

An Effect of Blends of Tyre Pyrolysis Oil & Diesel on Brake Specific Fuel Consumption of 4-Stroke C.I Engine

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Abstract- The Purpose of this study is to improve the performance of 4 stroke single cylinder diesel engine with blending of tire pyrolysis oil and diesel. Tire pyrolysis oil is obtained by pyrolysis process of waste tires. Tire pyrolysis oil has a similar properties of diesel. Pyrolysis process involves the chemically decomposes organic materials by heat in the absence of oxygen. An experiment was conduct on 4 stroke CI engine with employing the blends of TPO and diesel in respect of 5%, 10% & 15%. During an experiment readings were observed. optimum parameters for lowest brake specific fuel consumption are 5% of tyre pyrolysis oil blend with diesel, 145 bar injection pressure and 10 kg load.

Keywords – Diesel, Tire pyrolysis oil (TPO), Injection pressure, Engine performance, Blends of TPO & diesel, bsfc

I. INTRODUCTION

As per current situations concerned with availability of fossil fuel and increasing the demand of vehicles at point of view of transportations, it is necessary to think about it. Also it is noted that prices of petrol and diesel are continuous increases. Day by day increasing the consumption of fossil fuels like petrol and diesel, possibility makes in future that their sources will not available so more. Also today's main problem is the pollution created from vehicles. So, ours effort must be go in that direction which reduces the pollution and also find a suitable alternative for the fossil fuels. [Sk.Mohammad Younus et al. (2013), Mr. Krunal B Patel et al. (2013)]

As per current scenario, India is a diesel based economy. Diesel consumption is around five times the consumption of petrol. So, to reducing the pollution & achieve a great economical benefit, we have to find suitable alternatives for diesel engine and must be do research work on them.

Tire pyrolysis oil have a similar properties of diesel. It is obtained from waste tires with pyrolysis process. The tire pyrolysis process converts waste tires into potentially recyclable materials such as flammable gas, pyrolysis oil and carbon black. It was determined that the oil production yield of tire pyrolysis process has a maximum at 350°C and decomposes rapidly above 400°C.

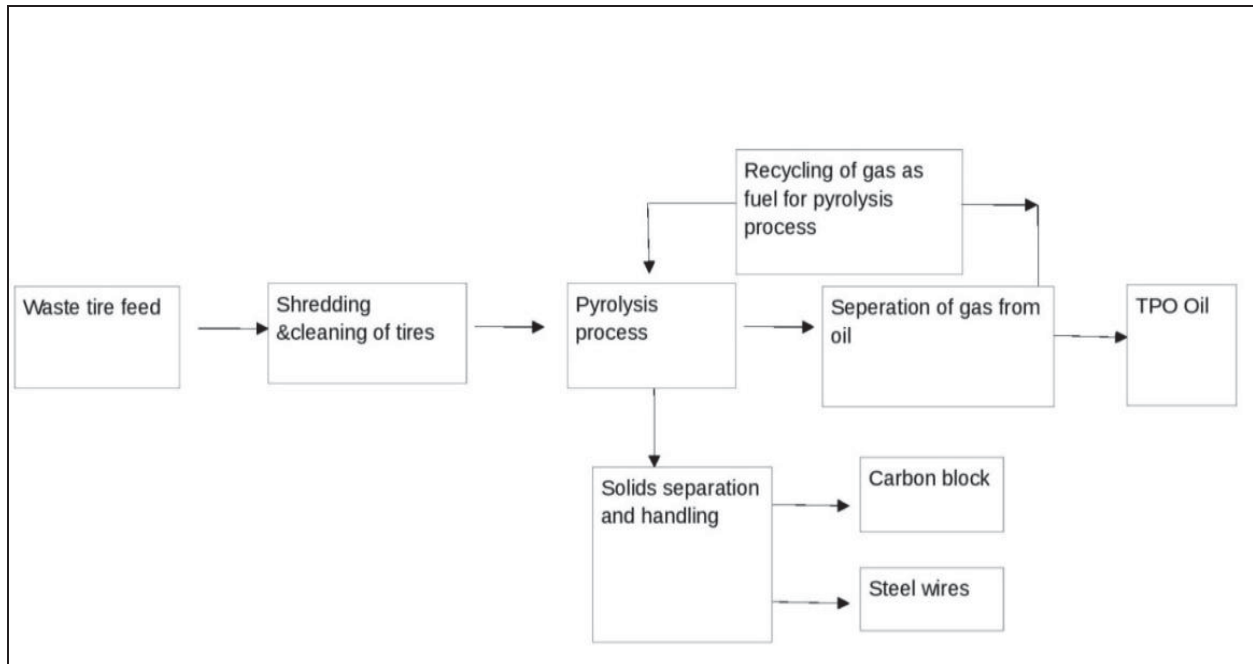


Figure 1: Process to makes of tyre pyrolysis oil

Table 1 Properties of Diesel & Tire pyrolysis oil[Jinang M. Patel et al 2013, C. Wongkhorsub et al.2013, Sk.Mohammad Younus et al.2013]

Properties (condition)	Unit	TPO	Diesel
Density	Kg/m ³	834	799
C.V	Kj/kg	42500	45814
Carbon content	%	84.67	87
Hydrogen content	%	10.44	13
Oxygen content	%	4.17	-
Viscosity @ 40°C	cp	2.69	1-4.11
Flash Point	°C	68	70

II. EXPERIMENTAL SET-UP & PROCEDURE

The setup consists of single cylinder, four stroke, water cooled diesel engine. The engine is coupled to a rope brake dynamometer through a load cell. The injection point can be changed for research tests. On the upper part of plunger the adjustable screw is attached to the injector. Injection pressure is changed by rotating the adjusting screw. Control panel is involve that supply of air, furl and cooled water. The experiment has been performed on 4 stroke single cylinder diesel engine. In this experiment, Tire Pyrolysis Oil used as a blend with diesel with different percentage of 5%, 10% & 15% An injection pressure was also change during an experiment. Taguchi method is used for this experiment. This method uses a special set of arrays called orthogonal arrays. These standard arrays stipulates the way of conducting the minimal number of experiments which could give the full information of all the factors that affect the performance parameter. The orthogonal arrays method lies in choosing the level combinations of the input design variables for each experiment. In this experiment, three factors and four levels are involved with

taguchi method. So, the orthogonal array becomes L16 for conduct the experiment. Three factors are included that % of TPO, Injction pressure and Load.

Table 2 Engine Specification

Engine	Single cylinder four stroke
Bore × Stroke	80 mm × 110 mm
Compression ration	18:1
Maximum Power	4.2 kw
Rated speed	1500 rpm
Capacity	650 cc

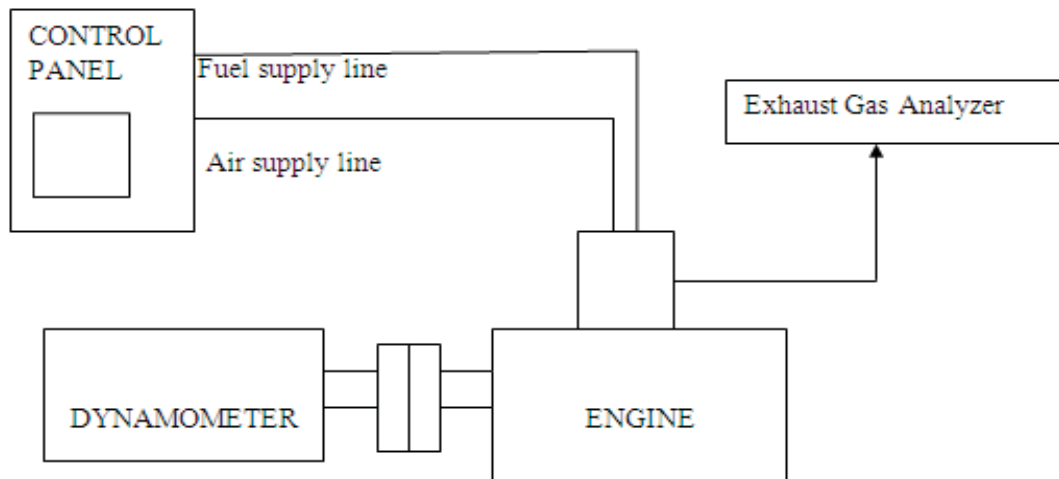


Figure 2 Block diagram of experimental set-up

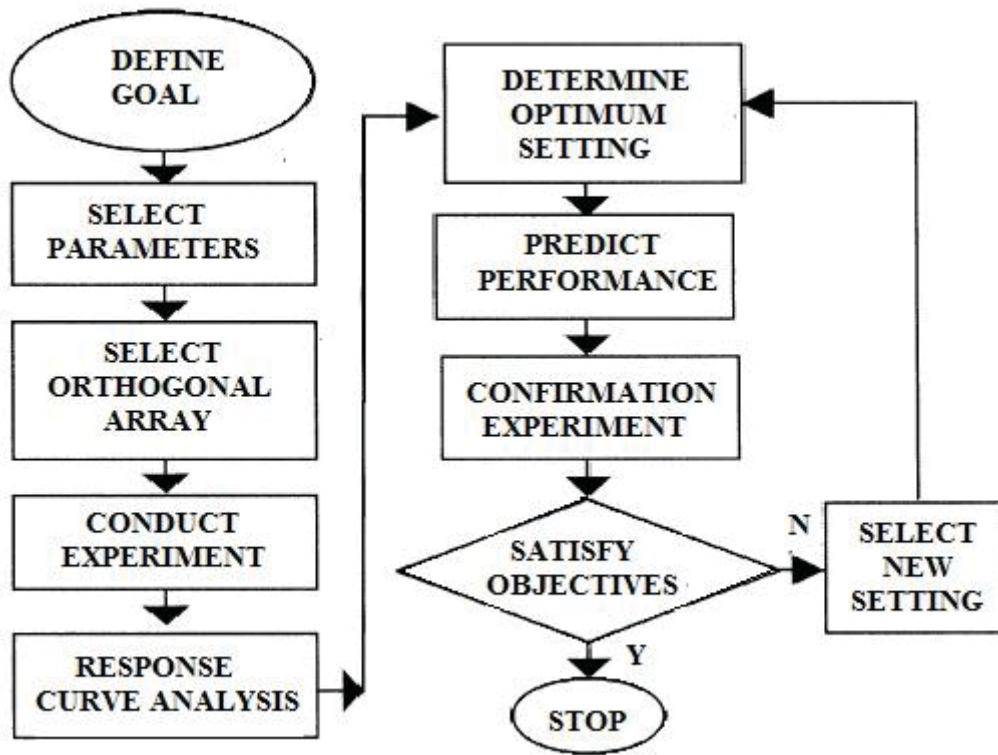


Figure 3 Taguchi Method steps

III. RESULT ANALYSIS

Table 3 L16 orthogonal array

Sr No.	% of TPO	Injection pressure Bar	Load kg	BSFC kg/kWh
1	0	145	1	2.020
2	0	160	4	1.890
3	0	190	7	1.780
4	0	210	10	1.540
5	5	145	4	1.180
6	5	160	1	2.270
7	5	190	10	0.987

8	5	210	7	1.090
9	10	145	7	0.980
10	10	160	10	0.890
11	10	190	1	3.018
12	10	210	4	2.020
13	15	145	10	0.900
14	15	160	7	1.020
15	15	190	4	2.100
16	15	210	1	3.128

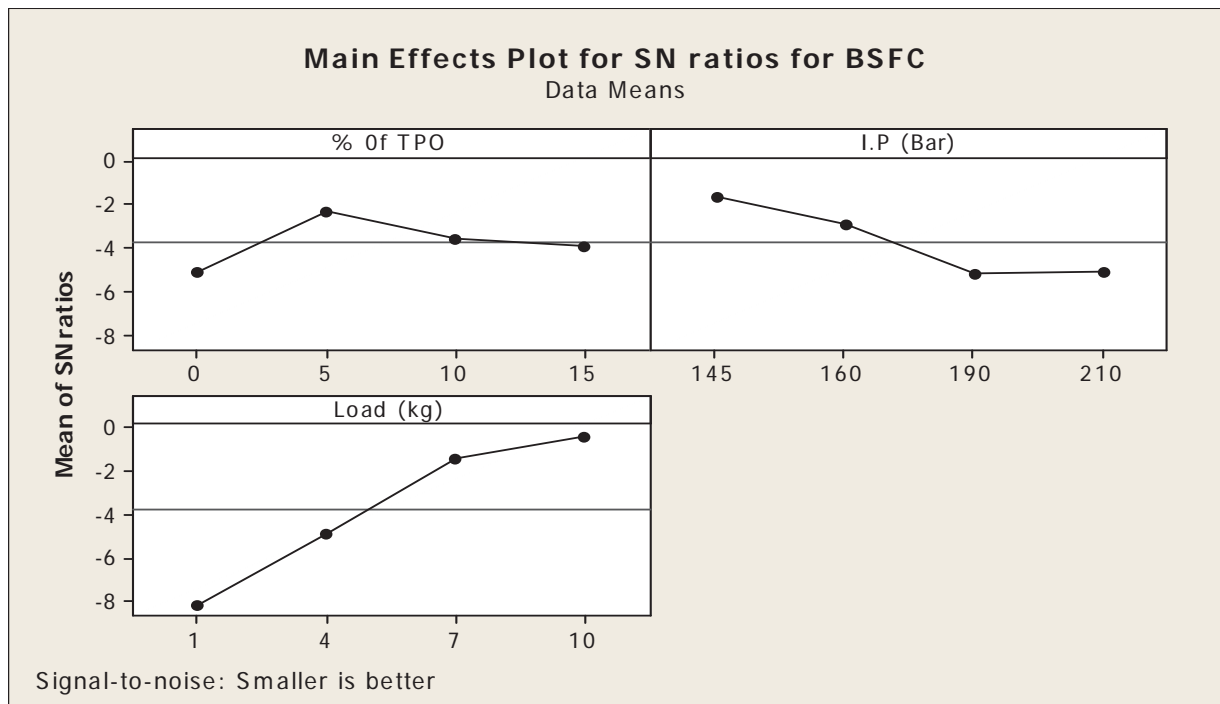


Figure 4 Main effect plot for S/N Ratio for SFC(kg/kWh)

From above graph , it is observed that optimum parameter for lowest brake specific fuel consumption are 5% of tyre pyrolysis oil blend with diesel, 145 bar` injection pressure and 10 kg load. At starting blending of TPO with diesel BSFC decrease, but then it is slightly increase.

LEVEL	% of TPO	INJECTION PRESSURE(Bar)	Load(kg)
1	-5.09877	-0.77024	-7.33853
2	-2.16875	-1.54834	-3.47543
3	-3.62925	-3.89511	0.46021
4	-3.90209	-3.41432	0.72574
Delta	2.93002	3.12487	8.06427
Rank	2	3	1

In the response table, Highest S/N ratio is considered. So, it is observed from response table for optimum parameters. Delta is the difference between highest and lowest value in the table. Rank indicates that, which parameters have a highest effect on Bsf. Load has a highest effect, and lowest effect of injection pressure is occur.

Table 5 Predict performance at optimum combination of parameters:

S/N Ratio	Brake specific fuel consumption (kg/kwh)	Experimented value of Brake specific fuel consumption (kg/kwh)
3.12427	0.379347	0.3934

IV. CONCLUSION

From above analysis, optimum parameters for lowest brake specific fuel consumption are 5% of tyre pyrolysis oil blend with diesel, 145 bar injection pressure and 10 kg load. At the beginning of blending TPO in diesel, BSFC is decreased, but than it is slightly increased to more TPO blending in diesel. When injection pressure decreased, BSFC decreased.

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