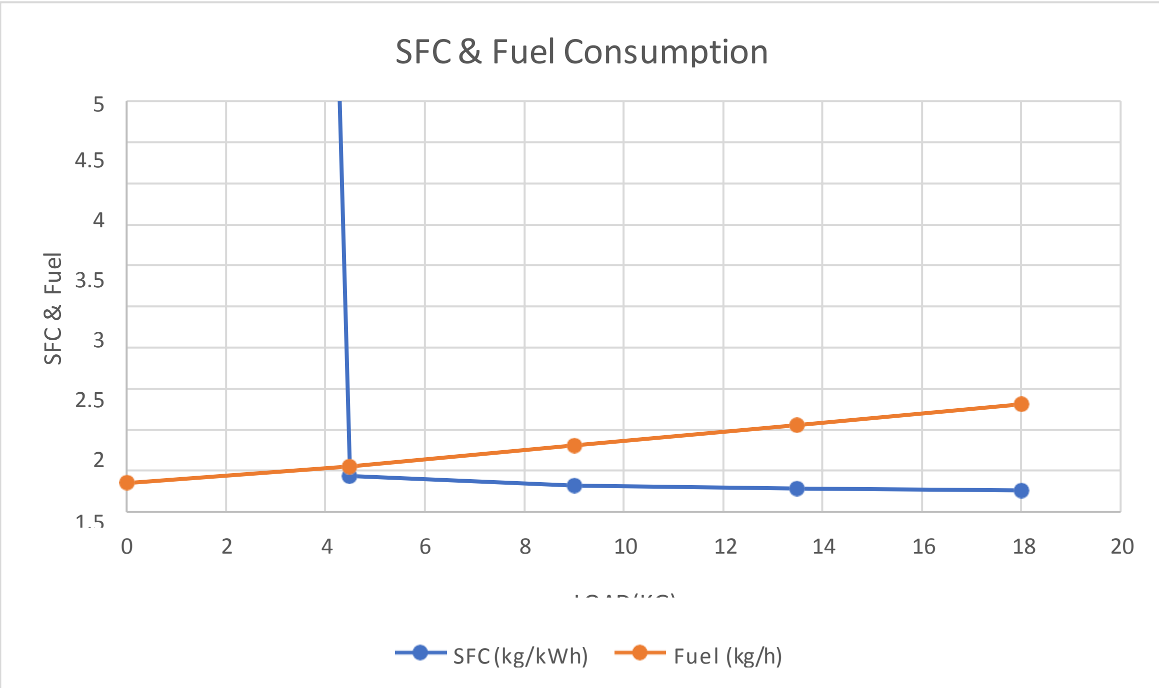
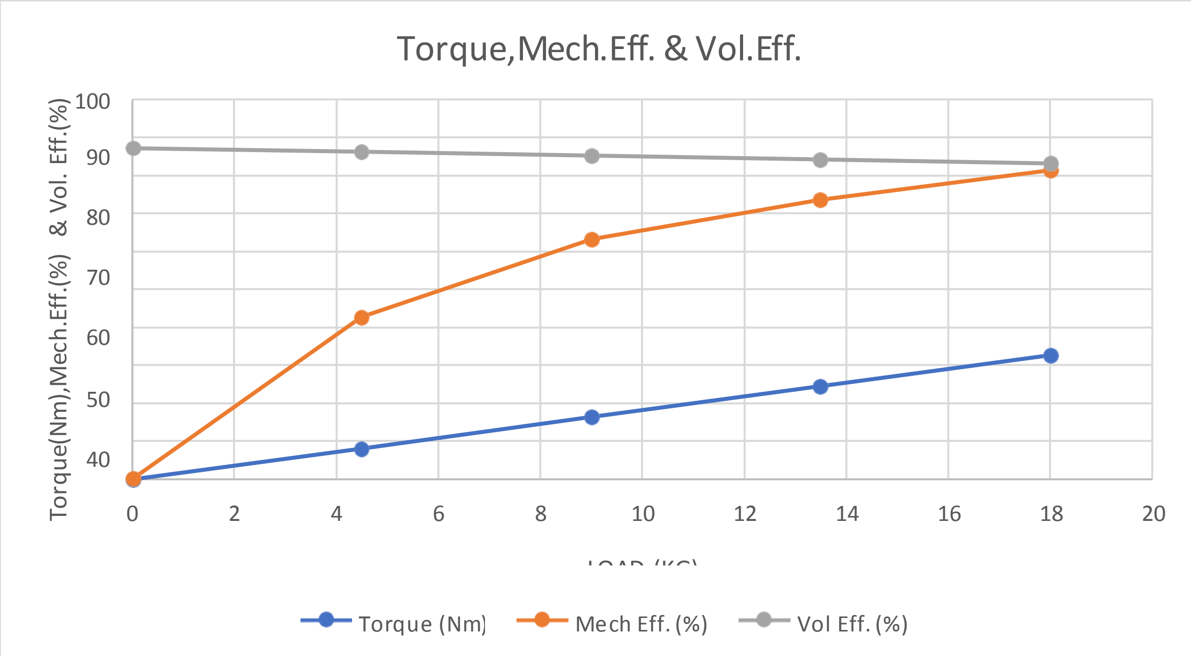


Fig. 8: Torque, Mechanical efficiency, Volumetric efficiency:



B. EXHAUST GAS EMISSION DATA:

Table 4: Exhaust gas analysis table for conventional diesel

Load (Kg)	CO %	HC PPM	CO2 %	O2 %	NOX %	Lambda	Opacity %
0.01	0.038	28	2.01	18.06	128	7.131	1.7
4.5	0.036	30	3.83	15.43	521	3.784	5.7
9.01	0.042	52	5.56	13.11	1047	2.627	16.7
13.5	0.049	58	7.45	10.42	1496	1.964	31.8
18.02	0.142	67	9.49	6.89	1794	1.475	62.5

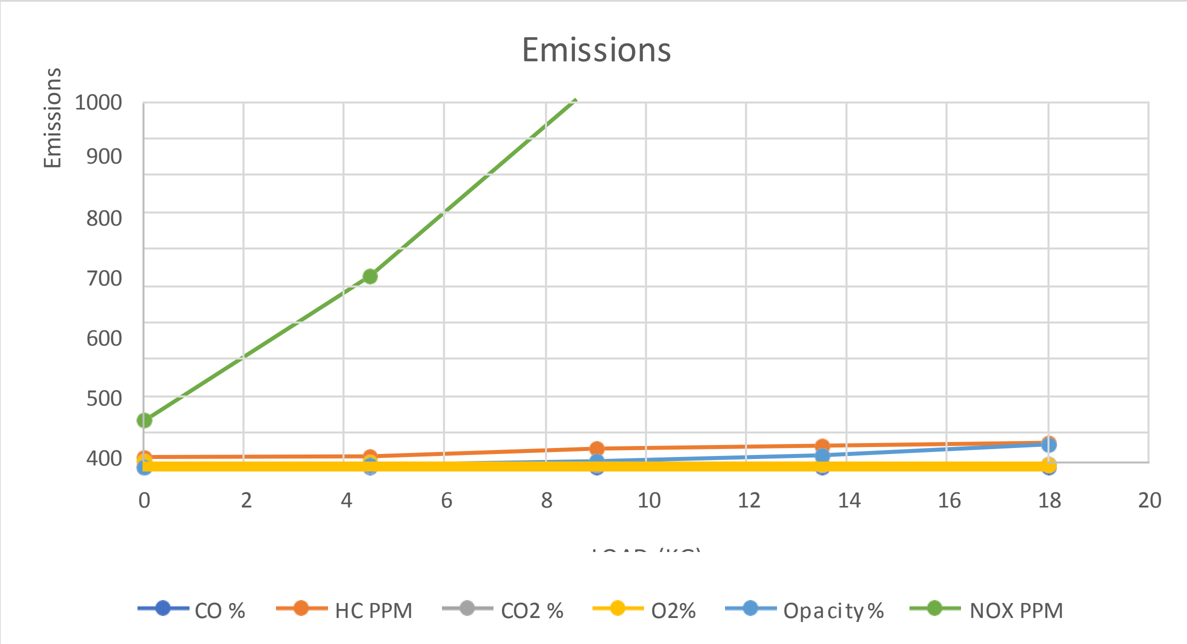


Fig. 8: Exhaust Gas Emissions graph:

IV CONCLUSION AND SCOPE OF FUTURE WORK

CONCLUSION

- The fuels with different compositions of diesels, soap nut oil and Diethyl Ether are blended by using mechanical stirrer.
- The performance tests like Indicated Power, Break Power, Specific Fuel Consumption, Total Fuel Consumption, Mechanical efficiency, Break Thermal Efficiency, Indicated Thermal Efficiency were conducted on single cylinder four stroke diesel engine. And analysis of exhaust emissions also conducted.

Comparison of mechanical properties at load 4.5KG

Fuel	IP	BP	FP	IMEP	BMEP	BTHE	ITHE	Mech. Eff.
Diesel	3.00	1.29	1.72	3.62	1.55	19.66	45.89	42.84
B60	2.96	1.28	1.68	3.58	1.55	18.48	42.61	43.38
B80	2.98	1.29	1.70	3.60	1.55	18.59	43.10	43.14
B20+IPA	3.05	1.29	1.76	3.68	1.55	18.38	43.56	42.19

Comparison of emission gases at load 4.5KG

Fuel	CO(%)	HC PPM	CO2(%)	O2(%)	NOx PPM	Lambada	Opacity (%)
Diesel	0.036	30	3.83	15.43	521	3.784	5.7
B60	0.027	21	3.65	15.89	434	4.02	19.6
B80	0.022	15	3.66	15.87	434	4.017	28.6
B20+IPA	0.009	5	3.59	15.76	471	4.073	15.7

- In the above comparison table of emissions B20+Iso propyl Alcohol results in lowering HC
- In the above comparison tables B60 results in high mechanical efficiency and low pollutant gases.

Future Scope:

- There is a scope for future work by changing blends B60(soap nut oil % + diesel %) B80 (Soapnut oil % + Diesel %).......
- Emissions are reduced therefore we can protect environment
- By using alternative fuels, we can reduce greenhouse effect
- Make it mandate to use biofuels in metro cities

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