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A Critical Review of Performance Analysis of Nano Coolants in Diesel Engine

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Abstract*: Recent years witness the nano technology development in engineering applications as a powerful tool to use with base fluid. Many researchers have contributed the nanofluid use in internal combustion exhaust gases recirculation system. In this paper, we have highlighted the published works carried by various authors.*
Keywords*: nanocoolant, diesel engine, emission etc.*

I. Introduction:

Sharma *et al.* [1] presented in their technical paper diesel was used in almost all the fields like transportation, fright, construction, agriculture and port. Emission of pollutants was the major problem associated with the diesel fuel. High Particulate Matter (PM) and Oxides of Nitrogen (NOx) emissions remains a challenge of technical issues for thediesel engine today. It is important to save the fuel to compensate energy demand. The emission norms on internal combustion engine are becoming more and more stringent with a view to improve the ambient air quality. Several experiments are being conducted to mix diesel with some other appropriate material which can give some better result with high performance parameter and comparatively less hazardous emission. Jatropha biodiesel has given a new edge in the field of saving the conventional source of energy like diesel due to its various similar chemical properties with diesel. The use of antioxidant additives not only slows down the oxidation processes but also improves the fuel stability up to a certain extent; so calculated amount of antioxidant was mixed with diesel and jatropha blend. Nano metal oxide additives are reported to be effective in lowering diesel emissions.

Nagaraj Banapurmath et al [2] presented in their technical paper different methods have been adopted to reduce tail pipe emissions and these include engine modification, fuel alteration, and exhaust gas treatment. Low emission characteristics and equivalent energy density of biodiesel are useful for replacement for petroleum fuels in internal combustion engines. Recently addition of catalytic reactivity materials like metal and oxide materials to biodiesel and their effect on engine performance has been reported in the literature. Due to their special properties like higher thermal conductivity, chemical and electrical properties enhanced properties of the base fuel diesel/biodiesel when these additives were used has been reported. In the present work both engine modification as well as fuel alteration techniques have been adopted to study their effect on diesel engine performance and emission characteristics. Engine modification involved provision of tangential slots on the piston crown surface. Fuel modification included addition of metal and metal oxide nano-particles to Honge biodiesel called Honge Oil Methyl Ester as an alternative fuel for diesel engine applications. Experimental investigations were carried out to determine performance, emission, and combustion characteristics of diesel engine operated on diesel, HOME and HOME silver nano-particles blended fuels.

The biodiesel was prepared from honge oil called Honge Oil Methyl Ester The silver nano-particles were blended with HOME in the mass fractions of 25ppm and 50ppm using a mechanical homogenizer and an ultra sonicator. Subsequently, the stability characteristics of silver nano-particles blended–biodiesel fuels were analyzed under static conditions for their homogeneity. A considerable enhancement in the brake thermal efficiency with substantial reduction in the harmful pollutants from the engine for the nano-additive biodiesel blends was observed. Maximum brake thermal efficiency was obtained for HOME+ 50SILVER with reduced harmful pollutants compared to HOME+25SILVER blends. With swirl intended slots provided on the piston crown surface the performance was further improved using HOME+50SILVER in general and for 6.5mm slot on the combustion chamber in particular.

Ranaware A. A., Satpute S. T.[3] presented in their technical paper the correlation between performance and emission characteristics of a compression ignition engine while using cerium oxide nanoparticles and water-based ferrofluid as additive to diesel fuel. The cerium oxide acts as an oxygen donating catalyst and provides oxygen for the oxidation of CO or absorbs oxygen for the reduction of NOx. The activation energy of cerium oxide acts to burn off carbon deposits within the engine cylinder at the wall temperature and prevents the deposition of non-polar compounds on the cylinder wall results reduction in HC emissions. Adding ferrofluid to diesel fuel has a perceptible effect on engine performance, increasing the brake thermal efficiency relatively up to 12% and decreasing the brake- specific fuel consumption relatively up to 11% as compared to diesel fuel. Furthermore,

from the analysis of engine exhaust, it was found that NOx emissions were lower than that of diesel fuel while the CO emissions increased.

M.Santhanamuthu et al [4] presented in their technical paper the performance and emission characteristics of internal combustion engine fuelled by polanga oil diesel fuel blend experimentally . To enhance the engine performance, iron oxide nanoparticles were doped with polanga oil–diesel fuel blend as additive. Performance and emission characteristics of diesel engine were studied for 10%, 20% and 30% (by weight) polanga oil with neat diesel. Iron oxide nanoparticles were added in three difference concentrations viz., 100, 200 and 300 ppmlevels in all the three polanga oil – diesel fuel blends to study their effects on engine performance. The engine was loaded at five different brake powers for each polanga oil – diesel – iron oxide nanoparticle fuel blends. It was observed that the presence of iron oxide nanoparticle reduces the ill effects of polanga oil in diesel. At 25%polanga oil blend with diesel and iron oxide nanoparticles concentration of 150 ppm, the engine performancewas observed to be similar to that of running on neat diesel. Hence doping of iron oxide nanoparticle withPolanga oil – Diesel fuel could be one of the potential substitutes for diesel in running CI engines.

N. R. Banapurmath1 et al [5] presented in their technical paper the biodiesel derived from honge oil called Honge oil methyl ester (HOME) was used as an alternative fuel as it was locally and abundantly available. Different metal and metal oxide nano-particles were then added to HOME to prepare novel hybrid fuel blends. Biodiesel-nanoparticles blends were prepared with the aid of an ultra-sonicator and the nanoparticles used were varied in the mass fraction of 25ppm and 50 ppm. Experimental investigations were carried out on a single cylinder four stroke diesel engine fuelled with biodiesel-nanoparticle blends to determine performance, combustion and emission characteristics. The result showed considerable enhancement in the brake thermal efficiency with reduced harmful exhaust emission from engine with addition of nano-particles to HOME.

V. Sajith, C. B. Sobhan, and G. P. Peterson[6] presented in their technical paper the results of experimental investigations on the influence of the addition of cerium oxide in the nanoparticle form on the major physicochemical properties and the performance of biodiesel. The physicochemical properties of the base fuel and the modified fuel formed by dispersing the catalyst nanoparticles by ultrasonic agitation are measured using ASTM standard test methods. The effects of the additive nanoparticles on the individual fuel properties, the engine performance, and emissions are studied, and the dosing level of the additive was optimized. Comparisons of the performance of the fuel with and without the additive are also presented. The flash point and the viscosity of biodiesel were found to increase with the inclusion of the ceriumoxide nanoparticles. The emission levels of hydrocarbon and NOx are appreciably reduced with the addition of cerium oxide nanoparticles.

Ajin C. Sajeevan and V. Sajith [7] presented in their technical paper the effect of cerium oxide nanoparticles on performance and emissions of diesel engine. Cerium oxide nanoparticles were synthesized by chemical method and techniques such as TEM, EDS, and XRD have been used for the characterization. Cerium oxide was mixed in diesel by means of standard ultrasonic shaker to obtain stable suspension, in a two-step process. The influence of nanoparticles on various physicochemical properties of diesel fuel has also been investigated through extensive experimentation by means of ASTMstandard testing methods. Load test was done in the diesel engine to investigate the effect of nanoparticles on the efficiency and the emissions from the engine. Comparisons of fuel properties with and without additives are also presented.

Ali M.A. Attia Ahmed et al [8] presented in their technical paper the experimental investigation to examine the effect of nano additives on diesel engine performance at variable operating conditions of load and speed. In this work, alumina nano-particles are added to a mixture of jojoba methyl ester (biodiesel) and conventional diesel fuel at the most recommended value (20% biodiesel and 80% diesel fuel) with different doses from 10 up to 50 mg/l. The received mixture was homogenized with an ultra sonicator mixer. It is found that, the appropriate nano-additives dose corresponding to optimal engine performance was about 30 mg/l. At this dose, the overall BSFC was reduced by about 6%, engine thermal efficiency was increased up to 7%, and all engine emissions have been reduced (NOx about 70%, CO about 75 %,smoke opacity about 5%, and UHC about 55 %) compared with the corresponding values obtained when only a blended fuel of 20% biodiesel was used.

Prajwal Tewari, Eshank Doijode, N.R. Banapurmath, V.S[9] presented in their technical paper experimental investigations to determine performance, emission, and combustion characteristics of diesel engine using multi walled carbon nanotubes (MWCNTs) blended biodiesel fuels. The fuel combinations used for the study were neat diesel for base line data generation, and CNT blended –biodiesel. The biodiesel was prepared from honge oil called Honge Oil Methyl Ester [HOME]. The MCNTs were blended with the biodiesel fuel in the mass fractions of 25 and 50 ppm with the aid of a mechanical homogenizer and an ultrasonicator. Subsequently, the stability characteristics of MWCNT blended –biodiesel fuels were analyzed under static conditions. The investigation were carried out using an experimental set-up consisting of a single-cylinder diesel engine coupled with an eddy current dynamometer loading device, an MRU 1600s five gas analyzer, a Hartridge smoke meter, and a data-acquisition system comprising a high pressure piezoelectric pressure sensor and a crank angle encoder. All the experiments were conducted at a constant speed of 1500 rpm and the results revealed that a considerable enhancement in the brake thermal efficiency and substantial reduction in the harmful pollutants due to the incorporation of MWCNTs in the biodiesel fuels were observed.

R. Manikandan, N. Sethuraman[10] presented in their technical paper experimental investigation to establish the performance and emission characteristics of single cylinder diesel engine by using ethanol-ceric oxide blend. At initially preparation phase, the ethanol and cerium oxide by Continuous magnetic stirring has to be done but the blend should not mix completely. The another method of preparing blend by sonigation (ultrasonic bath) used for complete mixing of blend and highly reduced separation of ethanol–cerium oxide. At the second phase Ethanol-cerium oxide-Diesel blend prepared by using adding acetone and di-ethyl ether to reduce the distribution of fuel particles. . By this investigation the cerium oxide acts as oxygen donating catalyst and provides oxygen for the oxidation of CO or absorbs oxygen for the reduction of NOx. The ethanol-cerium oxide acts to burn off carbon deposits within the engine cylinder and the combustion chamber and prevents the deposition of compounds on the cylinder wall results in reduction of HC emissions. The di-ethyl ether which improves the cetane number of fuel molecules.

Mookan Rengasamy et al [11] presented in their technical paper, the biodiesel was synthesized from castor oil using synthesized iron nanoparticles. The FTIR results confirmed the presence of methyl and ester group in the produced biodiesel. The specific gravity, kinematic viscosity, flash point, cloud point, water content, carbon residue, refractive index, copper corrosion and calorific value according to ASTM test methods for biodiesel were 0.914, 9.8mm2/s at 40oC, 185oC, 6oC, 0.17 vol. %, 0.042wt %, 1.460, 1a and 9295cal/gm respectively. The physicochemical properties of produced biodiesel were compared with conventional diesel and ASTM D6751 standard of biodiesel specifications..

V. Arul Mozhi Selvan et al [12] presented in their technical paper to establish the performance and emission characteristics of a compression ignition engine while using cerium oxide nanoparticles as additive in neat diesel and diesel-biodiesel-ethanol blends. In the first phase of the experiments, stability of neat diesel and diesel-biodiesel-ethanol fuel blends with the addition of cerium oxide nanoparticles are analyzed. After series of experiments, it was found that the blends subjected to high speed blending followed by ultrasonic bath stabilization improves the stability. The phase separation between diesel and ethanol was prevented using vegetable methyl ester (Biodiesel) prepared from the castor oil through transesterification process. In the second phase, performance characteristics are studied using the stable fuel blends in a single cylinder four stroke computerised variable compression ratio engine coupled with an eddy current dynamometer and a data acquisition system. The cerium oxide acts as an oxygen donating catalyst and provides oxygen for the oxidation of CO or absorbs oxygen for the reduction of NOx. The activation energy of cerium oxide acts to burn off carbon deposits within the engine cylinder at the wall temperature and prevents the deposition of non-polar compounds on the cylinder wall results reduction in HC emissions.

G.Balaji and M.Cheralathan [13] presented in their technical paper the experimental investigation on the effect of carbon nanotubes (CNT) additive on performance and emissions in a methyl ester of neem oil fuelled direct injection diesel engine. The nano additive is mixed in various proportions (100 to 300 ppm) with methyl ester of neem oil. The performance and emissions was tested in a computerized single cylinder, 4-stroke, stationary, water-cooled diesel engine of 3.5 kW rated power. Results show that the nano additive was effective in increasing the performance and controlling the NO emissions of methyl ester of neem oil fuelled diesel engines.

Ajay kumar[14] presented in their technical paper Using an emulsion of diesel in water as a fuel has been a recent field of study in this field. Water/diesel (W/D)emulsified formulations are reported to reduce the emissions without compensating theengine's performance. In present work an emulsion was prepared by adding nanoparticle as a fuel additive.A detailed experiment study has been conducted to evaluate the effect of cerium oxide dose level in 15% water emulsion diesel. The emulsification method was used to produce E15.The span 80 and tween 80 were used as surfactants. The cerium oxide nanoparticle dose level in water emulsion diesel were 40, 60, 80 ppm respectively. The experiments were performed in a 4-cylinder, 4-stroke water cooled diesel engine at constant 1650 RPM, over different load condition. The properties such as viscosity, flash point, and calorific value were also determined as per standards. Experiments were conducted using diesel and different blends of emulsion such as E15, E15CeO240, E15CeO260, and E15CeO280 by varying the load on engine. Performance and emission parameter of different blends of emulsion were compared to pure diesel. Results reported that cerium oxide blended fuels substantially improve the performance and reduce harmful pollutants.

Vishwajit A. Bhagwat, Chetan Pawar , N. R. Banapurmath [15] presented in their technical paper the performance and emission characteristics of diesel engine using graphene nanoparticles blended biodiesel fuels.The fuel combinations used for the study were neat diesel forbase line data generation and graphene nanoparticle blended – biodiesel. The biodiesel was prepared from honge raw oil called Honge Oil Methyl Ester [HOME]. The graphene nanoparticles were blended with the biodiesel fuel in the mass fractions of 25ppm and 50 ppm with the aid of a mechanical homogenizer and an ultrasonicator. Subsequently, the stability characteristics of graphene blended – biodiesel fuels were analysed under static conditions.The investigation were carried out using an experimental set-up consisting of a single-cylinder diesel engine coupled with an eddy current dynamometer loading device and theresults revealed that a considerable higher enhancement in thebrake thermal efficiency and substantial reduction in theharmful pollutants for the blend of graphene nanoparticle dueto the incorporation of graphene nanoparticle gives more surfacearea for reactivity and having higher thermal conductivity were observed.

A.Selvaganapthy, et al [16] presented in their technical thesis the possible effects of adding nano particles with diesel. The project was conceivedafter understanding the real need to improve the efficiency of the diesel engine without influencing the emissions to asevere degree. The nano particles are using for project was Zinc Oxide and Copper oxide, this project involves two separatetests on same composition of these nano particles with the values of diesel used as a reference. In the present work,experimental investigations have been carried out on using ZnO nano particle with diesel. The present work mainly focuseson comparing the different nano particles with diesel to improve the performance of compression ignition engine.

References

[1]. S K Sharma, R K Das, R Kumar Performance Parameter Analysis Of Diesel Engine Byusing A Mixture Of Diesel, Jatropha Oil, Mno -Nanomaterial And A Suitable Antioxidant -A Review International Journal of Mechanical and Production Engineering, , V 1(6), 2013, pp 32-36

[2]. Nagaraj Banapurmath, T. Narasimhalu1, Anand Hunshyal, Radhakrishnan Sankaran,Mohammad Hussain Rabinal, Narasimhan Ayachit, Rohan Kittur "Effect of silver nano-particle blended biodiesel and swirl on the performance of diesel engine combustion ", International Journal of Sustainable and Green Energy V3(6), 2014, pp-150-157

[3]. Ranaware A. A., Satpute S. T. "Correlation between Effects of Cerium Oxide Nanoparticles and Ferrofluid on the Performance and Emission Characteristics of a C.I. Engine," IOSR Journal of Mechanical and Civil Engineering : pp- 55-59

[4]. M.Santhanamuthu, S.Chittibabu, T.Tamizharasan and T.P.Mani "Evaluation of CI engine performance fuelled by Diesel-Polanga oil blends doped with iron oxide nanoparticles", International Journal of ChemTech Research V6 (2), 2014, pp 1299-1308

[5]. N. R. Banapurmath, Radhakrishnan Sankaran, A.V. Tumbal, Narasimhalu T. N. A. M. Hunashyal, N. H. Ayachit "Experimental investigation on direct injection diesel engine fuelled with graphene, silver and multiwalled carbon nanotubes-biodiesel blended fuels ," International Journal of Automotive Engineering and Technologies V 3(4), 2014 pp. 129 – 138

[6]. V. Sajith, C. B. Sobhan, and G. P. Peterson, "Experimental Investigations on the Effects of Cerium Oxide Nanoparticle Fuel Additives on Biodiesel Advances in Mechanical Engineering", V 2010, Article ID 581407, 6 pages

[7]. Ajin C. Sajeevan and V. Sajith , "Diesel Engine Emission Reduction Using Catalytic Nanoparticles: An Experimental Investigation ", Journal of Engineering, V2013, Article ID 589382, 9 pages

[8]. Ali M.A. Attia Ahmed I. El-Seesy Hesham M. El-Batsh Mohamed S. Shehata, "Effects Of Alumina Nanoparticles Additives Into Jojoba Methyl Ester-Diesel Mixture On Diesel Engine Performance", Proceedings of the ASME 2014 International Mechanical Engineering Congress and Exposition IMECE2014, November 14-20, 2014, Montreal, Quebec, Canada pp 1-10

[9]. Prajwal Tewari, Eshank Doijode, N.R. Banapurmath, V.S "Experimental Investigations On A Diesel Engine Fuelled With Multiwalled Carbon Nanotubes Blended Biodiesel Fuels", International Journal of Emerging Technology and Advanced Engineering, V 3(3), 2013,pp-72-76

[10]. R. Manikandan, N. Sethuraman "Experimental Investigation of Nano Additive Ceric Oxide (Ceo2) -Ethanol Blend on Single Cylinder FourStroke Diesel Engine", International Journal of Recent Development in Engineering and Technology V 3(2), 2014 pp- 24 -29

[11]. Mookan Rengasamy, Sundaresan Mohanraj, Senthilkumar Harsha Vardhan, Ravichandran Balaji, Velan Pugalenthi , "Transesterification Of Castor Oil Using Nano-Sized Iron Catalyst for the Production Of Biodiesel Journal of Chemical and Pharmaceutical Sciences, Issue 2: 2014, pp-108-112

[12]. V. Arul Mozhi Selvan, R. B. Anand and M. Udayakumar", Effects Of Cerium Oxide Nanoparticle Addition In Diesel And Diesel-Biodiesel-Ethanol Blends On The Performance & Emission Characteristics Of A CI Engine ARPN Journal of Engineering & Applied Sciences V4(7),2009, pp-1-6

[13]. G.Balaji and M.Cheralathan Effect of CNT as additive with biodiesel on the performance and emission characteristics of a DI diesel engine International Journal of ChemTech Research V7(3), 2014, pp-1230-1236

[14]. Ajay Kumar, "Effects Of Cerium Oxide Nanoparticle On Compression Ignintion Engine Performanceand Emission Charachteristic When Using Water Diesel Emuslion Master In Engineering Department Of Mechanical Engineering Thapar University Patiala-147004, India July 2014

[15]. Vishwajit A. Bhagwat, Chetan Pawar , N. R. Banapurmath Graphene Nanoparticle - Biodiesel Blended Diesel Engine International Journal of Engineering Research & Technology (IJERT) pp 75-79

[16]. A.Selvaganapthy, A.Sundar, B.Kumaragurubaran, P.Gopal "An Experimental Investigation to Study the Effects of Various Nano Particles with Diesel on Di Diesel Engine", ARPN Journal of Science and Technology V3(1), 2013 pp-112-116

