

The effect of addition of carbon nanoparticles on gasoline to power and fuel consumption

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Abstract. The concerns about the continuity of energy supply have sparked the idea of many people to find things that can be used to save fuel use. One of the popular ways developed at this time is the addition of carbon nanoparticles. Carbon nanoparticles are carbon particles with a range size of 1/1,000,000,000 m. Rice husk nanoparticle carbon with chemical characteristics (magnesium, aluminium, silica, potassium) are non-ferrous metal elements. The addition of carbon nanoparticles in the fuel serves as a catalyst (conductor of heat) in the burning process of the fuel. The carbon chemical content will add carbon to the fuel. The mass of rice husk carbon nanoparticles is which dissolved in gasoline fuel, causing molecules in the fuel to increase mass concentration and make shorter distance between molecules. Carbon nano additives can create micro explosions in the combustion process. Micro explosions will increase the pressure produced in the combustion chamber, also the micro explosion will accelerate the combustion process. With increasing pressure and combustion speed will increase the power produced.

1. Introduction

Ideas about energy sources are discussed because of the increasing number of uses for industries and motor vehicles. Prices tend to increase due to depleting supplies. The side effects caused by the use of fossil fuels are pollution problems. Various predictions about petroleum reserves will run out in less than 50-80 years [1]. Concerns about the continuity of energy supply created the idea of finding "something" that could be used to save fuel use or even replace fossil fuels (diversification) to maintain the continuity of life. However, humanity will still exist, and even continue to grow every day and all of them need energy to do various activities.

Various methods have been adopted to reduce the volume of fossil fuel use. One of them is mixing fossil fuel with certain additives so that it can increase engine power which has implications for fuel savings. The old method that is usually used is the addition of (Tetra Ethyl Lead (C_2H_5)₄Pb). But this method has been abandoned because it causes toxic Pb emissions. At this present, the most testing method is the use of bio nanoparticles. Bio particles are chosen because they are renewable, easily available from the surrounding environment and not polluting and non-toxic. Nanoparticles are chosen because of their very smooth size, so that it can mix homogeneously with oil and not cause a blockage in the injector hole which has a very small hole size. Various nanoparticles have been tested such as: Mn_2O_3 , Cerium Oxide (CeO_2) [2], aluminium oxide (Al_2O_3) [3] and others.



Carbon is an element that has unique properties. Carbon that we know as charcoal as a solid matter, but carbon also exists in the air as CO₂ Gas. Even diamond which is the hardest material is a carbon atom. The size of minimized carbon will be carbon nanoparticles, namely carbon with a particle size of 1 / 1,000,000,000 m [4, 5].

Carbon nanotubes (CNTs) are as useful additives for increasing the octane number. Functionalized carbon nanotubes containing amide groups have a high reactivity and can react with many chemicals. These compounds can be solubilized in gasoline to increase the octane number [6].

Reports on an experimental investigation that was conducted to recommend the most suitable dose level of multiwalled carbon nanotubes (MWCNT) into biodiesel-diesel fuel blend at which the optimum diesel engine performance is attained. In this study, nano-particles of size from 10 to 15 nm with tube length 1-10 microns, the dose level is varied from 10 to 50 mg/l by step of 10 mg/l was mixed into the biodiesel-diesel fuel blend with the help of ultrasonicator. A single cylinder diesel-engine-test facility was used to study the effect of nanoparticles dose level on engine combustion and environmental performance parameters with a constant speed of 2000 rpm and different engine torque. The results of the present study showed that the biodiesel-diesel fuel blend slightly decreases the mechanical engine performance and increases its emission characteristics at all tested engine operating conditions [7].

These nanomaterials, thus have green engineering potential for various sectors such as automotive/aerospace, solar/fuel cell, and environment management industries. Using appropriate green nanocomposites design may offer a path to sustainable energy and environmental advancement. Development of new high performance nanocarbon designs has been a challenging topic of research in this regard [8].

When added to fuels in an amount from about 0.01% to about 15% by weight, carbon nano tube can enhance the burning rate, function as anti knock additives, render the fuels conductive and increase their viscosity. Carbon nanotubes as fuel additives offer many advantages. For example, because of their ability to trap free radicals, carbon fibrils can function as an antiknock additive. Carbon nanotubes can act as a burning rate catalyst because when added to liquid fuels they accelerate the burning rate, promote clean burning and suppress smoking [9].

At the moment, testing is done to improve the quality of fossil fuels by mixing fossil fuels with bio carbon nanoparticles. Bio carbon is chosen because it is easily obtained which is waste produced by combustion. The presence of bio carbon nanoparticles with non-chemical characteristics will be used as a catalyst (heat conductor) in the oil combustion process. The chemical content (carbon) will add carbon molecules in the oil, it's predicted to increase calorific value. The mass of bio carbon nanoparticles dissolved in oil, causing molecules to increase mass concentration, and make the inter-molecular distances shorter.

In this research, mixing rice husk carbon nanoparticles at a gasoline at concentrations of 1 and 2 ppm will be carried out. Carbon nanoparticles, which are renewable bio-carbon, and do not cause toxic effects on their emissions. The concentration of carbon nanoparticles in gasoline, obtained by measurement of bio carbon mass using mass and gasoline volume measurements using a measuring cup, performs a volume and mass scale equation into the scale (ppm). The existence of rice husk bio carbon nanoparticles with characteristics of the chemical elements (magnesium, aluminium, silica, calium) is a non ferrous metal element that will function as a catalyst to help accelerate combustion and carbon content will increase mass concentration.

This current research aims to explore the Power dan fuel consumption of engines using gasoline fuels with the addition of rice husk carbon nanoparticles. Tests carried out on varied loads using gasoline fuels sold at gas station with added carbon nanoparticles.

2. Experimental apparatus and methods

The research was conducted by testing methods with laboratory test equipment. The first step of the research was carried out in an analytical laboratory. the gasoline was used in this research is gasoline which sold at gasoline station, and the gasoline was added with nanoparticle in analytical laboratories with concentrations of 1 ppm and 2 ppm. the next step is experimental test (experimental research),

which is test the performance of the engine using a dynamo meter indicator load cell type TD 800PM as shown in Figure 1.

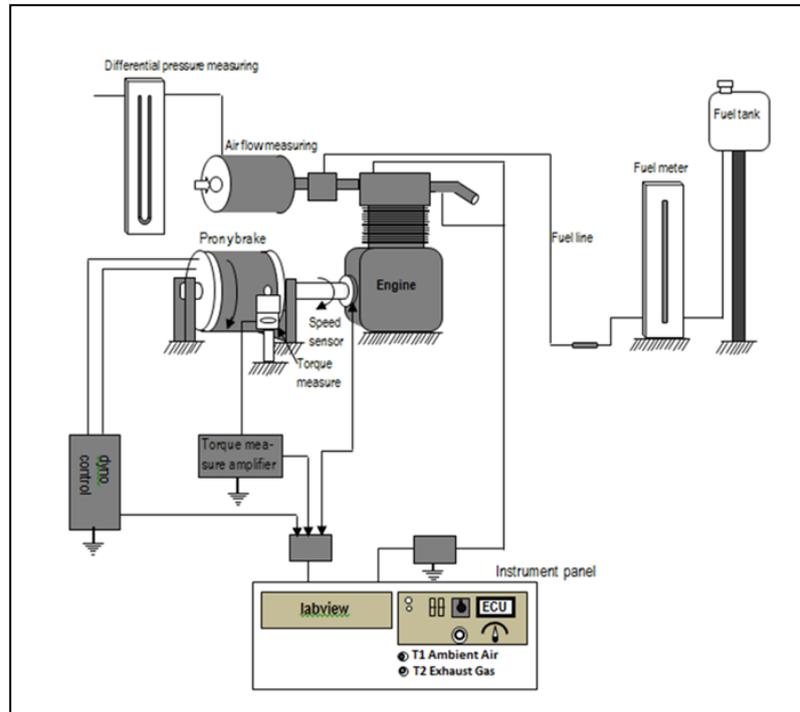


Figure 1. Set-up experimental.

3. Results and discussion

By using the initial engine speed data of 3500 rpm, the load increases every 1 kg. Load arm length 20 cm, Fuel volume is 5 ml. LHV of gasoline 42400 (kJ/kg). Using the formulas (Torsi) $\tau = Fr$, Fuel consumption Q_{mf} (kg/s) obtained from formula $Q_{mf} = Q_{vf} \times \rho_f$, Power produced (P) = $2\pi Frn/60$ kW. The air flow rate through the orifice plate is calculated by equation $Q_{va} = Q_{ma}/\rho_a = \alpha \varepsilon (\pi d)^2/4 \sqrt{(2\Delta p/\rho_a)}$, Combustion chamber volume $Q_{th} = \text{engine total displacement volume} \times n / (2 \times 60)$ (m³/s), volumetric efficiency $\eta_v = Q_{va}/Q_{th} \times 100\%$. So that the results of calculations are obtained as presented in Table 1, 2 and 3.

Table 1. Calculation of gasoline data.

n (rpm)	Net Force (kg)	Fuel Consumption			Manometer Reading (mm H ₂ O)	A/F ratio	P kW	B _{sfc} (kg/kWh)
		Time (s)	Q _{vf} (l/s)	Q _{mf} (kg/s)				
3500		17.62	0.00028	0.00019864	75	6.2970	0	
3450	1	15.45	0.00032	0.00022654	80	5.7026	0.7088	1.15052
3340	2	18.7	0.00027	0.00018717	80	6.9022	1.3725	0.49094
3189	3	18.09	0.00028	0.00019348	65	6.0186	1.9656	0.35435
2918	4	19.81	0.00025	0.00017668	60	6.3323	2.3981	0.26522
2646	5	21.92	0.00023	0.00015967	60	7.0067	2.7182	0.21147

Where:

Room temperature : 29
 Air bok/Orifice diameter : 300/15
 Atmospherik pressure : 105.2kPa
 Manometer slope : 1:10

Fuel type : gasoline

Table 2. Calculation of gasoline + 1ppm carbon nano data.

n (rpm)	Net Force (kg)	Fuel Consumption			Manometer Reading (mm H ₂ O)	A/F ratio	P kW	B _{sfc} (kg/kWh)
		Time (s)	Q _{vf} (l/s)	Q _{mf} (kg/s)				
3500		17.58	0.00028	0.00019909	90	6.8824	0	
3455	1	23.85	0.00021	0.00014675	70	8.2345	0.7099	0.74423
3360	2	20.75	0.00024	0.00016867	55	6.3504	1.3807	0.4398
3260	3	20.27	0.00025	0.00017267	60	6.4793	2.0094	0.30935
3010	4	23.46	0.00021	0.00014919	60	7.499	2.4737	0.21711
2650	5	34.59	0.00014	0.00010119	60	11.057	2.7223	0.13381

Where:

Room temperature : 29

Air bok/Orifice diameter : 300/15

Atmospherik pressure : 105.2kPa

Manometer slope : 1:10

Fuel type : gasoline + 1 ppm carbonnano

Table 3. Calculation of gasoline + 2ppm carbon nano data.

n (rpm)	Net Force (kg)	Fuel Consumption			Manometer Reading (mm H ₂ O)	A/F ratio	P kW	B _{sfc} (kg/kWh)
		Time (s)	Q _{vf} (l/s)	Q _{mf} (kg/s)				
3500		16.47	0.0003	0.00021251	340	12.532	0	
3431	1	15.36	0.00033	0.00022786	335	11.601	0.7049	1.16367
3281	2	16.78	0.0003	0.00020858	330	12.579	1.3482	0.55695
3081	3	17.41	0.00029	0.00020103	330	13.051	1.8991	0.38109
2869	4	18.8	0.00027	0.00018617	320	13.878	2.3579	0.28425
2655	5	20.02	0.00025	0.00017483	280	13.824	2.7275	0.23075

Where

Room temperature : 29

Air bok/Orifice diameter : 300/15

Atmospherik pressure : 105.2kPa

Manometer slope : 1:10

Fuel type : gasoline + 2 ppm carbonnano

The test results show that the power produced P (kW) by uses gasoline fuel plus 1 ppm carbon nano higher than using pure gasoline or gasoline fuel plus 2 ppm carbon nano. This is because a bit of carbon content will help speed up the combustion processes, this is due to the presence of micro explosion caused by carbon nanoparticles [2]. But increased carbon content becomes higher, which is 2 ppm resulting in a decrease in power. This is due to a reduction in the amount of fuel entering the combustion chamber. Graph comparison of the power between gasoline, gasoline plus 1 ppm carbon nano and gasoline plus 2 ppm carbon nano can be seen in Figure 2.

The results of testing on fuel consumption show that fuel consumption using gasoline plus 1 ppm carbon nano is lower than using pure gasoline and using gasoline plus 2 ppm carbon nano. This is due to reduced heat value of fuel entering the combustion chamber due to the addition of carbon nano, which causes increased fuel consumption to carry the same load as shown in Figure 3.

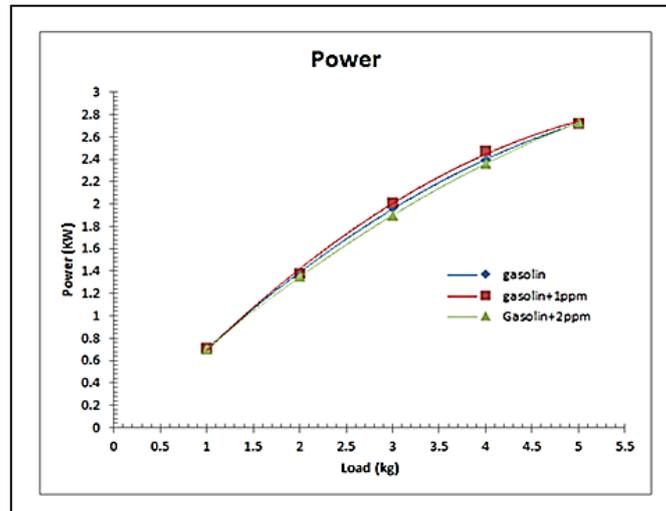


Figure 2. Comparison of the power produced between gasoline, gasoline + 1 ppm carbon nano and gasoline + 2 ppm carbon nano.

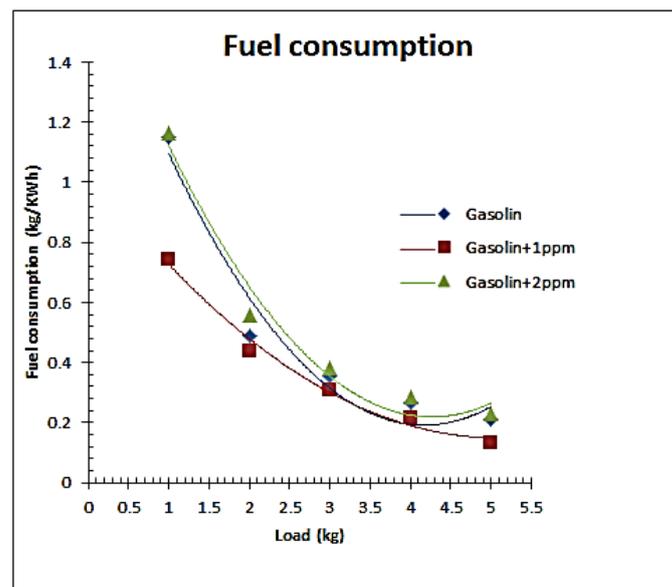


Figure 3. Comparison of fuel consumption using gasoline, gasoline + 1 ppm carbon nano and gasoline + 2 ppm carbon nano.

4. Conclusions

By using gasoline fuel plus 1 ppm carbon nanoparticles produced greater power than pure gasoline or using gasoline fuel plus 2 ppm carbon nanoparticles at the same load. By using gasoline fuel plus 1 ppm carbon nanoparticles specific fuel consumption is lower than using pure gasoline or using gasoline plus 2 ppm carbon nanoparticles at the same load.

5. References

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