Developing of ANN model for prediction of performance and emission characteristics of VCR engine with orange oil biodiesel blends

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Abstract

Biodiesel is used as a valuable alternative to the conventional fossil fuel, as it is non-toxic, renewable and biodegradable resource. Engine parameters like compression ratio, injection timing and injection pressure play key role in the combustion of fuel. The present study focuses on ANN model for predicting the performance characteristics like brake thermal efficiency, brake specific fuel consumption and emission characteristics like carbon monoxide, oxides of nitrogen and hydrocarbon emissions at varying loads and compression ratios (17, 17.5, 18). Seven training algorithms each with four combinations of training

functions were investigated. Levenberg–Marquardt (trainlm) with log and tan sigmoidal transfer function provided the best results amongst the other six training algorithms. It was found to be an accurate predicting model for analyzing the performance and emission characteristics VCR engine with biodiesel blends. In all compression ratios, 20 OME showed better thermal efficiency and reduced fuel consumption than diesel. Lower CO and HC emissions were observed with 20 OME than diesel except NOx.

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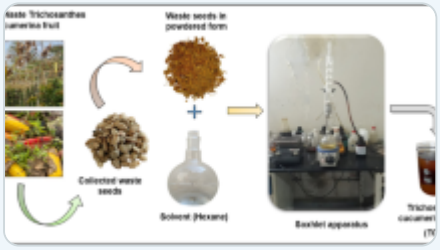

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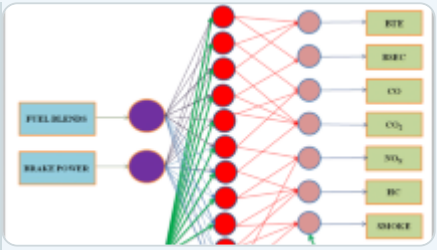

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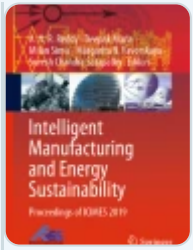

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Abbreviations

VCR: Variable compression ratio

ANN: Artificial neural network

BTE: Brake thermal efficiency

BSFC: Brake specific fuel consumption

CO: Carbon monoxide

NOx: Oxides of nitrogen

HC: Hydrocarbon

OME: Orange oil methyl ester

20 OME: 20% orange oil methyl ester + 80% neat diesel

CR: Compression ratio

References

1. Karthickeyan V, Balamurugan P, Senthil R (2016) Studies on orange oil methyl ester in diesel engine with hemispherical and toroidal combustion chamber. Therm Sci 20:981–989. doi:10.2298/TSCI16S4981K

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2. Karthickeyan V, Balamurugan P, Senthil R (2016) Production of orange oil methyl ester and experimental investigation on thermal barrier coated diesel engine. Asian J Res Soc Sci Humanit 6:156–178. doi:10.5958/2249-7315.2016.00601.8

Google Scholar

3. Karthickeyan V, Balamurugan P, Senthil R (2017) Investigation on environmental effects of thermal barrier coating with waste cooking palm oil methyl ester blends in diesel engine. Biofuels (Accepted for Publication)

4. Karthickeyan V, Arulraj P (2014) Experimental investigation on emission characteristics of catalytic converter using different wash coat material. Appl Mech Mater 550:62–70. doi:10.4028/www.scientific.net/AMM.550.62

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5. Karthickeyan V, Balamurugan P, Senthil R (2015) Experimental Investigation of tyre pyrolysis oil (TPO) in diesel engine without any engine modification. J Biofuels Bioenergy 1:170–183. doi:10.5958/2454-8618.2015.00018.8

Article Google Scholar

6. Ramadhas AS, Jayaraj S, Muraleedharan C (2004) Use of vegetable oils as IC engine fuels—a review. Renew Energy 29:727–742. doi:10.1016/j.renene.2003.09.008

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7. Naik SN, Goud VV, Rout PK, Dalai AK (2010) Production of first and second generation biofuels: a comprehensive review. Renew Sustain Energy Rev 14:578–597. doi:10.1016/j.rser.2009.10.003

Article Google Scholar

8. Atadashi IM, Aroua MK, Aziz AA (2011) Biodiesel separation and purification: a review. Renew Energy 36:437–443. doi:10.1016/j.renene.2010.07.019

Article Google Scholar

9. Najjar YSH, Amer MMB (2016) Using a smart device and neuro-fuzzy control system as a sustainable initiative with green cars. J Energy Inst 89:256–263. doi:10.1016/j.joei.2015.01.021

Article Google Scholar

10. Sharma YC, Singh B, Upadhyay SN (2008) Advancements in development and characterization of biodiesel: a review. Fuel 87:2355–2373. doi:10.1016/j.fuel.2008.01.014

Article Google Scholar

11. Yogish H, Chandarshekara K, Pramod Kumar MR (2013) A study of performance and emission characteristics of computerized CI engine with composite biodiesel blends as fuel at various injection pressures. Heat Mass Transf und Stoffuebertragung 49:1345–1355. doi:10.1007/s00231-013-1181-4

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12. Vairamuthu G, Sundarapandian S, Thangagiri B (2016) Use of *Calophyllum inophyllum* biofuel blended with diesel in DI diesel engine modified with nozzle holes and its size. Heat Mass Transf und Stoffuebertragung 52:1005–1013. doi:10.1007/s00231-015-1623-2

Article Google Scholar

13. Purushothaman K, Nagarajan G (2009) Effect of injection pressure on heat release rate and emissions in CI engine using orange skin powder diesel

solution. Energy Convers Manag 50:962–969. doi:10.1016/j.enconman.2008.12.030

Article Google Scholar

14. Tüccar G, Tosun E, Özgür T, Aydin K (2014) Diesel engine emissions and performance from blends of *Citrus sinensis* biodiesel and diesel fuel. Fuel 132:7–11. doi:10.1016/j.fuel.2014.04.065

Article Google Scholar

15. Muralidharan K, Vasudevan D (2011) Performance, emission and combustion characteristics of a variable compression ratio engine using methyl esters of waste cooking oil and diesel blends. Appl Energy 88:3959–3968. doi:10.1016/j.apenergy.2011.04.014

Article Google Scholar

16. Amarnath HK, Prabhakaran P (2012) A study on the thermal performance and emissions of a variable compression ratio diesel engine fuelled with karanja biodiesel and the optimization of parameters based on experimental data. Int J Green Energy 9:841–863. doi:10.1080/15435075.2011.647167

Article Google Scholar

17. Javed S, Murthy YVVS, Baig RU, Rao DP (2015) Development of ANN model for prediction of performance and emission characteristics of hydrogen dual fueled diesel engine with Jatropha Methyl Ester biodiesel blends. J Nat Gas Sci Eng 26:549–557. doi:10.1016/j.jngse.2015.06.041

Article Google Scholar

18. Roy S, Banerjee R, Das AK, Bose PK (2014) Development of an ANN based system identification tool to estimate the performance-emission

characteristics of a CRDI assisted CNG dual fuel diesel engine. J Nat Gas Sci Eng 21:147–158. doi:10.1016/j.jngse.2014.08.002

Article Google Scholar

19. Parlak A, Islamoglu Y, Yasar H, Egrisogut A (2006) Application of artificial neural network to predict specific fuel consumption and exhaust temperature for a diesel engine. Appl Therm Eng 26:824–828. doi:10.1016/j.applthermaleng.2005.10.006

Article Google Scholar

20. Uzun A (2012) A parametric study for specific fuel consumption of an intercooled diesel engine using a neural network. Fuel 93:189–199. doi:10.1016/j.fuel.2011.11.004

Article Google Scholar

21. Bietresato M, Calcante A, Mazzetto F (2015) A neural network approach for indirectly estimating farm tractors engine performances. Fuel 143:144–154. doi:10.1016/j.fuel.2014.11.019

Article Google Scholar

22. Oğuz H, Sarıtas I, Baydan HE (2010) Prediction of diesel engine performance using biofuels with artificial neural network. Expert Syst Appl 37:6579–6586. doi:10.1016/j.eswa.2010.02.128

Article Google Scholar

23. Pai PS, Rao BPS (2011) Artificial neural network based prediction of performance and emission characteristics of a variable compression ratio CI engine using WCO as a biodiesel at different injection timings. Appl Energy 88:2344–2354. doi:10.1016/j.apenergy.2010.12.030

Article Google Scholar

24. Yusaf TF, Buttsworth DR, Saleh KH, Yousif BF (2010) CNG-diesel engine performance and exhaust emission analysis with the aid of artificial neural network. Appl Energy 87:1661–1669. doi:10.1016/j.apenergy.2009.10.009

Article Google Scholar

25. Roy S, Ghosh A, Das AK, Banerjee R (2014) A comparative study of GEP and an ANN strategy to model engine performance and emission characteristics of a CRDI assisted single cylinder diesel engine under CNG dual-fuel operation. J Nat Gas Sci Eng 21:814–828. doi:10.1016/j.jngse.2014.10.024

Article Google Scholar

26. Holman JP (2007) Experimental techniques for engineers, 7th edn. Tata MCGraw Hill, New Delhi

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27. Karthickeyan V, Balamurugan P, Senthil R (2016) Comparative studies on emission reduction in thermal barrier coated engine using single blend ratio of various non-edible oils. J Braz Soc Mech Sci Eng 1:1–11. doi:10.1007/s40430-016-0645-0

Google Scholar

28. Karthickeyan V, Balamurugan P, Senthil R (2015) Investigation of CI engine fueled with ethanol nano additives blended diesel. Proc First Int Conf Recent Adv Bioenergy Res 1:121–130. doi:10.1007/978-81-322-2773-1

Google Scholar

29. Taghavifar H, Taghavifar H, Mardani A et al (2015) A numerical investigation on the wall heat flux in a di diesel engine fueled with *n*-heptane using a

coupled CFD and ANN approach. Fuel 140:227–236. doi:10.1016/j.fuel.2014.09.092

Article Google Scholar

30. Ismail HM, Ng HK, Queck CW, Gan S (2012) Artificial neural networks modelling of engine-out responses for a light-duty diesel engine fuelled with biodiesel blends. Appl Energy 92:769–777. doi:10.1016/j.apenergy.2011.08.027

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Electronic supplementary material

Below is the link to the electronic supplementary material.

Appendix I Results of various performance metrics using the Matlab is attached (DOCX 97 kb)

Appendix II Details of the Matlab Simulation (DOCX 797 kb)

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