An Elsevier Indexed Journal ISSN-2230-7346

Journal of Global Trends in Pharmaceutical Sciences

INFLUENCE OF TRANSESTERIFICATION ALUMINUM OXIDE NANOPARTICLE IN COCONUT OIL IN A DIESEL ENGINE

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ARTICLE INFO

Key Words

Biodiesel, Coconut oil, Emissions, Engine, Experimental result, HC (unburned hydrocarbons)

ABSTRACT

For controlling the global warming, emission, enhance engine performance pursuance more- over the crisis of petroleum products, biodiesel is the promising solution. This investigation preeminent aim the influence of transesterification of Al_2O_3 in coconut oil, blends moreover the reduction of NOx, HC, and smoke emission. The present research work performed with two fuel blends by using traditional and Al_2O_3 as catalysts in the transesterification process. CBD and CBDA 10%,20%, 30% and 40% blends were showed reduced emissions of NOx of 10.18%, 9.39%, 9.26%, and 9.56% and smoke controlled 10.09%, 9.46%, 5.80%, and 2.01% respectively. By the addition of Al2O3 nanoparticles in coconut, biodiesels reveled the im- provement in brake thermal efficiency and brake specific fuel consumption. Also shows the diminish in CO and UHC. Empirical conclusion appears the better BTE in CBDA blends 4.02%, 4.32%, 2.60% and 1.20% and lessened BSFC 1.5%, 1.6%, 3.7% and 3.6% efficiency at different blends at higher loads. Coconut biofuels and Al_2O_3 Nano Particles associated major challenges and future developments are measured.

INTRODUCTION

According to UNCO and WHO the world population are facing the most dramatic prob- lems which population surge, food crisis, and crude oil demand [2]. Every day our life energy plays a key role and due to population growth in rural and urban, transportation, daily us- age goods, lifestyle, and industries required more energy demand [10]. Conventional energy usage increased. In addition, the exhaust emissions from traditional energies exhaled the air swiftly defilement and deterioration cause major health problems like asthma, allergy, and airway disease [1]. The major reason for air contaminants (Carbon dioxide, unburned hydro- carbons, smoke and nitrogen oxides) is more usages of petroleum fuels for transportation, industries and peoples' needs and at the same time petroleum industries cannot maintain the demand and supply, so non-gulf countries concentrated on alternative solutions for con- trolling the emissions and stabilizing the market is biofuel. In the present market, two types of oil are available for producing the alternative fuels one is edible oil and other is non-edible oils. "Food vs Fuel" the so many researchers cannot encourage research towards the usage of biofuels by using edible oilseeds [3]. Most of the researchers are concentrating on controlling emissions and improving the specific fuel consumption of miscellaneous oils like esculent and non-esculent oils [4]. Oils like Coconut, mustard and jatropha run diesel engines directly without any modifications and also run the engine direct raw oil and chemical processed blend form along with diesel in engine [5]. The problem of using 100% pure coconut biofuels are observed nitrogen oxides are increasing [6] and for meeting the emission standards to use suitable methods like adding of Nanoparticles as an additive for biodiesel various investigators shows the best performance and emission. In this connection adding of nanoparticles as a catalyst along with alcohol in the chemical process and also shows the improvement in fuel properties [7]. It is clear that from the above reappraisal, exhibits the alternative fuels are deliberated as one of the proxy source for diesel. Oil was tired of dried coconut and alcohol prepared by a chemical transesterification process. Based on the past literature reviews a gap in adding the nanoparticles to coconut oil in the transesterification referral and fuel in a Compression ignition engine. Hence, the current work provokes to analysis the use of al_2O_3 molecules in the transesterification treatmentand performance of diesel engines.

Material and method: Collect the 500g of coconut oil in the reactor maintained at the temperature of 95.8^0C. 8:5 molar ratio of methanol to coconut oil and 0.3% (wt.\wt.) oil had used for the chemical

are observed significantly. By adding of Al2O3 oxides ignition short delay period reduces the combustion span [14].

process. Alumina nanoparticles (0.1 g (12.5 wt%) CaO–MgO (8:2)/Al2O3) was slowly added to the mixture during transesterification by vigorous stirring and heating simultaneously as per the reaction temperature and time. The reaction products are made to settle down in a conical flask overnight where the physical separation takes place due to gravity and yields the methyl ester in the top layer, glycerol in the middle layer and catalyst phase settles down at the bottom layer. Table1 shows the reference standard ASTM properties of diesel and coconut biodiesel with Al_2O_3 and figure 1 shows the SEM & TEM images of Al_2O_3.

1. Experimental setup

Diesel engine (AV1, Kirloskar) used for testing of biodiesels. Schematic test setup as shown in figure 2. And its specification in table 2. AVL digas 444 smoke meter and AVL 437C opacimeter models are used for emission analysis. Table 3 gives the information about the emission analyzer limits.

2. Result and Discussion:

2.1. Emission analysis:

2.1.1. Oxide of nitrogen emission:

Due to excess of oxygen content in biofuel, combustion temperature raised and dwelling time available for NOx formation in chemical reactions [12]. Zeldovich mechanism shows the NOx formation below [13]:

$$\{N_2\} + \{O\} \rightarrow NO + \{N\}$$

$$\{N\} + \{O_2\} \rightarrow NO + \{O\}$$

$$\{N\} + \{OH\} \rightarrow NO + \{H\}$$

However, by adding of Nanoparticles in transesterification processes, lowered NOx emissions.

Figure 3 & 4 shows the of swerving the coconut oil (CBA) and Nano Coconut oil (CBAN with a decrease of NOx

Table 1: Properties of fuel

Test description	Reference		Diesel	Al_2O_3 Coconut Biodiesel Blend			
			B00	B10	B20	B30	B40
Density	Unit	Limit	0.832	0.833	0.835	0.836	0.839
Calorific Value	gm/cc	0.800-0.900	42.70	42.40	42.11	41.89	41.71

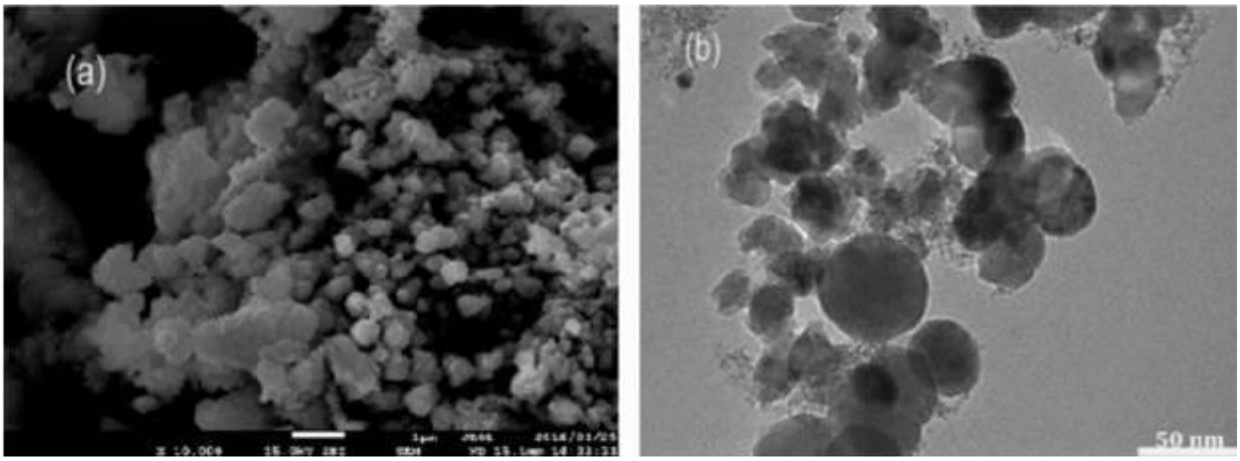

Figure 1: SEM and TEM image of Alumina Nano-particle

Table 2: Specification of an test setup

make, model	TMEC-10
stroke	2
cylinder	1
rated power	5.12kW
rated speed	1500 rpm
bore diameter	87.5 mm
stroke (L)	
110 mm compression ratio	17.5:1
number of injecters	1
INJECTION timing	23 BTDC
injection pressure	200 bar

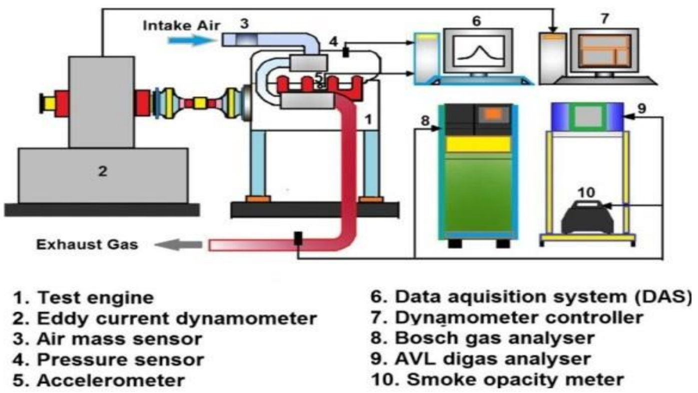

Figure 2: Schematic of the test engine

Table 3: Limits of exhaust gas analyzer

Pollutant	Range	Accuracy
CO	0–15.0 vol. %	0.01 vol. %
HC	0–30000 ppm vol	±1 ppm vol
NOx	0–5000 ppm vol.	±1 ppm
SMOKE METER	0–100%	±1%

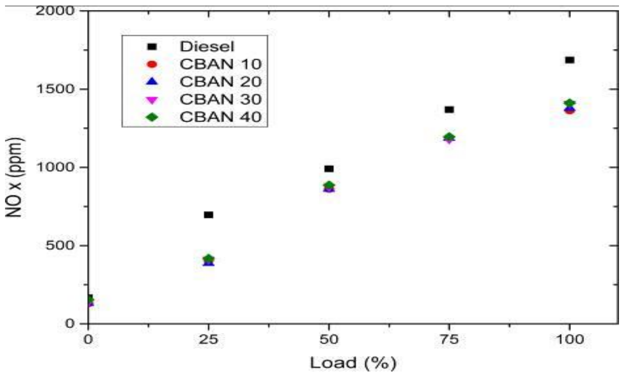

Figure 3: Nano Coconut Oil Load Vs NOx

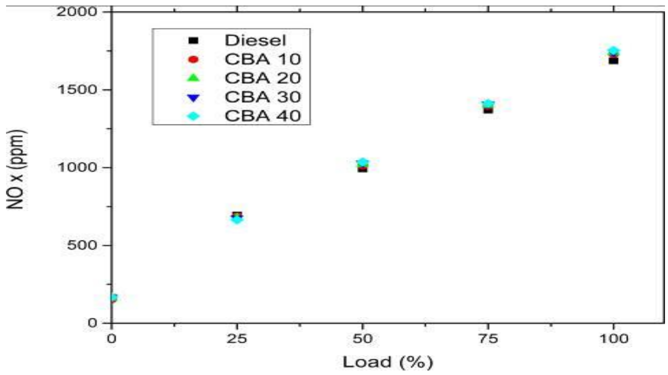

Figure 4: Coconut oil Load Vs NOx

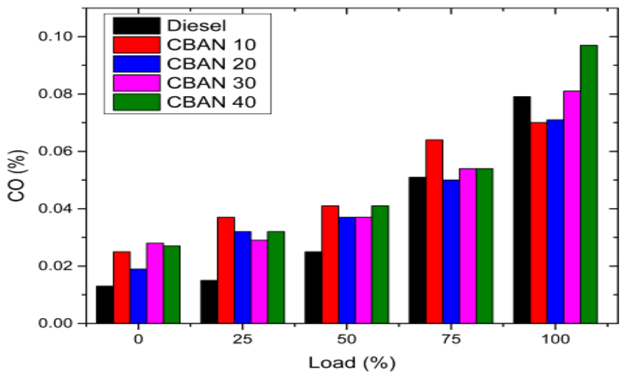

Figure 5: Nano Coconut Oil Load Vs CO

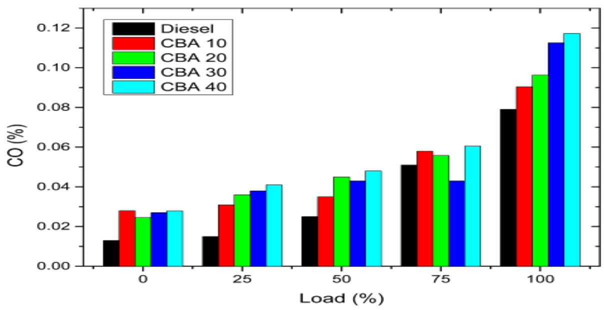

Figure 6: Coconut oil Load Vs Co

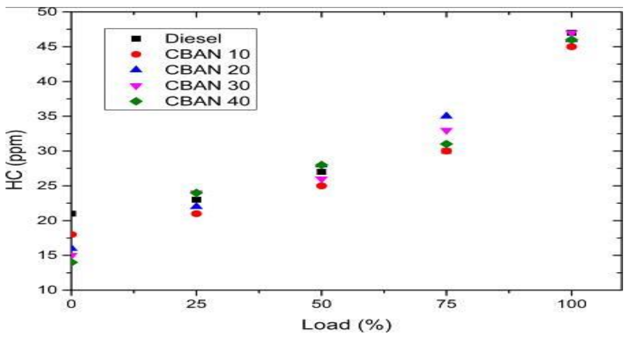

Figure 7: Nano Coconut Oil Load Vs HC

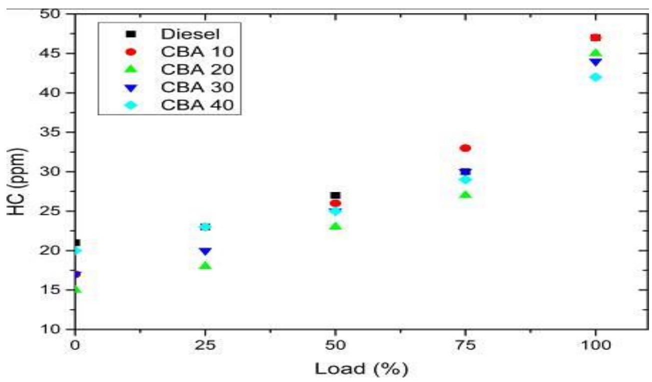

Figure 8: Coconut oil Load Vs HC

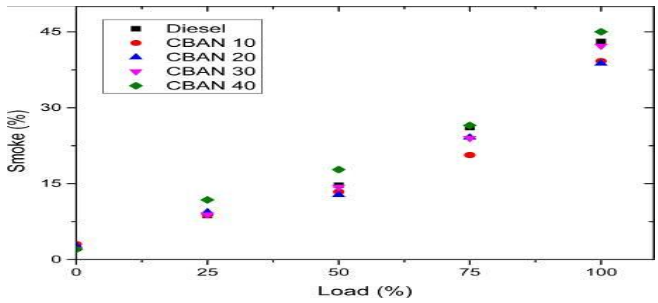

Figure 9: Nano Coconut Oil Load Vs Smoke

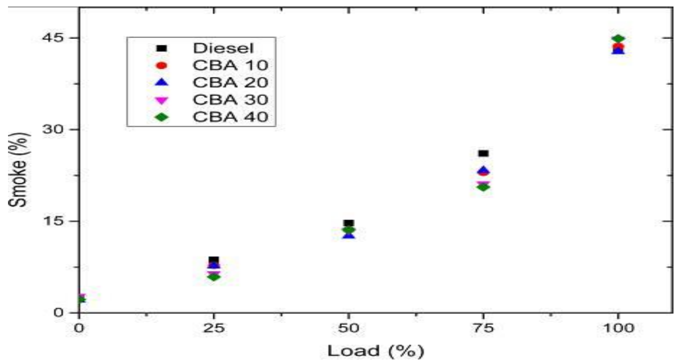

Figure 10: Coconut oil Load Vs Smoke

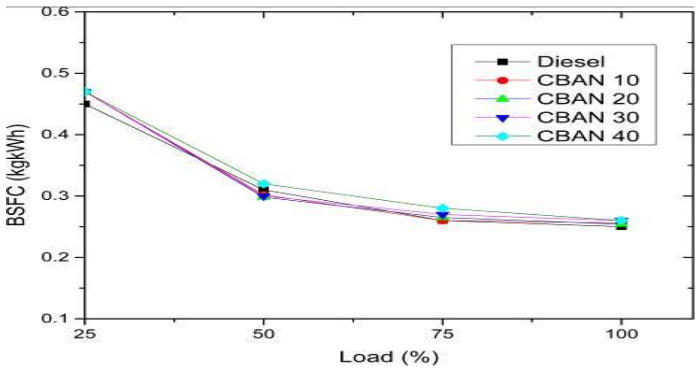

Figure 11: Nano Coconut Oil Load Vs BSFC

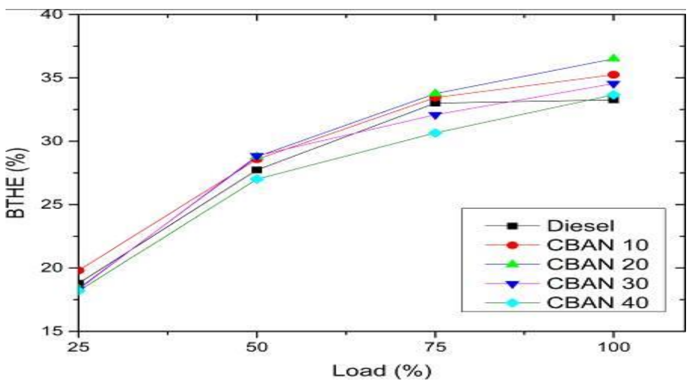

Figure 12: Coconut oil Load Vs BSFC

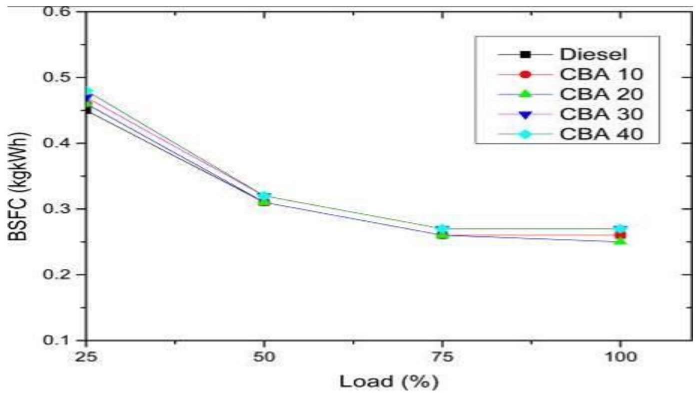

Figure 13: Nano Coconut Oil Load Vs BTHE

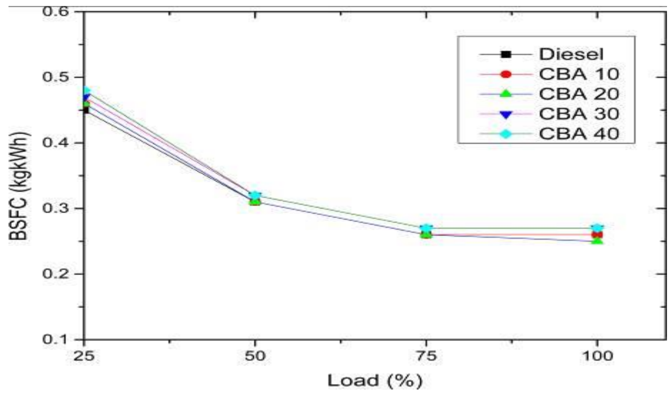

Figure 14: Coconut oil Load Vs BTHE

when compared at 10, 20, 30 and 40 blends NOx are reduced to 10.18%, 9.39%, 9.26%, and 9.56% respectively at full loads.

2.1.2. Carbon monoxide (CO):

Due to presences of the high amount of oxygen in biofuels, the combustion rate is good and fuel burnt completely it reduces the CO emissions [15]. If load will increase fuel quantity of intake rises causing incomplete combustion and CO emissions to awaken. Adding Al2o3 Nanoparticles surplus oxygen content boots to fuel and reduces the combustion delay and gives less CO emissions in the tailpipe. Figure 5 & 6 CO emissions at high loads for tra- ditional transesterification and Al2O3 transesterification blends 10,20,30 and 40 are 22.2%, 26%, 28.3% and 17.9% respectively.

2.1.3. Hydrocarbons (UHC):

Biodiesel having surplus oxygen which helps for smooth combustion and unburnt hydro- carbons reduces when coming to diesel base fuel [16]. Adding of Al2O3 in biofuel preparation it gives better-controlled UHC emissions. Al2O3 boot the fuel with oxygen at higher loads where fuel ratio increases and oxygen level reduced. Nanoparticles increase the better ther- mal conductivity in fuel gives complete combustion and lesser HC [15]. At load increases the which causes the rich- mixture gives deficient combustion. Figures 7 & 8 shows at maximum loads compare with both fuel 4.25%, 2.17%, 6.38%, and 8.69%.

2.1.4. Smoke:

Maintaining of an engine at a constant speed an increasing of loading on engine higher fuel quantity required more [17] and also rich fuel mixture required for running at maximum load. As the fuel quantity increases dropping of oxygen level in the cylinder inside combustion

and enhanced antioxidant addition and rises the C-C bonds which rises the incomplete combustion of HC and built smoke formation [18]. Generally, biodiesels having high oxygen molecules and
water vapor, Nanoparticle Al2O3 having evaporation nature it reduces the vapor and gives better spray momentum and reduces delay period and control the unburnt hydrocarbons simultaneously smoke also reduces at maximum load also [19]. At maximum loads compare with Al2O3 transesterification and traditional transesterification the smoke for blends ratio
10. 20, 30 and 40 observes 10.09%, 9.46%, 5.80% and 2.01% variation shows in figure 9 & 10.

2.1.5. Brake Specific fuel consumption:

If brake power increases BSFC reduces. The BSFC of coconut oil is much greater than diesel at normal engine loads. The higher viscosity of fuel and at higher loads reduce the air-fuel mixture leads to partially incomplete combustion in engines and results rise the BSFC [11]. Aluminum oxides nanoparticles Publicist the combustion chain reaction and axed BSFC. It is seen that the explicit brake specific fuel utilization of nanoparticle-mixed coconut biodiesel was higher than that of unadulterated biodiesel. This can be most likely
ascribed to the way that the nearness of potential nanoparticles in the coconut biodiesel upgraded its surface area /volume proportion, to improve the synergist impact and lessen fuel utilization [19]. Comparing both fuel conventional and AL2O3 transesterification at maximum loads are 1.5%, 1.6%, 3.7% and 3.6% reduced BSFC at different blends shown in figure 11 & 12.

2.1.6. Brake thermal efficiency (BTHE):

The BTHE illustrates in figure 13 &14. By observing the results, the BTHE of Al2O3 fuel improved when contrast to diesel [11]. At maximum loads, these nanoparticles promote lofty combustion rate and buffers the BTHE [20]. When compared with doping of Al2O3 with and without in biofuel the BTHE improved 4.02%, 4.32%, 2.60% and 1.20% at different blends ration. These fuels enthrall properties shows improvement in fuel properties and shorten the ignition defer.

5. CONCLUSION:

In this analysis coconut oil based diesel with al_2O_3 decreases the NOx and smoke pol- lutants. CBD and CBDA results enumerated that the UHC and CO are emissions were reduced. The presence of alumina nanoparticles in the biofuels rises the evaporations ten- dency, this results the improvement in outright combustion. coconut oil based diesel with al_2O_3 lessens the NOx and smoke pollutants The alumina nanoparticles help to ease the ul- timate temperature inside the cylinder by engrossing the heat energy in combustion. Brake thermal efficiency increased for CBDA when compared to CBD. In addition, the BSFC re- duced for CBDA compared to CBD at all loads alumina nanoparticles oxidizes the carbon deposits within the cylinder.
It has been presumed that the coconut biodiesel could be a suitable and renewable fuel for diesel engine application with no significant changes.

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