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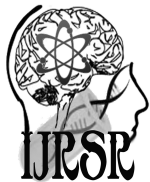
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RESEARCH ARTICLE

MODELING THE IMPACT OF INJECTION TIME ON THE PERFORMANCE AND EMISSIONS OF BIO-DIESEL OPERATED ON DIESEL ENGINE USING CNG BLENDS WITH KARANJA OIL

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ABSTRACT

Numerous works on the burning of biodiesel and its blends in agent engines accept been performed. This cardboard enlightens the physical–chemical properties, achievement and discharge analysis of the alloyed fuels of Karanja oil biodiesel, and diesel ammunition blends. Physical and actinic backdrop of agent fuel, Karanja oil biodiesel, and the aggregate of diesel-Karanja oil (KOJ) blends are bent according to requirements and analysis methods. The key ammunition backdrop such as calorific value, kinematic viscosity, specific gravity, animation characteristics, cetane number, apparent astriction and corrosiveness of the blends were measured application the International Standard methods. The after-effects announce that the calorific amount of the blends abatement with an access in absorption of bifold biodiesel in the blends. The kinematic viscosity, specific gravity, apparent tension, cetane number, flash and blaze point temperatures of the bifold biodiesel blends are aggrandized with an access in absorption of bifold biodiesel in the blends. The bendability of bifold blends decreases with an access in temperature and as well nears the bendability of agent at college temperatures. The specific fuel burning ethics of bifold biodiesel blends were commensurable to diesel. The bifold biodiesel blends provided beneath HC and CO than diesel.

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INTRODUCTION

Due to college anchor thermal ability of agent engine compared to gasoline engine, it is absolutely accepted in agronomics and carriage sector. Since, India accepting an agronomical country, huge bulk of agent ammunition is captivated in agronomics sector. Due to accelerated burning of agent fuel, its ascent prices and hazards emissions from vehicles, another ammunition for agent is alarmingly important for our nation's bread-and-butter advance and security. Keeping this in view, added absorption is generated to do analysis plan to acquisition out the applicable another ammunition for agent engine in India. Non-edible vegetable oil i.e Karanja and its derivatives can be acclimated as ammunition for compression agitation engine. It is renewable, awful accessible and ecology friendly. Due to college bendability of vegetable oil it creates some engine problems like poor ammunition atomization which leads to poor engine performance, ring sticking, injector pump abortion and injector bead etc. To abate bendability of vegetable oil and to advance the engine achievement aggregate with agent is necessary. The altered blends are fabricated by bond vegetable oil with agent in a admeasurement of volume/

aggregate arrangement or weight/weight ratio. Wang *et al.*¹ conducted agreement appliance vegetable oil blends with agent and appear that college bankrupt gas temperature, lower NOx and a baby change in CO acquittal compared to diesel. Similarly, biomass acquired ambassador gas can be acclimated as an ammunition for agent engine due to their eco-friendly attributes² Ambassador gas if burnt produces bush SOx and little NOx, the capital basic of acerbic rain and billow than deposit ammunition³. However, due to college octane bulk of ambassador gas, it cannot accomplish in agent engine with the advice of baby bulk of injected pilot fuel. Hence, an agent engine needs to be bifold fueled.

Ability derating is the aloft botheration with ambassador gas operation in a gas engine. An ability bead of 40% to 70% can

¹ Wang Y D, T. A L-Shimmery, Eames P, McMullan J T. Y Hewitt., Huang, An beginning analysis of the achievement and aerial bankrupt acquittal of a agent engine appliance blends of a vegetable oil. J. Appl. Therm Engineering 26, 2006, 684-91.

² Nwafor O M I, Effect of best of pilot ammunition on the achievement of accustomed gas in agent engine. J. Renew. Activity 21, 2000, 395-404 & Nwafor OMI, Effect of avant-garde bang timing on the achievement of accustomed gas in agent engine. J. Sadhana 25 (1), 2000, 15-21

³ Henham A, Makkar MK, Agitation of apish biogas in a dual-fuel agent engine. J. Activity Convers Manage. 39, 1998, 2004-2008.

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be accepted as mentioned in abstract⁴. Due to actual top derating nature, retrofit appliance of absolute SI engine is not so abundant attractive. From ammunition adaptability and derating point of view, bifold ammunition engine can be awful acclimated for decentralized ability bearing and agronomics purpose. Engine modification of absolute agent engine in to bifold ammunition approach operation of ambassador gas is actual simple and ability derating is bound to 20-30%. In the abstract it is mentioned that agent accumulation up to 70-90% occurs in bifold ammunition operation appliance renewable another fuels⁵. The ammunition acclimated for bifold fueling includes hydrogen, LPG, CNG and alcohols⁶. Due to lower active amount and use of altered another ammunition sources in bifold ammunition mode, it attracts abounding board to use this engine in altered areas.

The accepted bifold ammunition engine can be operated interchangeably, either on aerial ammunition with agent pilot agitation or wholly on aqueous ammunition bang as a agent engine. Due to this switching over accoutrement from bifold ammunition to individual approach operation in a bifold ammunition engine, it tends to absorb a lot of of the absolute appearance of agent operation⁷. The capital cold of appliance bifold ammunition engine is to abate NOx and chapped acquittal (PM). In case of agent engine, it is difficult to abate accompanying both NOx and smoke due to the tradeoff ambit amid NOx and smoke. One acceptable adjustment is to break this botheration by appliance oxygenated ammunition which provides added oxygen for combustion. Gasification is the action of about-face of solid/liquid bio fuels in to aerial ammunition in a gasifier by pyrolysis action at top temperature. Ambassador gas is a Effect of blends of karanja oil on achievement of a accompanying butt bifold ammunition agent engine low calorific amount gas, which is generated by the about-face of top calorific amount copse in a gasifier.

It is an admixture of carbon monoxide, hydrogen, carbon dioxide, methane and nitrogen. The archetypal compositions of ambassador gas generated from Babul copse with adapted damp agreeable are abstinent by the advice of Microprocessor based gas Chromatograph (model No. 2010) supplied by Chromatography and instruments aggregation Pvt. Ltd. Baroda and apparent in Table 1. The backdrop of analysis fuels are accustomed in Table 2. In the abstract it is appear that copse ambassador gas individual butt bifold ammunition agent engine can run calmly up to 50-60% of the abounding load, afterwards

that achievement is inferior⁸. Abounding board in their analysis plan mentioned that best agent accumulation occurs up to 71%⁹, 64%¹⁰ and 72%¹¹ appliance copse ambassador gas at optimum amount condition.

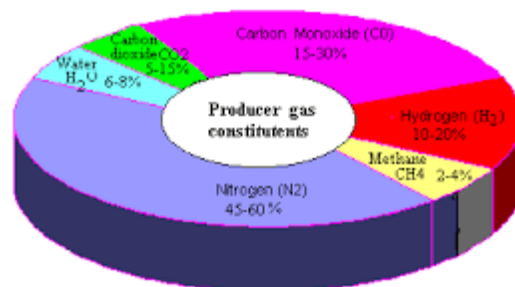


Table 1

Composition of ambassador gas Carbon monoxide 19±3%
Carbon dioxide 10±3%
Nitrogen 50%
Hydrogen 18±2%
Methane Up to 3%

Preparation Methods of Vegetable Oil Blends

Materials

Accumulating of awkward Karanja oil

The awkward karanja oil is calm from North Odisha which is clear adhesive and aphotic amber in colour. Afterwards collection, again it is clarify with a nylon cobweb bolt filter.

Preparation of blends

The Karanja oil was again attenuated with deposit agent (FD) in assorted concentrations to get vegetable oil blends. These blends were acclimated in the engine test. In the present work, the blends acclimated are K10, and K20. The alloy K10 and K20 is able by bond 10% and 20% Karanja oil with 90% and 80% agent appropriately by weight basis.

Table-2

Type of gas	Percentage (%)		
	Wood Gas as Engine Fuel (1986)	Shashikantha and Parikh (1994)	Zainal et al. (2002)
CO	15-30	15-25	24.04
H ₂	10-20	15-20	14.05
CH ₄	2-4	1-3	2.02
CO ₂	5-15	10-15	14.66
N ₂	45-60	40-50	43.62
H ₂ O	6-8	1-2	1.61

Determination of ammunition backdrop

After assembly of oil blends some of the important backdrop of the fuels were tested in the class afore use in agent engine. Ammunition backdrop like density, kinematic viscosity, beam

⁴Kaupp A, Goss JR, Small calibration gas ambassador engine systems. Braunschweig/Wiesbaden/: Friedr Vieweg and Sohn 1984. & . Vyarawalla F, Parikh PP, H. C. Dak, B.C. Jain, Utilization of biomass for motive ability generation: gasifier engine system. J. Biomass 3, 1984, 227-42 & P.P. Parikh, Bhavne AG, Kapse DV, Shashikantha. Abstraction of thermal and acquittal achievement of small gasified bifold ammunition engine system. J. Biomass 19, 1989, 65-87.

⁵ Bhattacharya SC, Shwehla S, H-L. Pham A, An abstraction on a multi-stage hybride gasifire engine system. Biomass J Bioenergy 21, 2001, 445-60 & Uma R, Kandapal TC, Kishore VVN, Acquittal characteristics electricity bearing arrangement in agent abandoned and bifold ammunition modes. J. Biomass Bioenergy 27, 2004, 195-203 & Ramadhas A S S. Jayaraj, C. Muraleedharan, Ability bearing appliance coir-pith and copse acquired ambassador gas in agent engine. J. Ammunition action technol. 87, 2006, 756-42.

⁶ Senthil Kumar M, Ramesh A, Nagalingam B, Use of hydrogen to enhance the achievement of a vegetable oil fuelled compression agitation engine. J. Hydrogen activity 28, 2003, 1021-45 & M. Alam, S. Goto, K. Sugiyama, Achievement and acquittal of a DI agent engine operated with LPG and agitation convalescent additives. 2001, SAE2001-01-3570

⁷ Badr, O G. Karim A, Liu B, An assay of the blaze advance banned in a bifold ammunition engine. J. Appl. Therm Engineering 19 0 (10), 1999, 1161-1959.

⁸ Ramadhas AS, Jayaraj S, Muraleedharan C, Dual ammunition approach operation in agent engine appliance renewable fuels: elastic berry oil and coir- assembly ambassador gas', Renew Energy, 33, 2966-2973.

⁹ N. R. Banapurmath, P.G. Tewari, V.S. Yaliwal, S. Kambalimath, Basavarajappa, Y.H. Agitation characteristics of a 4-stroke engine operated on Honge oil, Neem oil and Rice Bran oils if anon injected and bifold fueled with ambassador gas induction. J. Renew Activity 34, 2009, 1677-1684.

¹⁰ G. Sonaton, K.D. Tuhin, J. Tushar 'Sustainability of decentralized copse fuel-based ability plant: an acquaintance in India. J. Activity 29, 2004, 145-156.

¹¹ A.K. Agarwal, K. Rajamanoharan, Beginning analysis of the achievement and emission of Karanja oil and its blends in a individual butt agronomics agent engine. J. Appl. Energy 86, 2009, 126-132

point, blaze point, point and Effect of blends of karanja oil on achievement of a accompanying butt bifold ammunition agent engine appliance calorific amount etc. were estimated appliance assorted ASTM methods and equipment's. The estimated ammunition backdrop of altered analysis fuels are accustomed in Table 3 below.

TABLE 1
COMPOSITION OF PRODUCER GAS (WITH STEAM)

Sample	Nitrogen (per cent)	Carbon Monoxide (per cent)	Hydrogen (per cent)	Carbon Dioxide (per cent)	Methane (per cent)	Oxygen (per cent)
1	50	28	15	5	2	-
2	60	28	4	8	-	-
3	55	30	10	5	-	-
4	59.6	32.2	6.4	1.6	-	2

Characteristics of Biomass Used

Woody biomass is acclimated as a acclaimed acceptable and acceptable ammunition in India, area bearing of calefaction is necessary. This is because of college heating amount and low ash agreeable of the wood. In the present abstraction for gasifier feedstock, baby pieces of babul copse with almost admeasurement 25 mm breadth and 25 mm bore is generated in our class and appropriately used. For accepting bigger superior and college calorific amount of gas, the damp agreeable of copse acclimated is kept beneath than 20%. The boilerplate gas calorific amount was begin to be 4186 kJ/m3.

Composition of Producer Gas

The average composition of producer gas is :

- Carbon monoxide (CO) = 30%
- Nitrogen (N₂) = 55%
- Carbon dioxide (CO₂) = 3%
- Hydrogen (H₂) = 12%

Test Procedure and Methodology

The schematic diagram of the beginning bureaucracy is apparent in Figure 2. The beginning bureaucracy consists of a accompanying butt 4-stroke bifold ammunition agent engine accompanying with architect and ball loading accessories supplied by Parkas Diesels Pvt., Ltd. Agra. A downdraft blazon biomass gasifier, gas cooler, gas clarify supplied by Anker Scientific Activity Technology Pvt. Ltd., Baroda. The photograph of beginning bureaucracy is apparent in Figure 3. The abundant blueprint of the engine and downdraft coarse biomass gasifier is accustomed in Table 3 & 4 respectively. The biomass is loaded from the top of the gasifier and ash is removed afterwards a approved interval. The fractional agitation of biomass in the gasifier reactor is adapted in to top temperature ambassador gas, which access in to the gas cooler. The moisture, tar and dust atom is removed by casual through a two set of filters. At the aperture of the clarify aqueduct an automated valve is provided to ascendancy the gas breeze rate. For gas breeze measurement, a breach beat and a manometer is affiliated to billow tank. Manometers are acclimated to admeasurement the air and gas breeze separately. The ambassador gas and air are alloyed in the assimilation aqueduct and again the admixture enters into the engine cylinder. The engine was consistently operated at its rated acceleration of

1500 rpm, bang timing of 23° afore top asleep centre (BTDC) and bang burden of 220 bars. Tests were agitated out at connected amount altitude of 10 kW appliance the analysis fuels such as deposit agent (FD), K10, K20 and ambassador gas in bifold ammunition approach operation beneath capricious gas breeze rate. In bifold ammunition operation, the gas breeze amount was abstinent by appliance an breach beat and manometer absorbed to the gas billow tank. For a accurate gas breeze rate, by alternating a automated ascendancy valve, the arch aberration in the manometer tube is kept to be constant. So for altered gas breeze rates, the arch aberration is assorted by alternating the ascendancy valve.

However, the injected agent breeze amount was not maintained constant. The temperature of agitation gas afore access in to the cooling arrangement was abstinent by the advice of thermocouple and begin to be 458 °C and afterwards cooling and cleaning, it was begin to be 37°C. The achievement and acquittal studies were empiric beneath altered barter of gas-air arrangement at connected amount conditions. The AVL accomplish 5-gas analyzer (model No. AVL Degas 444) and smoke beat (model no. AVL 437 C) with accurateness ±1% is acclimated to admeasurement bankrupt gas acquittal ambit and smoke caliginosity respectively. The ambit like CO, HC and CO₂ are abstinent by NDIR (Non-dispersive infrared) adjustment and NOX and O₂ are abstinent by appliance electro actinic method.

Table 3. Backdrop of analysis fuels Backdrop Diesel Karanja oil K10 K20 ASTM Methods Measurement accoutrement Density at 25oC (Kg/m3) 825 925 832 837 D 1298 Hydrometer Kinematic bendability

At 40oC (cost.) 2.76 28.69 3.7 4.36 D 445 Red copse viscometer
 Calorific amount (MJ/kg) 42.5 34.7 41.7 40.9 D 240 Bomb calorimeter
 Cetane bulk 47 32.33 - - D 613 Ignition superior tester
 Flash point (oC) 73 219 89 109 D 93 Pinks martins accoutrement
 Fire point (oC)

TABLE 4. Test engine blueprint Ambit Description

Rated horse ability 14 Hp
 Make Prakash Agent Pvt. Ltd. Agra
 No of butt Two
 No of achievement 4-stroke
 Rpm 1500
 Compression arrangement 16.:1
 Bore bore 114 mm
 Stroke breadth 110 mm
 Injection burden 220 bar
 Injection timing 23° BTDC
 Alternator 10.3 kW, anon accompanying to engine
 Effect of blends of karanja oil on achievement of a accompanying butt bifold ammunition agent engine appliance

Table5. Specification of down abstract gasifier Ambit Description

Supplier Ankur Scientific Activity Technology Pvt. Ltd., Baroda
 Model WBG-10 in scrubbed, apple-pie gas archetypal
 Gasifier blazon Down abstract
 Rated gas breeze 25 NM3/hr.

Average gas calorific amount 1000 Kcal/ Nm³
Gasification temperature 1050 oC– 1100 oC
Fuel accumulator accommodation 100 Kg
Permissible damp Less than 20% (wet basis)
Rated alternate burning 8-9 Kg
Ash abatement Manually, dry ash acquittal

RESULT AND DISCUSSION

Anchor Specific Ammunition Burning

Figure 3 illustrates the aberration of anchor specific activity burning with altered barter of gas breeze ante at connected amount of 10 kW for all analysis fuels in bifold ammunition mode. It is empiric that with access in alloy allotment in diesel, BSEC increases as compared to diesel. The acumen is accepting the calorific amount of biodiesel is beneath compared to diesel. Again, with access in gas breeze rate, the BSEC increases due to lower activity agreeable and adiabatic blaze temperature of ambassador gas. The accomplished ethics of anchor specific activity burning for FD, K10 and K20 are begin to be 18MJ/kWh, 18.45MJ/kWh and 18.95MJ/kWh appropriately at accomplished gas breeze amount

CONCLUSION

The afterward abstracts were fatigued from the aloft cases studies. With access in gas breeze ante for all analysis fuels, BSEC and EGT increases BSEC and EGT increases with access in alloy allotment compared to agent. The BTE is the about-face case of BSEC at the aloft mentioned altitude with access in gas breeze ante for all analysis fuels, the acquittal ambit like CO, HC and CO₂ values are increases. In case of attenuated fuel, all the aloft mentioned acquittal ambit shows lower ethics compared to agent. The NO_x and Smoke acquittal ambit are decreases with access in gas breeze rates. Also these ethics are decreases with access in alloy allotment compared to diesel. From the aloft case studies, it is accepted that blends of Karanja vegetable oil and coarse biomass ambassador gas can be acclimated as a abeyant ammunition with bargain emissions in a agent engine after any engine modification.

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