Prospects of *2, 5-Dimethylfuran as* a Fuel: Physico-chemical and Engine Performance Characteristics Evaluation

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Abstract

Due to the recent developments of improved production methods of 2, 5-dimethylfuran, (known as DMF) from waste biomass, it is being considered as a next generation biofuels. Energy content of DMF is comparable to that of gasoline. However little is known about its behavior in S.I. engines. Therefore, this work reviews the current status of technological developments regarding production from biomass, safety and environmental concerns and presents an experimental evaluation of its blend with gasoline in terms of physico-chemical properties and engine.

Keywords: *2, 5-Dimethylfuran, Biomass, Biofuels, Engines*

Introduction

Search for new fuel alternatives is becoming more insistent in view of the growing concerns of environmental pollution, energy security and future of oil supplies, and, improving engine technologies. Most of the promising fuels of bio-origin like biodiesel, methane, methanol, ethanol and Fischer–Tropsch fuels are gaining prominence. Synthesis of new furan based fuels for use in vehicle applications biofuels by next-generation methods of production from biomass is one of the most exciting developments of recent times with the long-term objective to develop the best possible combination of fuel components to meet the requirements of futuristic combustion processes. Furan based fuels have received renewed interest because of increased economic demand for new sources of energy from waste biomass. Progress in the development of furan-based fuels has been made in terms of a selective catalytic defunctionalization with homogeneous transition metal catalyst in a multiphase reaction system which enables a hydrogen free pathway to furans. Among these 2,5-dimethylfuran (25DMF) is a potential biofuels candidate. Its blending research octane number makes it nearly twice as effective on a molar basis as ethanol .Also its energy density is close to that of gasoline. The laminar burning velocity of 2,5-DMF closely matches that of gasoline. 2-5, DMF can be chemically synthesized from authentic, inedible, lignocelluloses material, untreated maize leaves and waste biomass, but other routes are also promising. This paper presents a review of development of production pathways of 2, 5-dimethylfuran from biomass, evaluation of its fuel properties, environmental concerns along with experimental engine studies. Important fuel properties like RVP, VLI, Distillation density and surface tension for 5 %(v/v), 2-5 dimethylfuran blend is gasoline are experimently determined and their effect on engine operation is discussed. Comparative evaluation of Engine performance of 5% (v/v) 2,5-dimethylfuran blend is gasoline have been carried out on a constant speed carbureted S.I. engine and results are discussed.

Methodology

For the present investigation, 5% 2, 5-dimethylfuran was blended with gasoline (v/v) by 'splash blending'. Physicochemical properties like density, surface tension, distillation, flash point, RVP of blend were analyzed as per ASTM methods. These blends were then observed for 2-3 weeks for any visible separation Engine test was carried out on gasoline run gen-set which consists of Constant speed SI engine coupled with a self-excited brushless alternator.Resistive load bank was used for electrical loading of the gen-set, equipped with Voltmeter, Ammeter and Frequency meter for measurement of the load. The load bank was a singlephase load circuit consisting of a combination of stable resistive elements of appropriate rating, wired such that the total load current is adjustable to any value up to 125% of Max. Full throttle current of the gen-set under test was measured with accuracy of ±0.1 Amp. Voltmeter and Ammeter were AC RMS meters, direct acting analog/digital type conforming to BIS 1248 (part 4), and accuracy class 1. The range of frequency meter was 45 to 65 Hz.

Results and Discussion

Test results of 5 %(v/v) 2,5-dimethylfuran blend of gasoline in a SI genset reveal that its volumetric fuel consumption is similar to gasoline.2,5-dimethylfuran blend burns faster than gasoline.No considerable change in fuel consumption. Slight power drop at full load was observed. CO and HC emissions decresed on all loads while NO emissions were observed to be slightly high.

Conclusions

2,5-dimethylfuran seems to be a feasible bio-fuel candidate due to favorable properties. Its 5 % (v/v) blend with gasoline exhibits comparable engine performance characteristics. However economic pathways of its production from biomass need to be developed.

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