Bibliometric analysis, physical properties, and experimental evaluation of additives-diesel ternary blends

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Abstract

The availability of petroleum fuels is being challenged due to h[illegible] and heavy dependence on imports, raising awareness of the need for cleaner alternatives. Urbanization, air quality, economic factors, and emissions limits motivate the search for alternative fuels compatible with compression ignition engines. A comprehensive bibliometric analysis further underscores the escalating worldwide research efforts in this critical domain. According to the existing literature, nitromethane and 2-ethoxy ethyl acetate have demonstrated superior physical and combustion properties compared to other additives. To explore their potential, a meticulous performance and emission analysis was conducted using a single-cylinder, 4-stroke VCR CI engine, employing varying proportions of 2-ethoxy ethyl acetate and a constant 2% blend of nitromethane, with EEA concentrations ranging from 5, 10, to 15% (v/v). This research delved into the influence of these diverse fuel blends on the performance of CI engines and exhaust characteristics within a compression ratio spectrum spanning from 17 to 20. The experimental findings revealed that

ternary blends, although having a marginal impact on engine performance, exhibited lower emissions compared to pure diesel. The pinnacle of this investigation emerged with the EEA5NM2D93 blend, which yielded optimal results in terms of both performance and emission characteristics.

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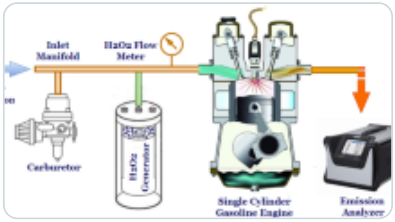

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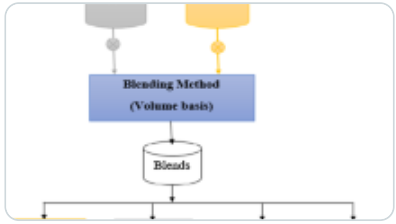

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Not applicable.

Abbreviations

BP: Brake power

BSFC: Brake specific fuel consumption

BTE: Brake thermal efficiency

CI: Compression ignition

CO: Carbon monoxide

CO_2: Carbon dioxide

CR: Compression ratio

EEA: 2−Ethoxy ethyl acetate

HC: Hydrocarbon

kg: Kilogram

kJ: Kilojoules

MEA: 2−Methoxy ethyl acetate

NM: Nitromethane

NO_x: Nitrogen oxides

ppm: Parts per million

rpm: Revolutions per minute

UHC: Unburnt hydrocarbon

VCR: Variable compression ratio

References

Ahmed W, Kazi SN, Chowdhury ZZ, Johan MRB, Soudagar MEM, Mujtaba MA, Gul M, Badruddin IA, Kamangar S (2020) Ultrasonic assisted new Al_2O_3@TiO_2-ZnO/DW ternary composites nanofluids for enhanced energy transportation in a closed horizontal circular flow passage. Int Commun Heat Mass Transf 120:105018. https://doi.org/10.1016/j.icheatmasstransfer.2020.105018

Article CAS Google Scholar

Jhalani A, Sharma S, Singh D, Sharma PK (2022) Cow-urine emulsified diesel fuel: preparation, stability, and rheological study for diesel engine application . Environ Sci Pollut Res. https://doi.org/10.1007/s11356-022-24578-1

Kumar C, Rana KB, Tripathi B (2019) Effect of diesel–methanol–nitromethane blends combustion on VCR stationary CI engine performance and exhaust emissions. Environ Sci Pollut Res 26(7):6517–6531. https://doi.org/10.1007/s11356-018-04058-1

Article CAS Google Scholar

Kumar C, Rana KB, Tripathi B (2020a) Effect of ternary fuel blends on performance and emission characteristics of stationary VCR diesel engine. Energy Sources A: Recovery Util Environ Eff. https://doi.org/10.1080/15567036.2020.1785591

Kumar C, Rana KB, Tripathi B (2020b) Performance evaluation of diesel–additives ternary fuel blends: an experimental investigation, numerical simulation using hybrid Entropy–TOPSIS method and economic analysis. Therm Sci Eng Prog 20(10):100675. https://doi.org/10.1016/j.tsep.2020.100675

Article Google Scholar

Kumar C, Rana KB, Tripathi B, Nayyar A (2018) Properties and effects of organic additives on performance and emission characteristics of diesel engine: a comprehensive review. Environ Sci

Pollut Res 25(23):22475–22498. https://doi.org/10.1007/s11356-018-2537-6

Article CAS Google Scholar

Kumar C, Rana KB, Verma P, Mahar M, Sharma SS (2020c) Use of 2–methoxyethyl ether and nitromethane as oxygenated additives for performance improvement and emission reduction of CI engine: experimental investigation and numerical simulation. Environ Sci Pollut Res 28:3960–3971. https://doi.org/10.1007/s11356-020-11547-9

Article CAS Google Scholar

Kumar V, Singh AP, Agarwal AK (2020) Gaseous emissions (regulated and unregulated) and particulate characteristics of a medium-duty CRDI transportation diesel engine fueled with diesel-alcohol blends. Fuel 278:118269. https://doi.org/10.1016/j.fuel.2020.118269

Article CAS Google Scholar

Marikatti M, Banapurmath NR, Yaliwal VS, Basavarajappa YH, Soudagar MEM, Marquez FPG, Mujtaba MA, Fayaz H, Naik B, Khan TMY, Afzal A, AI EL-S (2020) Hydrogen injection in a dual fuel engine fueled with low-pressure injection of methyl ester of *Thevetia peruviana* (METP) for diesel engine maintenance application. Energies 13(21):5663. https://doi.org/10.3390/en13215663

Article CAS Google Scholar

Mishra S, Chauhan A, Mishra KB (2020) Role of binary and ternary blends of WCO biodiesel on emission reduction in diesel engine. Fuel 262:116604. https://doi.org/10.1016/j.fuel.2019.116604

Article CAS Google Scholar

Moghaddam MS, Moghaddam AZ (2014) Chemical engineering research and design performance and exhaust emission characteristics of a CI engine fueled with diesel–nitrogenated additives. Chem Eng Res Des 92(4):720–726. https://doi.org/10.1016/j.cherd.2014.01.009

Article CAS Google Scholar

Mujtaba MA, Muk Cho H, Masjuki HH, Kalam MA, Farooq M, Soudagar MEM, Gul M, Afzal A, Ahmed W, Raza A, Khan TMY, Bashir S, Ahmad Z (2021) Effect of primary and secondary alcohols

as oxygenated additives on the performance and emission characteristics of diesel engine. Energy Rep 7:1116–1124. https://doi.org/10.1016/j.egyr.2020.12.008

Article Google Scholar

Nayyar A, Sharma D, Lal S, Bhardwaj B, Gautam V, Kumar C, Augustine M (2019) Study of performance and emissions of a stationary DI variable compression ratio CI engine fueled with n-butanol/diesel blends using Taguchi technique: analytical and experimental analysis. Energy Sources A: Recovery Util Environ Eff 22. https://doi.org/10.1080/15567036.2019.1666937

Rao R, Sharma A, Nayyar A, Kumar C (2020) Performance and emission characteristics of diesel-2 ethoxyethyl acetate-nitromethane blends on a CI engine—an experimental study. SAE Technical Paper 2020-01-0347. https://doi.org/10.4271/2020-01-0347

Senthil R, Kannan M, Deepanraj B, Nadanakumar V, Santhanakrishnan S, Lawrence P (2011) Study on performance and emission characteristics of a compression ignition engine fueled with diesel-2 ethoxy ethyl acetate blends. Sci Res 3(11):5. https://doi.org/10.4236/eng.2011.311141

Article CAS Google Scholar

Soudagar MEM, Banapurmath NR, Afzal A, Hossain N, Abbas MM, Haniffa MACM, Naik B, Ahmed W, Nizamuddin S, Mubarak NM (2020) Study of diesel engine characteristics by adding nanosized zinc oxide and diethyl ether additives in Mahua biodiesel diesel fuel blend. Sci Rep 10(1):15326. https://doi.org/10.1038/s41598-020-72150-z

Article CAS Google Scholar

Zhang Y, Gao S, Zhang Z, Li W, Yuan T, Tan D, Duan L, Yang G (2023) A comprehensive review on combustion, performance and emission aspects of higher alcohols and its additive effect on the diesel engine. Fuel 335:127011. https://doi.org/10.1016/j.fuel.2022.127011

Article CAS Google Scholar

Zhang Z, Tian J, Li J, Lv J, Wang S, Zhong Y, Dong R, Gao S, Cao C, Tan D (2022a) Investigation on combustion, performance and emission characteristics of a diesel engine fueled with diesel/alcohol/n-butanol blended fuels. Fuel 320:123975. https://doi.org/10.1016/j.fuel.2022.123975

Article CAS Google Scholar

Zhang Z, Li J, Tian J, Dong R, Zou Z, Gao S, Tan D (2022b) Performance, combustion and emission characteristics investigations on a diesel engine fueled with diesel/ethanol/n-butanol blends. Energy 249:123733. https://doi.org/10.1016/j.energy.2022.123733

Article CAS Google Scholar

Zhang Z, Tian J, Xie G, Li J, Xu W, Jiang F, Huang Y, Tan D (2022c) Investigation on the combustion and emission characteristics of diesel engine fueled with diesel/methanol/n-butanol blends. Fuel 314:123088. https://doi.org/10.1016/j.fuel.2021.123088

Article CAS Google Scholar

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Contributions

All authors contributed to the conception, design, writing, and experimental work conducted to prepare this article. Material preparation, data collection, and analysis were done by Chandan Kumar and Mukesh Kumar. The first draft of the manuscript was written by Chandan Kumar and

Sumit Sharma. The manuscript was reviewed, analyzed, and edited by Umesh Kumar Das. All authors have read and approved the final manuscript.

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Ethics declarations

Ethical approval

The authors hereby approves that principles of ethical and professional conduct have been followed in the work.

Consent to participate

The present research does not involve any human or animal participation.

Consent for publication

The authors and the responsible authorities at the institute/organization where this work has been carried out give their explicit consent to submit and publish the work in ESPR, if found suitable.

Competing interests

The authors declare no competing interests.

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