

Biofuel – Sustainable Energy for Diesel Powered Engines

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Overview

- **Biofuels**
 - ✓ What are biofuels?
 - ✓ Why biofuels?
 - ✓ Biofuel vs biodiesel?
- **Waste Vegetable Oil – Island of Mauritius**
- **Concluding Remarks**

What are biofuels?

- Chemical energy made from water, carbon dioxide and solar energy
- Plants use sunlight (photosynthesis) to make carbohydrates, oils, etc..
- These oils (fatty acids) can be converted to fuel (i.e. biofuel)
- Average photosynthetically available solar energy = 25,000 terawatts
- This is ~2250 X global energy consumption

Why biofuels?

- Political – energy security
- Economic – rising cost of fossil fuel, develop alternative industry base, etc...
- Social – employment (SMEs) + positive spillover effects
- Environmental – carbon “neutral” fuels, no sulphur, lower emissions, decreased risk of oil spills etc ...

Biofuel vs Biodiesel

- Biodiesel – made by the chemical conversion of vegetable or animal fat using a process called esterification.
- Negative - Uses toxic chemicals (lye and methanol)
- Positive – Does not need engine modifications & a value-added product

Waste Vegetable Oil (WVO)

Background

Year	Edible Oil imported (kt)	Cost (Rs cif)	Diesel used in transport (kt)	Diesel cost (Rs/t)
2004	~31.76	0.596 bn	165.8 <i>(of 322.9 ktoe)</i>	9700 <i>(Rs 1.59 bn)</i>
2005	~39.44	0.623 bn	168.2 <i>(of 333.2 ktoe)</i>	14651 <i>(Rs 2.44 bn)</i>

CO2 emissions from transportation in 2004 – 28.9%

Diesel Replacement Capacity

Assumptions:

1. All vegetable oil (VO) used for energy
2. 1.2 kg VO \Leftrightarrow 1 kg diesel oil (calorific values of various VOs are similar)

Diesel oil replacement fraction:

$$(39.44/1.2/168.2) \times 0.97 \times 100 (\%) = 19\%$$

Cost Savings

Assumptions – (1) used 2005 prices; (2) calorific value of WVO unchanged; (3) cost of recovering oil not included

% WVO Recovered	Replacement Capacity	Savings (Rs)
100	0.19	463.6 million
50	0.095	231.8 m
20	0.038	92.8 m
10	0.019	46.4 m
5	0.0095	23.2 m
2	0.0038	9.3 m

Technical Aspects

Conversion - costs

Item	WVO (Rs)	CNO (Rs)
Heat exchanger	9,800	9,800
Heater hose	1,500	3,000
Tank + heater	80	7,700
LPG valves	800	800
Oil hose, pumps, filter, fittings, filler	7,725	10,325
Labour	5,000	7,500
Total	24,905	39,125
Pay Back Time	-6,850 km	?

$$24,905 \text{ (Rs)} \times 9 \text{ (km/l)} / [32.75 - (\text{price of oil}) \times 1.2 \text{ (Rs/l)}]$$

Breakeven price of waste oil: 27.3 Rs/L

Innovative

“win-win-win” scenario between
Economics, Environment and Equity

Success of WVO depends critically on oil recovery rate!!

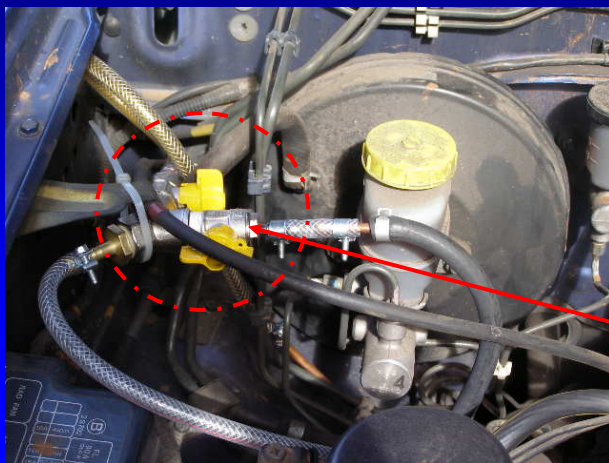
Initial Conversion

Two-tank system



Initial Conversion

Run selectively on either diesel or biofuel



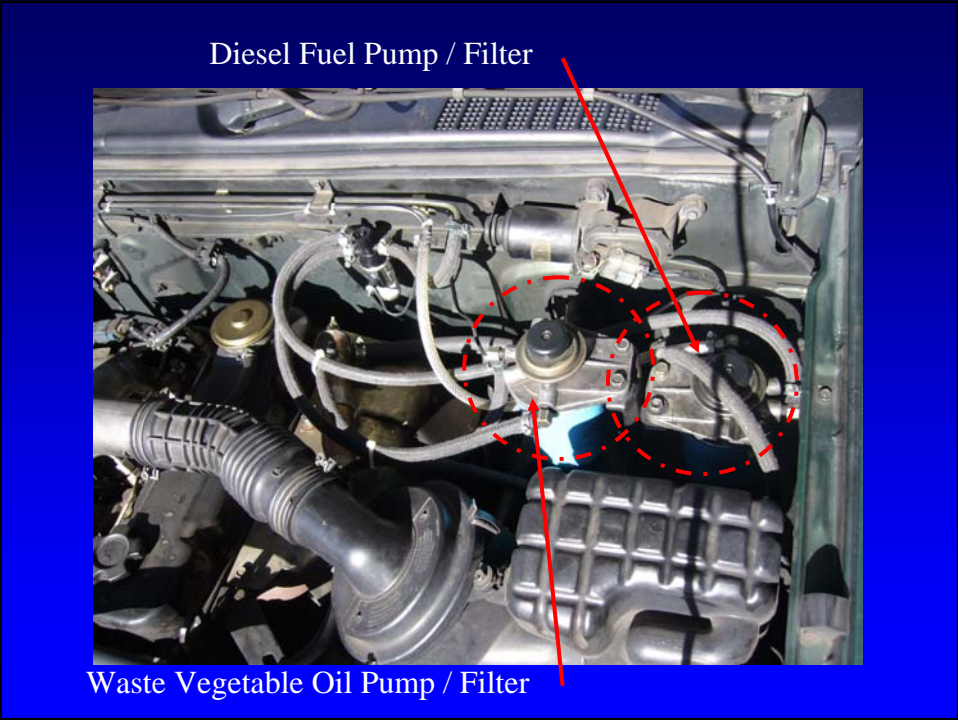
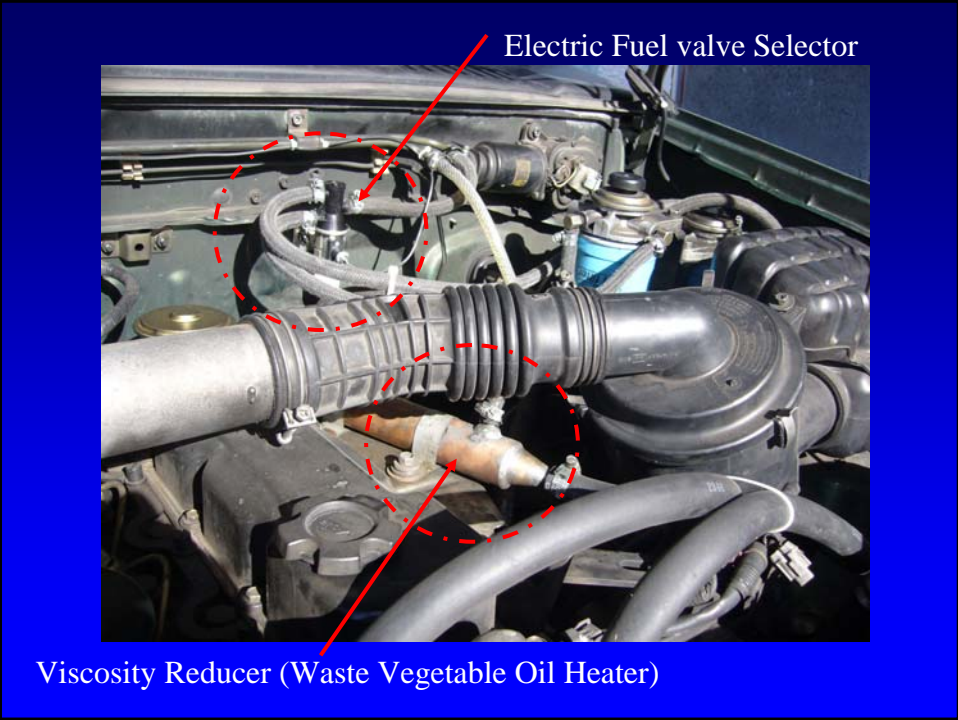
1. Start diesel
2. Run biofuel
3. Stop diesel

Manual Fuel
valves Selector



Permanent Conversion

Auxiliary Tank
Contains: Waste Vegetable Oil



Green House Gases (GHG) Emission CO2

- 1998 Nissan Pickup
Model: D22
Engine: TD27 (2700cc)
Average Km per year: 25,000
Average Fuel consumption: 30 Km/gallon
CO2 Emission per year: 6.1 Tons

Green House Gases (GHG) Emission CO2

- 2001 Honda Civic
Model: Civic
Engine capacity: 1500cc
Average Km per year: 25,000 Km
Average fuel consumption: 60 Km/gallon
CO2 Emission per year: 3.94 Tons

These figures can be obtained online: [Climatecare](#)

THANK YOU!!