IOP Conf. Series: Materials Science and Engineering **402** (2018) 012108 doi:10.1088/1757-899X/402/1/012108

# Recital and emanation individuality of cashew nut shell with methanol blends

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**Abstract.** Research on the significance of cashew nut methanol blend and increase on the efficiency and release of diesel engine being essential, the proportional experimentation be accepted lying on the work surface of dynamic stimulating diesel engine injected by untainted diesel and bio-diesel methanol blend (M5, M10, M15 and M30) below various atmospheric force (80 kilopascal, 90 kilopascal and 100 kilopascal). The investigational outcome choose with the intention of the respective brake-specific fuel utilization (BSFU) of bio-diesel methanol blend are enhanced compared with diesel below diverse atmospheric forces and with the aim of the corresponding BSFU obtains immense enhancement by way of the enhance of atmospheric force while the atmospheric force is inferior than 90 kilopascal. At 80 kPA, the Hydrocarbon and CO discharge increase significantly by means of the mounting engine loads along with accumulation of methanol, whereas at 90 kPA and 100 kPA their consequences on HC and CO discharges be least. The alters of atmospheric force and blend percentage of methanol contain no understandable consequence on NOx discharges. smolder discharges reduce noticeably through the increasing proportion of methanol in blend, particularly atmospheric pressure below 90 kPA.
**Keywords:** Biodiesel; Cashew nut shell liquid oil; Methanol; brake-specific fuel utilization; Efficiency.

## 1. Introduction

In recent times, CI diesel engine have acknowledged substantial notice as its elevated high temperature effectiveness and squat discharge; though, by means of the rigorous discharge standard and restricted fuel hold back, substitute energy for diesel engine encompassed. As a reutilizable and oxygen-enclosing alternate Biofuel, Methanol be a probable energy for automobile, that can be capable of be mix together with diesel otherwise be infused into cylinder unswervingly. There are lots of materials on the submission of Methanol scheduled for diesel engine, which concentrates on the three features: functional procedures of Methanol taking place in diesel engine, energy characteristics of Methanol-diesel mingle, and consequences with ignition and discharge distinctiveness of Methanol-diesel mingle [1–6].

Since Methanol be glacial particle and dissoluble in diesel be instantly exaggerated by high temperature and water existence, elevated proportion counted of Methanol to diesel is complicated, particularly beneath squat temperature (beneath in relation to 11˚C). With respect to blend Methanol and diesel, an emulsifier supposed to be supplemented. Several discussions specify as pungent hydrocarbon, center concentrate, and wax proportion of diesel are significant

aspects of it's mingle amid Methanol [1, 2]. Currently, the submission procedures of Methanol on diesel engine be capable of be separated into the subsequent four module: (i) Methanol-diesel mingle through aggressive drive [4], (ii) Methanol airing out via ingestion air accusation through carburetion or assorted inoculation, that coupled through confines with quantity of Methanol on account of the engine beat by elevated heaps, along with preclusion on flare satiating and backfire at squat heaps [3–6], (3) twin inoculation scheme necessitate an added persuasive inoculation scheme and a connected major propose alter of the drum top [6, 7], and (4) merge of Methanol and diesel fuel via an emulative or co-solvent to merge the dual energy in favor of avert their partition, entail no scientific adjustments happening within the engine surface [6, 8, 9].

The material and substance uniqueness of Methanol-diesel mingle be extremely significant toward its purpose scheduled for diesel engine. The firmness, solidity, thickness, outside pressure, precise heat, warmth value, and Cetane number of mingle include enormous propel on the inoculation, atomization, explosion, and incineration properties, at the same time arctic initiate, power, fuel utilization, and emanation distinctiveness of engine. Furthermore, the thrust and outflow of predictable container, energy channel, and sticking component be capable of be submit. Further rigorous anxieties are essential in favor of the assortment, carrying, handling the fuel since squat flash peak of Methanol-diesel mingles [9–13].

The cetane number is remarkable energy tenure in favor of diesel engines. It manipulates on engine initiate capability, emanation, crest cylinder force, and ignition sound. According to analysis conceded away by the work of Li et al. [12], every 15-vol% Methanol supplemented with bio diesel fuel, outcomes by 8.part diminution in resultant mingle's Cetane number. Through the accumulation of Cetane number enhancer, the incineration possessions are capable of attaining the stage of model at core elevated load.
Devoid of amendment, the Methanol-diesel combination diminishes the control of diesel engine with augmented brake precise energy utilization; Conversely, recital of model could reformed following fine-tune the fuel release and inoculation moment of engine [15–17]. The fatigue gas temperature and grease oil temperature be worse through process happening with Methanol-diesel bio-fuel mingle while evaluated to process happening with diesel.
Methanol-diesel bio-fuel mingle be capable of diminishing the smolder also Particulate matter discharges of diesel engine. The advanced diminution decides elevated proportion of Methanol within intermingles. The basis is with the intention of the oxygen substance in mingle be capable of supporting the grouping energy and oxygen, still with energy affluent area [19, 21–23]. The NOx discharge stay similar otherwise faintly compact among exploit of Methanol-diesel mingle among reverence with diesel; though, the NOx discharge may compact by further procedures, like EGR and SCR. The hydrocarbon (HC) discharges be augmented through the employ of Methanol-diesel bio-fuel mingle.

The advanced in this enhance is, the advanced the proportion of Methanol in the mingle, though, the HC discharges of mingles be capable of still convene the discharge values owing to little HC discharge of diesel engine. Citations [13, 24] proved that CO discharges with Methanol-diesel mingle augmented on squat stack then diminished on elevated stack. Furthermore, the $CO_2$ discharges dropped off with respect to squat C/H proportion of Methanol-diesel mingles. The unbalanced discharges of diesel engine have been furthermore exaggerated via accumulated Methanol. Reference [24] accounted about inflamed Methanol and acetaldehyde augmented while Methanol-diesel mingle is fueled in four-cyclinder direct-injection diesel engine, however formaldehyde, ethene, ethyne, 1,3-butadiene, and BTX in common diminished, particularly on elevated engine stack. A diesel oxidation medium (DOM) is establishing to diminish considerably the majority of the contaminant, together with atmosphere contaminated. Song et al. [24]

demonstrate with purpose of the substance of various types of PAHs and DNA harm point diminish in fatigue of E5 evaluate through diesel.
The atmospheric anxiety and air mass subsist to manipulate flaming procedure of engine, thus influence recital, energy utilization; with discharge distinctiveness on engine might distinct while the engine lope at diverse elevations. Subsequently, the relevance explores of Methanol-diesel mingles were roughly conceded out at squat elevation. As a result, to examine possessions of Methanol-diesel mingle on the recital and discharges of diesel engine underneath diverse atmospheric force, the proportional researches completed amid the engine filled with unpolluted diesel and Methanol-diesel mingles par with diverse heights [26–28]

## 2. System Methodology

### *2.1. Engine Setup*

The engine was a 3.298 L, direct-injection, turbocharged diesel engine. The applicable features of complete engine arrangement were specified in Table 1. Throughout experiment the engine was experienced devoid of every alteration.

**Table 1.** Engine Specification.

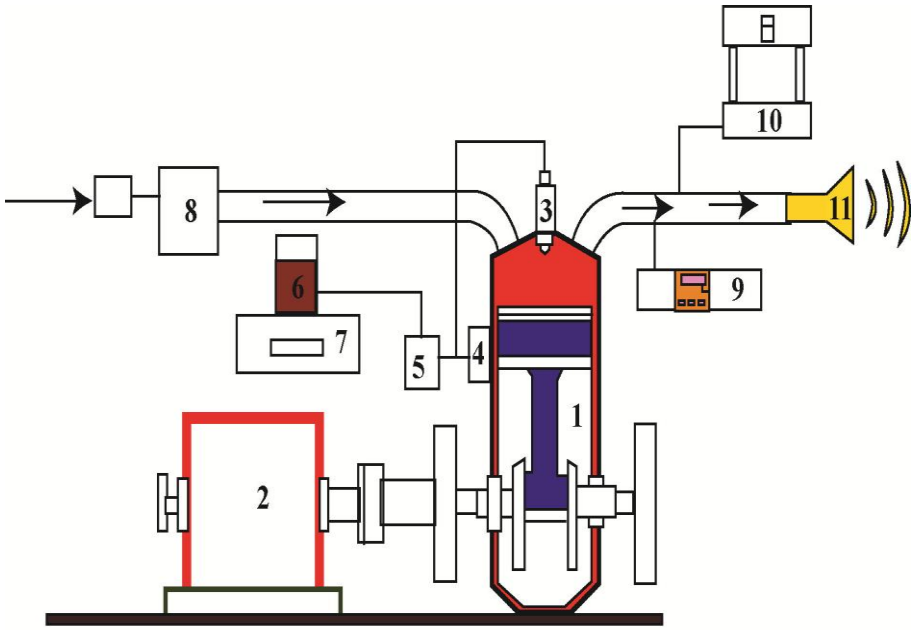
| | |
|---|---|
| Make | Vertical, Water cooled, Four stroke |
| Number of cylinder | KIRLOSKAR AV-1 |
| Bore | One |
| Stroke | 87.5 mm |
| Maximum power | 17.5:1 |
| Compression ratio | 661 CC |
| Displacement Volume | 110 mm |
| Speed | 3.7 kW |
| Injection opening angle | Eddy current dynamometer |
| Injection opening pressure | 23° b TDC |
| Dynamometer | 1500 rpm |

### *2.2. Materials compatibility*

The exercise of Methanol in gasoline engines in the early 1980s resulted in abundant resources compatibility studies, a lot of of which are as well relevant to the consequence of Methanol–diesel mingle in diesel engines and predominantly in the fuel inoculation arrangement. The worth of the Methanol has a tough persuade on its acidic property (Hardenberg and Schaefer, 1981). In addressing the troubles of Methanol deterioration connected with gasoline mingle; Brink et al. (1986) separated Methanol deterioration into three sort: common deterioration, arid deterioration and damp deterioration. Common deterioration was originated by ionic pollution, mostly chloride ions and acetic acid. Arid deterioration was accredited to the Methanol particle and its polarization. De la Harpe (1988) assessed information of arid deterioration of metals by

Methanol and identified that magnesium, lead and aluminum were vulnerable to element harass by arid Methanol. Humid corrosion is caused by isotropic water, which oxidizes the greater part of metals (Brink et al., 1986). Newly prepared mingles encloses pH neutral dry Methanol would be expected to have relatively little corrosive effect.

Mingle of Methanol and Diesel: Hydraulic shuddering emulsification mechanism be prepared, that have been established with persuasive drive of diesel engine. The Methanol and diesel be distributed via emulsification mechanism by dual fuel deliverance arrangements. The emulsified




Methanol/ diesel have been instilled through tube with drive and injector. The emulsification mechanism thus may offer diverse magnitude of Methanol and diesel exclusive of amending engine and impeding engine as given in figure 1. The emulsification mechanism be capable of exercise the 96% Methanol devoid of any emulsifier and surfactant [5].

**Figure 1**. Schematic diagram of the experimental engine setup

## 3. Results and Discussions

### *3.1. Scrutiny of Engine recital*

With squat heat rate (*Qj*) of Methanol worse compared with diesel, thereby essentially deem consequence of heat rate on constructing assessment of brake-specific fuel consumption (BSFC) and afterward by relate with comparable BSFC (*b*e), distinct like *b*e = BSFC∗*Q*je/*Q*id. *Q*je and *Q*jd be the squat heat rate of Methanol-diesel mingles and diesel, correspondingly.

Thereby observed be of Methanol-diesel mingles inferior with diesel. The Methanol being oxygenated energy with worse exterior pressure and torrid point, as a result the speedy vaporization of Methanol could endorse squirt recital and development of assortment gas, that superior for prior mix and subtle burning. Furthermore, elevated oxygen substance of Methanol could augment surplus air proportion and progress heat competence. Concurrently, drop off of $b_e$ have not been balanced with accumulation of Methanol. Contrasted to diesel, E10 abridged be

like 1.1 ~ 2.5%, whereas E15 by 1.7 ~ 3.1%, E20 by 2.4 ~ 2.8%, and E30 by 1.6 ~ 2.2%. The consequences designated as E15 and E20 have enhanced routine by E10 and E30 since E10 have worse percentage of Methanol and E30 perhaps have terrible emulsification. Thereby observed like be of mutually Methanol-diesel mingles and diesel have been drop off through the augment of atmospheric force. The diminution of be being immense at atmospheric force distorted from 81 kPa to 90 kPa, though the diminution was minor when atmospheric pressure distorted from 90 kPa to 100 kPa.

### *3.2. Discharge distinctiveness of HC*

The HC discharge in diesel-Methanol mingles beneath given atmospheric forces be exposed in Figure 2. Thus observed about the HC discharges beneath diverse atmospheric forces confirms noteworthy deviations while the blend ratios, engine rapidity, and heaps alteration. Through mounting velocity and masses, the consequence of atmospheric force on HC discharge failed noteworthy. At 2200 r/min and 81 kPa, the blend percentages have enormous possessions on the HC discharges, particularly at normal weight (50N·m), then cause to be the augment by 46% ~295%. The augment of Hydro carbon discharges of E30 become immense.

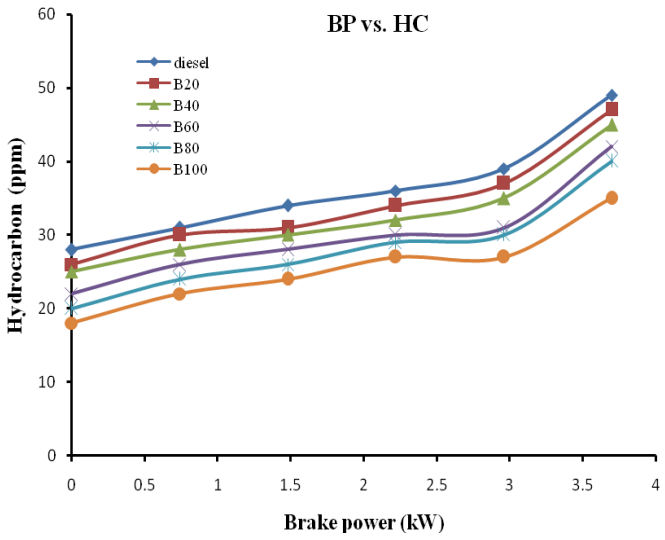



**Figure 2**. Variation on Hydrocarbon emission

The HC discharge augmented with the growing proportion of Methanol in mingles; conversely, the HC discharges of Methanol-diesel mingle almost accomplish the stage of archetype at 3200 r/min. Since Methanol had elevated concealed warmth of vaporization that diminishes the gas temperature thereby endorse terrifying of container wall, the Hydrocarbon discharge increase obviously through mounting substance of Methanol by squat velocity and weight of engine. While engine paces and masses set off, the temperature of gas and incineration cavity wall augments that speed up gas mingle structure and endorse the ignition of fuel, thereby mounting mingles of Methanol have trash persuade through HC discharges at superior engine pace and stack. Thus, HC discharge has trivial augment plus attained the stage of diesel-fueled engine at a few engine masses. Owing to superior hidden heat of vaporization and lesser cetane number, superior quantity of Methanol diminishes the gas temperature and delays the blast-off wait, that consequences by noteworthy augment of HC discharges of E30 at subordinate speed and load.

Furthermore, the partial emulsifiable capability on muddle contrivance by superior percentage of Methanol possibly will be a further cause. With the exceeding investigation, that supposed that HC discharge of Methanol-diesel mingles insist with engine pace, stack, and the mingle proportion of Methanol.

### *3.3. Emanation uniqueness of CO*

The CO discharges of Methanol-diesel mingles beneath three atmospheric forces be exposed in Figures 5, 6, and 7. At 2100 r/min and small stack (50N·m), E10, E20, and E30 improved the CO discharges by 20% ～240%, 32% ～303%, and 34% ～215%, correspondingly. through mounting engine velocity and engine stack atmospheric force have disorder persuade on the CO discharge. With short as well as center heaps, the elevated percentage of Methanol augmented the CO discharge to some extent.

At complete weight, CO discharges of Methanol-diesel mingles inferior than untainted diesel, particularly at 81 kPa. The investigational outcome specifies as Methanol-diesel mingles might not depreciate the CO discharges excluding for 2200 r/min and squat stack. The accumulation of Methanol grounds diminution of gas temperature that holds back the corrosion of CO thereby departs at squat weight. Through boost of engine velocity and heap, the augment of gas temperature, wall temperature, and oxygen substance of Methanol endorse the corrosion clause of CO, that drop off the harmful cause of totaling of Methanol. At complete heap, the surfeit air proportion is moderately squat, so the mounting percentage of Methanol reduces CO discharge significantly.

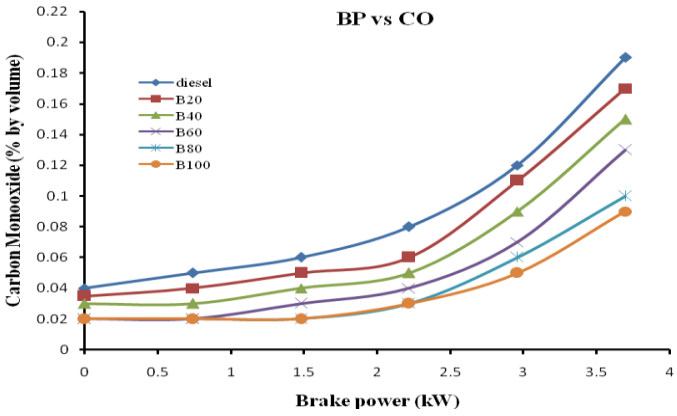



**Figure 3**. Variation on Carbon monoxide emission

Through the augment of atmospheric force, surfeit air proportion augments and consequence of Methanol being diluted, thus persuade of atmospheric force on the CO discharge is slender. Through prior investigation, so supposed to CO discharges of Methanol-diesel mingles supported on the engine velocity, weight, and the mingle percentage of Methanol.

### *3.4. Emanation uniqueness of NOx*

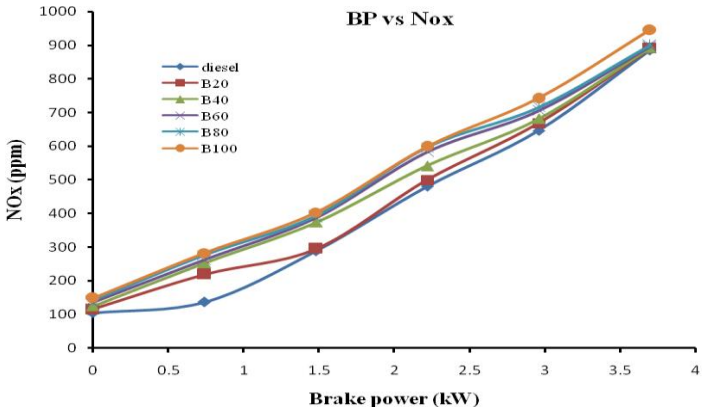



**Figure 4**. Variation on oxides of nitrogen (NOx) emission

Figure 4 demonstrated the NOx discharges of Methanol-diesel mingle beneath three atmospheric pressures. By diverse atmospheric forces and mingle scope, the NOx discharges explained the comparable drift. The Methanol-diesel mingles abridged the NOx discharge at the majority forms. At 1400 and 2200 r/min and squat load, slender augment of NOx discharge for E30 might provided through terrible emulsification at superior blend percentage.

The mounting oxygen substance can endorse the development of NOx; though, the highest gas temperature is the majority significant aspect of NOx production, thus reduced gas temperature grounds by superior concealed heat of vaporization of Methanol might decrease the NOx discharge.

### *3.5. Discharge Characteristics of Smoke*

At diverse atmospheric forces, the smoke discharges of Methanol diesel mingles got analogous inclination as like diesel. The smoke discharges of both mingles and diesel reduced by mounting atmospheric pressures. It proved as superior mingle percentage of Methanol resulted in inferior smoke discharge at the identical atmospheric pressure and load. At 2200 r/min while atmospheric pressure sort from 81 kPa to 90 kPa the smoke discharge of E10, E20, and E30 were abridged by 39%, 43%, and 55%, correspondingly.

Methanol has inferior carbon and sulfur proportion, little aromatic hydrocarbon, and inferior surface pressure and boiling point, which can endorse the spray and combustion characteristics of Methanol-diesel mingles and holds back the smoke discharge.

## 4. Conclusion

The influence recital of engine filled with Methanol-diesel mingles can convene requirement of prototype after amending the fuel release. Through mounting atmospheric pressure, the corresponding specific fuel utilization of both assortments and untainted diesel confirmed the same drift of drop off. When the atmospheric pressure is inferior to 90 kPa, the corresponding specific fuel utilization is considerably enhanced with the mount of atmospheric pressure; and the enhancement is diluted when atmospheric pressure is higher than 90 kPa.

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