The XXXI-st SIAR International Congress of Automotive and Transport Engineering
"Automotive and Integrated Transport Systems" (AITS 2021),
28th-30th October 2021, Chisinau, Republic of Moldova
Conference Series: Materials Science and Engineering, 2022, Vol. 1220, Nr. 1

The study on the influence of utilizing n-butanol at fuelling spark ignition engines

Cristian Sandu, Constantin Pană, Niculae Negurescu, Alexandru Cernat, Cristian Nuţu, Rareş Georgescu

https://doi.org/10.1088/1757-899x/1220/1/012004

Abstract

The ever-increasing emissions restrictions on internal combustion engines have led researchers into the study of alternative fuels solutions. As hybrid and electric vehicles started becoming more and more present in the markets worldwide, the popularity of conventional internal combustion engines started to decrease (we see this especially with diesel fueled engines). For spark ignition engines, alcohols and gasoline-blended mixes have proven to be an attractive solution in the last years. Out of these alcohols, we mention ethanol, methanol and butanol. Butanol is a promising solution because of its high oxygen content with the possibility of improving the combustion process and thus even reducing emissions. Butanol also has a high combustion speed and can potentially reduce the combustion duration while improving the overall thermal efficiency. High miscibility is another important aspect of butanol, allowing a higher percentage volume of butanol to be mixed with gasoline. The additional oxygen content may also improve combustion stability thus reducing cyclic variability. The objective of this study is to determine what is the impact of fueling a spark ignition engine with a blend of 10% vol. n-butanol and 90% vol. gasoline. The study will look at combustion stability, variability, thermal efficiency and emissions. A baseline was established at fueling the engine with pure gasoline at an engine speed of 2500 min−1 and an engine load of 55%. After the baseline, the same measurements were done at fueling with a blended mix of n-butanol and gasoline.

Keywords: engine fueling, butanol, gasoline

References

1. Gautam M. and Martin II D.W. 2000 Combustion characteristics of higher-alcohol/gasoline blends Proceedings of the IMechE Part A: J. Power and Energy **214** 497-511
Go to reference in articleGoogle Scholar

2. Yoon J, Ryu J and Lim K B 2005 A novel reconfigurable ankle rehabilitation robot for various exercises Proceedings of the 2005 IEEE International Conference on Robotics and Automation ICRA 2005 2290-2295
Go to reference in articleGoogle Scholar

3. Gautam M., Martin II D.W. and Carder D. 2000 Emission characteristics of higher-alcohol/gasoline blends, Proceedings of the IMechE Part A J. Power and Energy **214** 165-182
Go to reference in articleGoogle Scholar

4. Yacoub Y., Bata R. and Gautam M. 1998 The performance and emission characteristics of C1-C5 alcohol-gasoline blends with matched oxygen content in a single-cylinder spark-ignition engine Proceedings of the IMechE Part A: J. Power and Energy **212** 363-379
Go to reference in articleGoogle Scholar

5. Wu M, Wang M, Liu J and Huo H. 2008 Assessment of potential life-cycle energy and greenhouse gas emission effects 293 from using corn-based butanol as a transportation fuel Biotechnol Progr **24** 1204-1214
Go to reference in articleGoogle Scholar

6. Jin C., Yao M, Liu H, Lee C.F. and Ji J. 2011 Progress in the production and application of n-butanol as a biofuel Renew Sust Energ Rev **15** 4080-4106
Go to reference in articleGoogle Scholar

7. Doğan O. 2011 The influence of n-butanol/diesel fuel blends utilization on a small diesel engine performance and emissions Fuel **90** 2467-2472
Go to reference in articleGoogle Scholar

8. H. Huo M, Liu Y, Wang X, Wang H, Yao M and Lee CF 2014 Time-resolved spray, flame, soot quantitative measurement fueling n-butanol and soybean biodiesel in a constant volume chamber under various ambient temperatures Fuel **133** 317-325
Go to reference in articleGoogle Scholar

9. Liu H., Bi X, Huo M, Lee C.F. and Yao M. 2012 Soot Emissions of Various Oxygenated Biofuels in Conventional Diesel Combustion and Low-Temperature Combustion Conditions Energ Fuel **26** 1900-1911
Go to reference in articleGoogle Scholar

10. [Liu H., Li S, Zheng Z, Xu J and Yao M. 2013 Effects of n-butanol, 2-butanol, and methyl octynoate addition to diesel fuel on combustion and emissions over a wide range of exhaust gas recirculation (EGR) rates Appl Energ **112** 246-256
Go to reference in articleGoogle Scholar

11. Yuqiang L, Lei M, Karthik N, Timoty H L, Yilu L, Shengming L and Chia-Fon L 2016 Combustion, performance and emissions characteristics of a spark-ignition engine fueled with isopropanol- n-butanol-ethanol and gasoline blends Elsevier **184** 864-872
Go to reference in articleGoogle Scholar

12. Serras-Pereira J., Aleiferis P.G. and Richardson D. 2013 An Analysis of the Combustion Behavior of Ethanol, Butanol, Iso-Octane, Gasoline, and Methane in a Direct-Injection Spark-Ignition Research Engine Combustion Science and Technology **185** 484-513
Go to reference in articleGoogle Scholar

13. He B-Q, Yuan J., Liu M-B and Zhao H. 2014 Combustion and emission characteristics of a n-butanol HCCI engine Fuel **115** 758-64
Go to reference in articleGoogle Scholar

14. Zheng M., Han X, Asad U and Wang J. 2015 Investigation of butanol-fuelled HCCI combustion on a high efficiency diesel engine Energy Convers Manage **98** 215-24.b
Go to reference in articleGoogle Scholar
15. Alasfour F.N. 1997 Butanol -A single-cylinder engine study: Availability analysis Appl. Therm. Eng. **17** 537-549
Go to reference in articleGoogle Scholar
16. Alasfour F.N. 1998 NOx emission from a spark-ignition engine using 30% iso-butanol - gasoline blend: Part 1: Preheating inlet air Appl. Therm. Eng. **18** 245-256.d
Go to reference in articleGoogle Scholar
17. Alasfour F.N. 1998 NOx emission from a spark-ignition engine using 30% iso-butanol – gasoline
Go to reference in articleGoogle Scholar
18. Negurescu N., Pană C. and Popa M.G. 2013 Processes (Bucharest: Matrix ROM) Spark ignition engines
Go to reference in articleGoogle Scholar