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EXPERIMENTAL INVESTIGATION ON DIESEL ENGINE USING LINSEED OIL AND SUNFLOWER +COCONUT OIL METHYL ESTERS

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ABSTRACT: Consumption of bio-fuels increasing in internal combustion engines due to the scarcity, increased cost, increased emissions of conventional fuels. Vegetable oils have been used to possible alternative to diesel fuel in CI engines. In the present work, biodiesel was produced from vegetable linseed oil and combination of sun-flower and coconut oil , investigations were carried out to study performances and emissions by using biodiesel under the subsequently load (0%,25%,50%,75%,full load) on single cylinder four stroke water cooled diesel engine. Linseed oil and combination of (sunflower + coconut oil) is converted into biodiesel by the transesterification process, it becomes linseed methyl ester (LME) and sunflower &coconut methyl ester (SCME). B10, B20, B30 blends are prepared from LME and SCME combining with diesel.

Among three blends (of LME and SCME) B10 gives maximum Brake thermal efficiency but emission(CO,CO_2,HC) are reduced in case of B20(of LME and SCME) and it has brake thermal efficiency nearer to B10 comparing with diesel. B20 is better due to reduction in emission parameter and has second highest brake thermal efficiency.

Keyword: [Linseed oil, sunflower oil, coconut oil, methyl ester, biodiesel, emission].

1. INTRODUCTION

Diesel fuel is required the transport of industrial and agricultural goods &operation diesel tractor and pump sets in automobile sector. Demand and requirement of diesel more we need a replacement diesel with biodiesel coming from the alternative fuel likevegetable oils are eco-friendly and available is more because it is renewable, environment friendly and produced in rural areas. The term bio-diesel was introduced in unitedstatesduring year 1990. In most of the developed countries biodiesel is produced from rapeseed oil, soybean oil, cotton seed oil, olive oils, fish oil, jatropha oil etc…

Biodiesel are renewable source of energy that can help reduce green-house gas emissions, less global warming due to carbon in the fuel. In addition, biodiesel produces less exhaust emission.

Hence there is need to find some alternate fuel ,which can produced from the available local resources such alternative fuel are alcohol,

ethanol, vegetable oils, biodiesel etc. The present experimental work is carried out using linseed oil and combination of (sunflower & coconut oil) raw fuel or raw material as biodiesel production. The methyl ester of vegetable oils known as biodiesel and it cannot be used purely for combustion because of high viscosity &low calorific value. Biodiesel is renewable fuel like ethanol is liquid transportation fuels made from agricultural crops like corn and soybeans and linseed etc.

2. BIODIESEL PRODUCTION

It is process of producing the biofuel, biodiesel through the chemical reactions of transesterificationby using vegetable oil and animal facts or waste cooking oil. Pure oils are not suitable for diesel engines because due to cause of carbon deposits and pour point problem. So transesterification acts a major role for reduce viscosity of raw vegetable oil and it process of reacts with lipids (fats &oils) with the alcohol (methanol or ethanol) to produce biodiesel and impure co-product, glycerol. Mostly a catalyst is also used to improve the rate and yield of the equilibrium towards the product.

3. TRANSESTERIFICATION PROCESS

The transesterification is the method of biodiesel production from oils and fats process is the reaction of a triglyceride (fat/oil) with an Alcohol (methanol, ethanol or butanes) in the presence of some catalyst such as sodium hydroxide or potassium hydroxide to form esters and glycerol. A triglyceride has a glycerine molecule as its base with three long chain fatty acids attached. The characteristics of the oil/fat are determined by the nature of the fatty acids attached to the glycerine. A successful transesterification reaction is signified by the separation of the ester and glycerol layer after the reaction time. The heavier, coproduct, glycerol settles out and may be sold as it is or it may be purified for use in other industries, e.g. the pharmaceutical, cosmetics etc. in this experiment first 250ml of methanol is take in conical flask. The amount of KOH required is determined by titration process by slowly adding of potassium hydroxide to methanol. In this trill I observer 5.5 grams of KOH is needed for every 250ml of methanol. After this mixture is mixed with one liter of raw linseed oil, heated and maintained at 65-70^{0}C for 8hr, while the solution is continuously stirred. Two different layers are formed, the lower layer is glycerin and the upper layer is ester. The upper layer (ester) is separated and moisture is removed from the ester by using calcium chloride. It is observed that 90% ester can be obtained from vegetable oils.The use to two catalysts in two methyl ester sample for each three different types of oil 1.linseed oil 2.sunflower oil 3.Coconut oil as been taken. When using either KOH or CH_3ONa as base catalyst for methyl ester transesterification.

Figure: Transesterification Equipment

Figure: Separation of glycerol

Magnetic stirrer, Stir bars are used in inside the conical flask is placed; the magnetic stirrer is rotating around inside the flask because given magnetic field below the flask. Heating is given by electrical work both operation are taken place at time, same process repeating required removal glycerol optimum time for this process is 6 hours

Linseed oil

It is also known as flax seed oil or simply flax oil is a clean to yellowish drying oil. It is obtained by pressing, followed by an optional stage of solvent extraction .Linseed oil is produce a vegetable oil, oldest commercial oil and solvent precede flax seed oil has been used for centuries as a drying oil in painting and varnishing. One hundred grams of ground flaxseed supplies about 450 kilo-calories, 41grams of flat, 28 grams of fiber and 20 grams of protein

Figure: Linseed crop

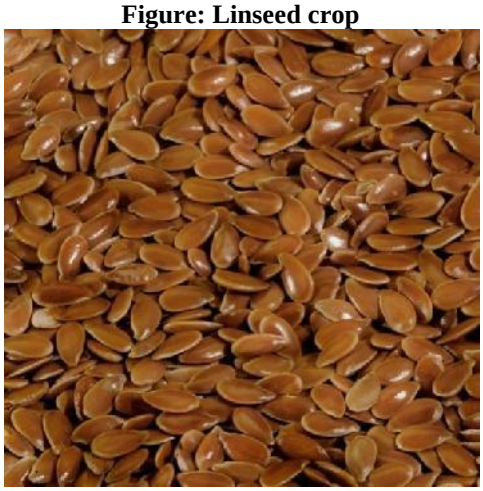

Figure: Linseedseed

Sunflower oil

It is oil already used for high-grade food oil, and the meal can be readily used as a livestock feed. And over 40% make it an excellent choice for a biofuel crop, because of already grown widely for use as food oil. A range of plant populations and row spacing work for sunflower production and recommended seeding rate for oil seed sunflower ranges from around 15000 to 24000 plants to the acre, with lower seeding rate in areas of low rainfall. Most sunflower oil is produced for human consumption for producers. Sunflower oil is extracted by the plant and used alternative oil for biodiesel.

Figure: Sunflower seed

Figure: Sunflower plant

Coconut oil

Coconut oil is a widely used for liquid biofuel that is clean, relatively cheap, easy to extract non-toxic and aromatic. The left oven coconut meal can be used make flour, biscuits, their having heating value are an efficient dry fuel,

making the common coconut one of the most useful nuts around.

4. EXPERIMENTAL SETUP

The experimental test rig is 4-stroke diesel engine it is a vertical, single cylinder ,water cooled engine connect to eddy current type dynomometer for loading. The test rig engine consists of the fuel supply system for diesel and bio-diesel on both fuel,water cooling system,lubricating system and direct fuel injection ,a high pressure fuel pump is used. Engine was directly coupled to dynamometer, exhaust gas temperature measured by thermocouple which is indicated readings on digital display, load applied by rope brake dynamometer at constant speed 1500 rpm to evaluate performances some operating parameter like speed, power output and fuelconsumption was measured.

Figure:Experimental setup

Make	Kirloskar
Power	5hp
Speed	1500rpm
No.of.cylinders	1
Compression ratio	16.5:1
Bore	80mm
Orifice dia	20mm
Type ignition	Compression ignition
Methods of loading	Rope brake
Method of starting	Crank shaft
Method of cooling	Water

Table: Engine specifications

Properties	Diesel	Linseed oil	Coconut oil	Sunflower oil
Specific gravity	0.83	0.917	0.918	0.864
viscosity@40 $^{\upsilon}$C(cst)	3.22	3.53	26.2	28.3
Flash point($^{\upsilon}$C)	54	185	260	254
Fire point(^{0}C)	65	192	279	273
Calorific value(kj/kg)	42500	39307	37260	38769

Table: Properties of diesel and biodiesel

5.RESULTS AND DISCUSSION A1) BRAKE THERMAL EFFICIENCY (Linseed oil)

The variation of brake thermal efficiency with brake power for different fuels is presented in fig 5.1 .the plot it is reveals that as the brake power increased brake thermal efficiency increases. The maximum thermal efficiency for L10 at full load (36) was higher than that of diesel(31.876).Increase brake thermal efficiency by (35.87) with the diesel.

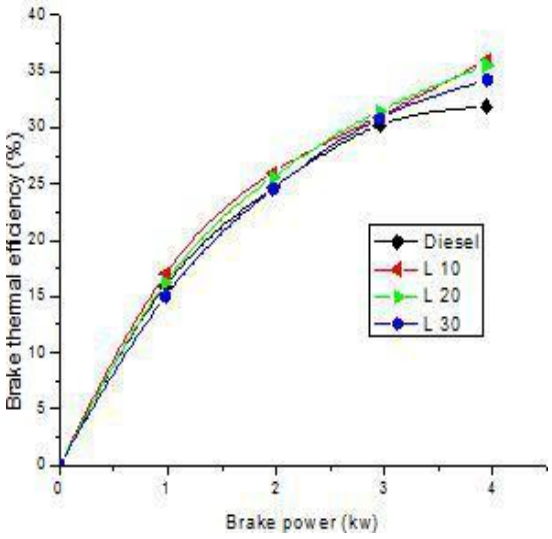

Figure:Brake power vs Brake thermal efficiency for Linseed oil

A2) BRAKE THERMAL EFFICIENCY (COMBINATION OF SUNFLOWER&COCONUT OIL)

The variation of brake thermal efficiency with brake power for different fuels is presented in fig 5.1.2 .The plot it is reveals that as the brake power increased brake thermal efficiency increases. The maximum thermal efficiency for S+C10 at full load (43.50) was higher than that of diesel(31.876).Increase brake thermal efficiency by (11.624) with the diesel.

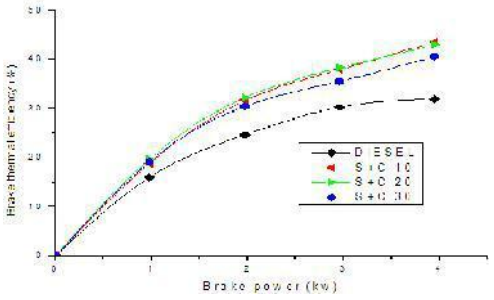

Figure: Load vs Brake thermal efficiency for sunflower+coconut

5.2.1. VOLUMETRIC EFFICIENCY (LINSEED OIL) SS

The variation of volumetric efficiency with brake power is shown in figure. The plot it is reveals that as the brake power increased volumetric efficiency increases. The plot it is reveals that as the brake power increase volumetric efficiency decrease. It is observed diesel contains(76.5) at full load, L10 at full load (77.6) also same as L20(77.6) compared diesel L10,L20, increases

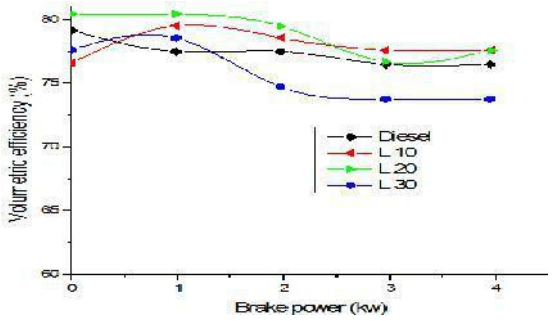

Figure: Brake power vs Volumetric efficiency for Linseed oil

5.2.2. VOLUMETRIC EFFICIENCY (COMBINATION OF SUNFLOWER & COCONUT OIL)

The variation of volumetric efficiency with brake power is shown in figure. The plot it is reveals that as the brake power increased volumetric efficiency increases. The plot it is reveals that as the brake power increase volumetric efficiency decrease. It is observed diesel contains(76.5) at full load, S+C10 at full load (79.6)

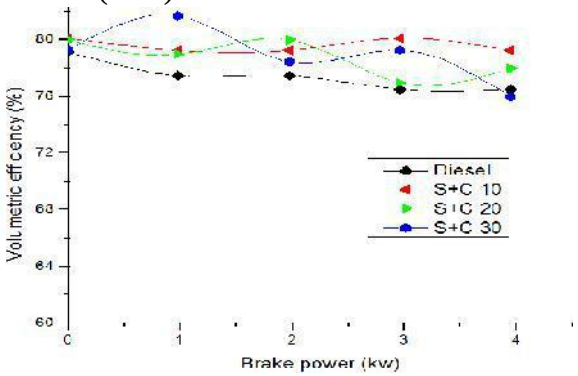

Figure: Brake power vs Volumetric efficiency for sunflower+coconut

5.3.1 INDICATED SPECIFIC FUEL CONSUMPTION (LINSEED OIL)

The variation of indicated specific fuel consumption with brake power is shown in figure.the plots it is reveals that as the brake power increase indicated specific fuel consumption decrease. L10 indicated specific fuel consumption decrease compared diesel , it is decrease at full load of engine.

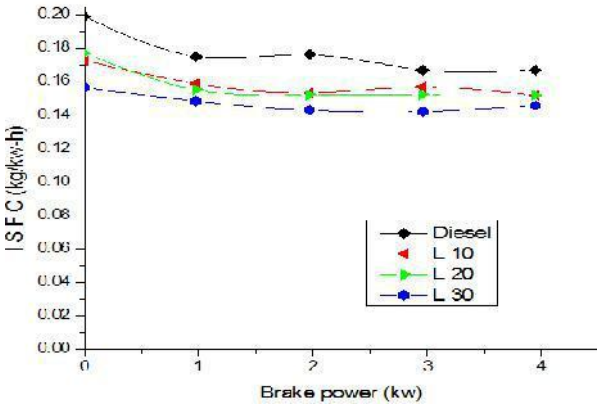

Figure: Brake power vs Indicated specific fuel consumption Linseed oil

5.3.2 INDICATED SPECIFIC FUEL CONSUMPTION (COMBINATION OF SUNFLOWER&COCONUT OIL)

The variation of indicated specific fuel consumption with brake power is shown in figure.the plots it is reveals that as the brake power increase indicated specific fuel consumption decrease. S+C 10 indicated specific fuel consumption decrease compared diesel , it is decrease at full load of engine

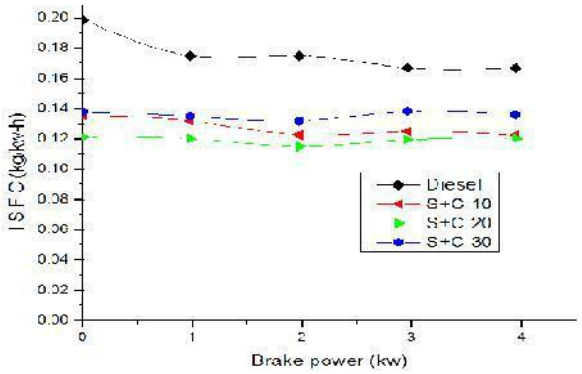

Figure: Brake power vs Indicated specific fuel consumption sunflower +coconut

5.4.1 BRAKE SPECIFIC FUEL CONSUMPTION (COMBINATION OF SUNFLOWER&COCONUT OIL)

The variation of brake specific fuel consumption with brake power is shown in figure. The plot it is reveals that as the brake power increase brake specific fuel consumption decreases .the brake specific fuel consumption S+C 10,S+C 20 nearer to each of blend is decrease at full load of engine.

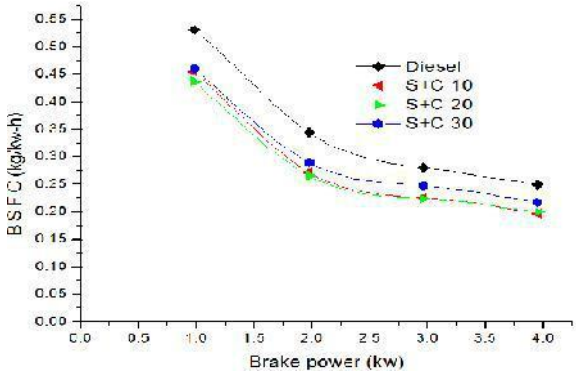

Figure : Brake power vs Brake specific fuel consumption for sunflower +coconut

5.4.1 BRAKE SPECIFIC FUEL CONSUMPTION(Linseed oil):

The variation of brake specific fuel consumption with brake power is shown in figure. The plot it is reveals that as the brake power increase brake specific fuel consumption decreases .the brake specific fuel consumption linseed oil L10 is decrease at full load of engine.

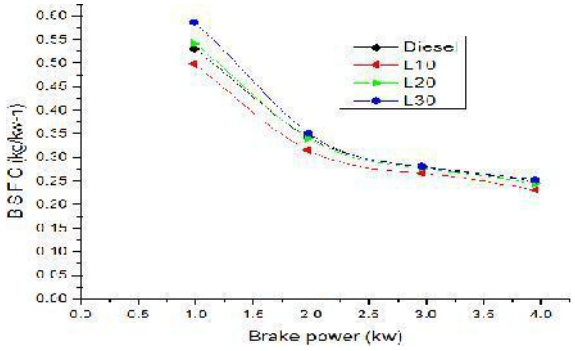

Figure: Brake power vs Brake specific fuel consumption for Linseed oil

6. EMISSION

6.1.1. CARBON DIOXIDE(CO_2)

The variation of carbondioxide with brake power is shown in fig . The co_2 emissions from a diesel engine indicated how efficiently the fuel is burnt inside the combustion chamber for linseed oil same diesel in chamber in the full load of engine from the graph.

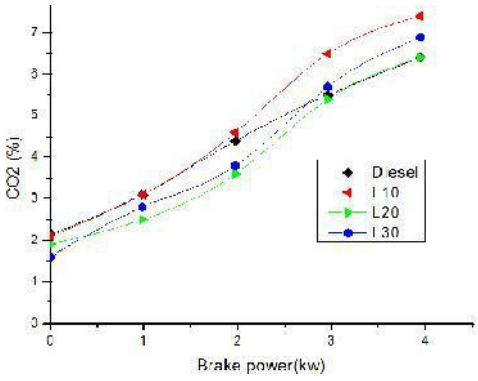

Figure: Brake power vs $CO_2$for Linseed oil

6.1.2 CARBON DIOXIDE(CO_2)

The variation of carbondioxide with brake power is shown in fig . The co_2 emissions from a diesel engine indicated how efficiently the fuel is burnt inside the combustion chamber for Combination of Sunflower&Coconut oil decrease co_2 S+C 20increase diesel is increasein the full load of engine from graph.

6.2.1. HYDRO CARBONS (HC)

The variation of hydro carbons with load is shown in figure. The plot it is reveals that as the load increases hydro carbons decreases. The hydro carbons of linseed oil blend L20 is decreased with compared diesel at full load conditions.

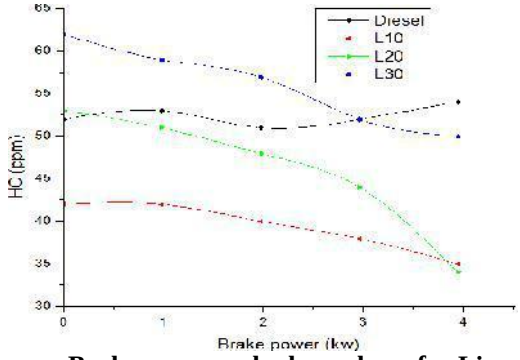

Figure: Brake power vs hydrocarbons for Linseed

6.2.2 HYDRO CARBONS (HC)

The variation of hydro carbons with load is shown in figure. The plot it is reveals that as the load increases hydro carbons decreases. The hydro carbons of combination of sunflower and coconut oil blend S+C 20 is decreased with compared diesel at full load conditions.

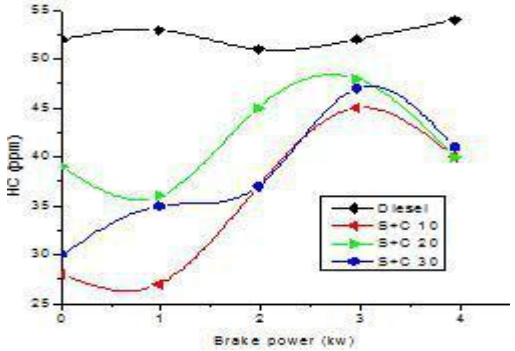

Figure: Brake power vs hydrocarbons for sunflower+coconut

6.3.1CARBON MONOXIDE (CO)

The comparison of carbon monoxide(co) for various biodiesel blends with respect to brake power shown in figure. Carbon monoxide is occurs only in exhaust, it is a product of incomplete combustion because of insufficient amount of air or time in the complete combustion linseed L20 is less is compare to diesel on full load load conditions is L20 is carbon monoxide is decreases.

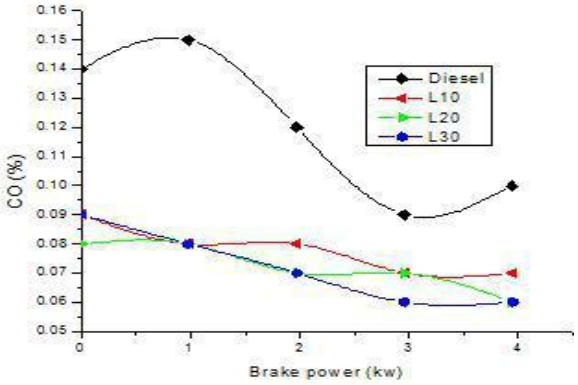

Figure: Brake Power vs CO for Linseed oil

6.3.2CARBON MONOXIDE (CO)

The comparison of carbon monoxide(co) for various biodiesel blends with respect to brake power shown in figure. Carbon monoxide is occurs only in exhaust, it is a product of incomplete combustion because of insufficient amount of air or time in the complete combustion combination of sunflower and coconut oil S+C 20 is less is compare to diesel on full load load conditions is S+C 20 is carbon monoxide is decreases

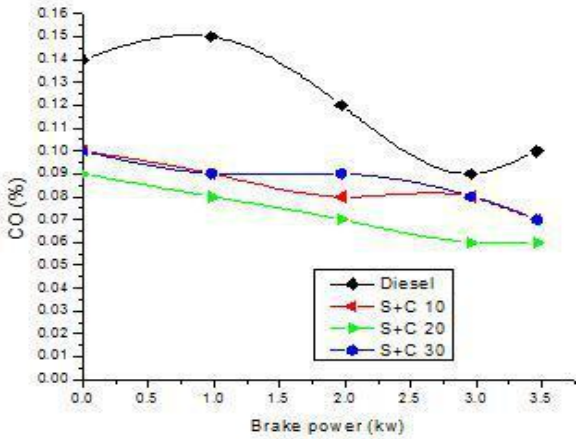

Figure: Brake power vs carbon monoxide for sunflower + coconut oil

CONCLUSIONS

The experiments are conducted on the four stroke single cylinder water cooled diesel engine at constant speed (1500rpm) with varying (0,1/4,2/4,3/4,full load) loads with diesel and different blends of linseed oil like (L10,L20,L30) and combination of sunflower and coconut oil like(S+C10,S+C20,S+C30). Brake thermal efficiency of linseed oil with compared to diesel is more.

L10 is (36%) and L20 is (35.54%) nearer to each other and higher than diesel (31.876%).Brake thermal efficiency of combination of sunflower and coconut oil with compared to diesel is more.S+C 10 is (43.504%) and S+C is (42.88%) nearer to each other and higher than diesel (31.876%)

Brake specific fuel consumption of linseed oil with compared to diesel is lessL10 is (0.232) and L20 is (0.245) are low than diesel (0.250)

Brake specific fuel consumption of combination of sunflower and coconut oil with compared is low.S+C 10 is (0.197) and S+C 20 is (0.20) of combination oil is low than diesel (0.250).

The emissions characteristics such as carbon monoxide (CO), hydro carbons (HC), carbon dioxide (CO_2) are also decreased, will compared to diesel and other blends. Significant reductions of carbon monoxide coming from the exhaust gases is low than diesel.

L20 (0.06) lower than diesel (0.10) so, the L20 best blend is used from blends and diesel also because nearest value of L10 and L20 but emission is more in compare to L10, we best blend is L20. Significant reductions of carbon monoxide coming from the exhaust gases is low than diesel,S+C20 (0.06) lower than diesel (0.10) so, the S+C20 best blend is used from blends and diesel also because nearest value of S+C20 emission is more in compare to S+C10, we best blend is S+C20.

And emissions characteristics also decreases will compared to diesel at 20% linseed oil&20%combination of Sunflower Coconut oil blend with diesel.

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