Engine performance and exhaust engineering essay

Engineering

CHAPTER 2

Hakan Bayraktar observed the effects of ethanol addition to gasoline on an SIengine performance and exhaustemissions, experimentally andtheoretically. Experimental applications have been carried out with the blends containing 1. 5, 3, 4. 5, 6, 7. 5, 9, 10. 5 and 12 vol% ethanol. Results obtained from both theoretical and experimentalstudies are compared graphically. Experimental results have shown that among thevarious blends, the blend of 7. 5% ethanol was the most suitable one from the engineperformance and CO emissions points of view. However, theoretical comparisons haveshown that the blend containing 16. 5% ethanol was the most suited blend for SI engines[1]. M. Bahattin Celik studied experimental determination of suitable ethanol–gasoline blend rate at high compression ratio for gasoline engine. In this study, ethanolwas used as fuel at high compression ratio to improve performance and to reduceemissions in a small gasoline engine with low efficiency. Initially, the engine whosecompression ratio was 6/1 was tested with gasoline, E25 (75% gasoline + 25% ethanol), E50, E75 and E100 fuels at a constant load and speed. It was determined from theexperimental results that the most suitable fuel in terms of performance and emissionswas E50. Then, the compression ratio was raised from 6/1 to 10/1. The experimentalresults showed that engine power increased by about 29% when running with E50 fuelcompared to the running with E0 fuel. Moreover, the specific fuel consumption, and CO, CO2, HC and NOx emissions were reduced by about 3%, 53%, 10%, 12% and 19%, respectively [2]. G. Najafi, et. al. did research on Performance and exhaust emissions of a gasolineengine with ethanol blended gasoline fuels using artificial neural network. The purpose ofthis study is to experimentally analyse the performance and the pollutant emissions of afour-stroke SI engine operating on ethanol–gasoline blends of 0%, 5%, 10%, 15% and20% with the aid of artificial neural network (ANN). The experimental results revealedthat using ethanol–gasoline blended fuels increased the power and torque output of theengine marginally. An ANN model was developed to predict a correlation between brake1power, torque, brake specific fuel consumption, brake thermal efficiency, volumetricefficiency and emission components using different gasoline–ethanol blends and speedsas inputs data. This study demonstrates that ANN approach can be used to accuratelypredict the SI engine performance and emissions [3]. Alan C. Hansen et. al in their review paper presented a review on the propertiesand specifications of ethanol blended with diesel fuel. Special emphasis is placed on thefactors critical to the potential commercial use of these blends. These factors includeblend properties such as stability, viscosity and lubricity, safety and materialscompatibility. The effect of the fuel on engine performance, durability and emissions arealso considered. The formulation of additives to correct certain key properties andmaintain blend stability is suggested as a critical factor in ensuring fuel compatibility withengines. However, maintaining vehicle safety with these blends may entail fuel tankmodifications [4]. Eliana Weber de Menezes et. al proposed an azeotropic TBE (ethyl tert-butylether)/ethanol mixture as a possible oxygenated additive for the formulation of eurosuper-type gasoline. Formulations containing this additive offer advantages over ethanol (lowvolatility and low solubility in water) and ETBE (higher octane number and lowerproduction cost). Gasoline with azeotropic additives show lower Reid vapor pressures(RVPs) than gasoline formulated with ethanol, and therefore low levels of volatileorganic compounds, similarly to highly pure ETBE. The use of the azeotropic mixturecontaining ethanol (renewable, deriving from biomass) and ETBE (produced fromethanol and isobutene) in its formulation is environmentally attractive in industrializedcountries due to the need to reduce carbon dioxide emissions [5]. Hu¨seyin Serdar Yu¨cesu, et. al in this study, explained the effect ofcompression ratio on engine performance and exhaust emissions at stoichiometric air/fuelratio, full load and minimum advanced timing for the best torque MBT in a singlecylinder, four stroke, with variable compression ratio and spark ignition engine. In theirstudy, test fuels were prepared using 99. 9% pure ethanol and gasoline blended with thevolumetric ratios of 0-30% (E0, E5, E10, E20 and E30). It is reported that, this arosefrom the original fuel injection system strategies which prepare rich fuel mixtures. Therefore, the leaning effect of ethanol to increase the air fuel equivalence ratio (k) to2higher value, and make the burning closer to be stoichiometric. As a result the bettercombustion can be achieved and higher torque output can be acquired [6]. Jincheng Huang, et. al., did an experimental investigation on the application ofthe blends of ethanol with diesel to a diesel engine. The test results show that it is feasibleand applicable for the blends with n-butanol to replace pure diesel as the fuel for dieselengine; the thermal efficiencies of the engine fueled by the blends were comparable withthat fueled by diesel, with some increase of fuel consumptions, which is due to the lowerheating value of ethanol. The characteristics of the emissions were also studied [7]. Mustafa Koç, et. al.

investigated experimentally, the effects of unleaded gasoline(E0) and unleaded gasoline-ethanol blends (E50 and E85) on engine performance andpollutant emissions in a single cylinder four-stroke spark-ignition engine at twocompression ratios (10: 1 and 11: 1). The engine speed was changed from 1500 to 5000rpm at wide open throttle (WOT). The results of the engine test showed that ethanoladdition to unleaded gasoline increase the engine torque, power and fuel consumption andreduce carbon monoxide (CO), nitrogen oxides (NOx) and hydrocarbon (HC) emissions. It was also found that ethanol-gasoline blends allow increasing compression ratio (CR)without knock occurrence [8]. Perihan Sekmen, Yakup Sekmen formulated mathematical model to find theperformance of an engine whose basic design parameters are known. This can bepredicted with the assistance of simulation programs into the less time, cost and nearvalue of actual. However, inadequate areas of the current model can guide future researchbecause the effects of design variables on engine performance can be determined before. In their study, thermodynamic cycle and performance analyses were simulated for variousengine speeds (1800, 2400 ve 3600 1/min) and various excess air coefficients (EAC)(0. 95-1. 05) to crank shaft angle (CA) with 1 degree increment at full load and 8: 1constant compression ratio (CR) of a SI engine with four stroke, single cylinder andnatural aspirated. Brake mean effective pressure, power, thermal efficiency, specific fuelconsumption (sfc), etc engine performance parameters were calculated; the values of peakcylinder pressures and temperatures and positions of them were determined by the presentprogram. Variations of these parameters with crank angle, engine speed and excess aircoefficient were presented graphically. The calculated results show good agreement with3literature. Simulation program was used to set for varies load, compression ratios, andengine sizes [9]. M. Al- Hasan investigated the effect of using unleaded gasoline–ethanol blendson SI engine performance and exhaust emission. A four stroke, four cylinder SI engine(type TOYOTA, TERCEL-3A) was used for conducting this study. Performance testswere conducted for equivalence air–fuel ratio, fuel consumption, volumetric efficiency, brake thermal efficiency, brake power, engine torque and brake specific fuelconsumption, while exhaust emissions were analyzed for carbon monoxide (CO), carbondioxide (CO2) and unburned hydrocarbons (HC), using unleaded gasoline–ethanol blendswith different percentages of fuel at three-fourth throttle opening position and variableengine speed ranging from 1000 to 4000 rpm. The results showed that blending unleadedgasoline with ethanol increases the brake power, torque, volumetric and brake thermalefficiencies and fuel consumption, while it decreases the brake specific fuel consumptionand equivalence air–fuel ratio. The CO and HC emissions concentrations in the engineexhaust decrease, while the CO2 concentration increases. The 20 vol.% ethanol in fuelblend gave the best results for all measured parameters at all engine speeds [10]. Sundeep Ramachandran presented a thermodynamic model for the simulation ofa spark ignition engine running on alternate hydrocarbon fuel. This paper aims to developa simple, fast and accurate engine simulation model without the need for a great deal ofcomputational power or knowledge of precise engine geometrical data. The model isbased on the classical two-zone approach, wherein parameters like heat transfer from thecylinder, blowby energy loss and heat release rate are also considered. Curve-fitcoefficients are then employed to simulate air and fuel data along with frozencomposition and practical chemical equilibrium routines [11]. M. A. Ceviz , F. Yuksel presented a paper to find out the ways to reduce cyclicvariability. A small amount of cyclic variability (slow burns) can produce undesirableengine vibrations. On the other hand, a larger amount of cyclic variability (incompleteburns) leads to an increase in hydrocarbon consumption and emissions. This paperinvestigates the effects of using ethanol–unleaded gasoline blends on cyclic variabilityand emissions in a spark-ignited engine. Results of this study showed that using ethanol–unleaded gasoline blends as a fuel decreased the coefficient of variation in indicated mean4effective pressure, and CO and HC emission concentrations, while increased CO2concentration up to 10vol.% ethanol in fuel blend. On the other hand, after this level ofblend a reverse effect was observed on the parameters aforementioned. The 10vol.%ethanol in fuel blend gave the best results [12]. Wei-Dong Hsieh, Rong-Hong Chen, Tsung-Lin Wu, Ta-Hui Lin did the studyto experimentally investigate the engine performance and pollutant emission of acommercial SI engine using ethanol–gasoline blended fuels with various blended rates(0%, 5%, 10%, 20%, 30%). Fuel properties of ethanol–gasoline blended fuels were firstexamined by the standard ASTM methods. Results showed that with increasing theethanol content, the heating value of the blended fuels is decreased, while the octanenumber of the blended fuels increases. It was also found that with increasing the ethanolcontent, the Reid vapor pressure of the blended fuels initially increases to a maximum at10% ethanol addition, and then decreases. Results of the engine test indicated that usingethanol–gasoline blended fuels, torque output and fuel consumption of the engine slightlyincrease; CO and HC emissions decrease dramatically as a result of the leaning effectcaused by the ethanol addition; and CO2 emission increases because of the improvedcombustion. Finally, it was noted that NOx emission depends on the engine operatingcondition rather than the ethanol content [13]. K Venkateswarlu, M Ramesh, K Veladri tested the effect of methanol-gasolineblends. Their work described the improved engine efficiency with higher compressionratios by using methanol-gasoline blends (mixing-methanol in small proportions withgasoline) as methanol had high anti-knock characteristics. Existing engines were notgenerally suitable to operate on higher contents of methanol, as the engine needs majormodifications. The present work considered methanol blended fuels M-10, M-20 and M-30 (number denotes the percentage of methanol in gasoline) as alternative fuel for fourstroke variable compression ratio spark ignition (S I) engine. Experimental resultsdemonstrated that an increase of 48% in brake thermal efficiency had been observedcompared to gasoline operation. An increase of 8% in volumetric efficiency was foundand a reduction of 24% in BSFC was observed [14]. Ivan Arsie, Cesare Pianese, Rizzo presented a thermodynamic modelforPrediction of Performance and Emission in a Spark Ignition Engine. This model is a part5of intergratged system of models of structure developed for optimal study and optimaldesign of engine control strategies [15]. Martyn Roberts studied benefits and challenges of VCR Engine. Potentialbenefits of Variable Compression Ratio (VCR) spark ignition engines were presentedbased on an examination of the relationship between Compression

Ratio, BMEP andspark advance at light load and full load. Alternative methods of implementing VCR areillustrated and critically examined. System control strategies are presented. Fuel economybenefits attainable from other technologies such as cylinder deactivation, camless valveoperation and GDI are shown to be inferior to the use of downsized boosted engines [16]. Antoni Jankowski, Alexander Sandel did the research on emission reuction ofengines using biofuels. Introduction of biofuels to fueling of automotive engines is theone method to decrease emissions of greenhouse gases. The CO2 from biofuels, is emittedduring combustion and absorbed during growth of tree end plants. The results of biofuelsapplying in viewpoint of exhaust emissions are presented in this paper. The mostpromising of biofuels for fueling of internal combustion engines are esters of vegetableoils and ethanol. Ethanol can be used for fueling spark ignition engines and compressionignition engines but vegetable oil esters can be used in compression ignition engines only. The paper describes an increase of CO2 content in atmospheric air and advantages andconcerns from using of biofuels [17]. Adnan Berber, Mustafa Tinkir, S. Sinan Gültekin and Ismet Çelikten useddifferent modeling techniques for prediction of diesel engine characteristics. In thierstudy, the characteristics of a four-stroke internal combustion diesel engine have beeninvestigated by means of artificial neural networks (ANNs) and adaptive neuro-fuzzyinference system (ANFIS) modelling techniques, using injection pressure, engine speedand torque. The proposed ANNs and ANFIS models are composed of the results ofimplemented measurements. ANNs model of the diesel engine has two subsystem. Thefirst subsystem has two outputs (BMEP, FF) and the second subsystem has single outputas specific fuel consumption (SFC). The performance of ANNs and ANFIS models arecompared with each other in same figures for same experimental data. The results ofmodeling techniques of a four-stroke internal combustion diesel engine are observed to bevery close with the experimental results [18]. 6

Mayur D. Bawankure, Prashant A. Potekar, Bhushan A. Nandane, Vivek R.

Gandhewar, found the methods to predict the performance evaluation of CI engine usingfuel blends. A comprehensive study on the ethanol as an alternative fuel with PalmStearin Methyl-Ester oil as additive has been carried out. A four stroke single cylinderwater cooled variable compression ratio diesel engine was used to study engine power, torque, break specific fuel consumption, break thermal efficiency and exhaust gastemperature with the diesel – ethanol blend with addition of small amount ofbiodiesel(PSME). The experiment result shows that the brake thermal efficiency of theengine increases for B40 blend for medium load capacity. It also shows that the exhaustgas temperature for B10 ratio is near the diesel fuel. Brake specific fuel consumption ofall ethanol Methyl-ester, diesel blends are lower compared with diesel at full load [19]. Alvydas Pikūnas, Saugirdas Pukalskas, Juozas Grabys found out the effect ofgasoline ethanol blend on engine performance. The purpose of their study was toinvestigate experimentally and compare the engine performance and pollutant emission ofa SI engine using ethanol–gasoline blended fuel and pure gasoline. The results showedthat when ethanol is added, the heating value of the blended fuel decreases, while theoctane number of the blended fuel increases. The results of the engine test indicated thatwhen ethanol–gasoline blended fuel is used, the engine power and specific fuelconsumption of the engine slightly increase; CO emission decreases dramatically as aresult of the leaning effect caused by the ethanol addition; HC emission decreases in someengine working conditions; and CO2 emission increases because of the improvedcombustion [20]. Wei-Dong Hsieha, Rong-Hong Chenb, Tsung-Lin Wub, Ta-Hui Lina did theresearch on effect of blending gasoline ethanol on engine performance and emissions ofthe engine. The purpose of the study was to experimentally investigate the engineperformance and pollutant emission of a commercial SI engine using ethanol–gasolineblended fuels with various blended rates (0%, 5%, 10%, 20%, 30%). Results showed thatwith increasing the ethanol content, the heating value of the blended fuels is decreased, while the octane number of the blended fuels increases. Results of the engine testindicated that using ethanol–gasoline blended fuels, torque output and fuel consumptionof the engine slightly increase; CO and HC emissions decrease dramatically as a result of7the leaning effect caused by the ethanol addition; and CO2 emission increases because ofthe improved combustion [21]. Wayne Moore, Matthew Foster and Kevin Hoyer presented the techniques forengine performance enhancement using ethanol fuel blends. In this paper results arepresented from a flexible fuel engine capable of operating with blends from E0-E85. Theincreased geometric compression ratio, (from 9. 2 to 11. 85) can be reduced to a lowereffective compression ratio using advanced valvetrain operating on an Early Intake ValveClosing (EIVC) or Late Intake Valve Closing (LIVC) strategy. DICP with a highauthority intake phaser is used to enable compression ratio management. The advancedvalve train also provides significantly reduced throttling losses by efficient control ofintake air and residuals. Increased ethanol blends provide improvements in power densitydue to knock resistance [22]. N. Seshaiah studied the effect of biofuel on performance of engine and itsemissions. In their research work, the variable compression ratio spark ignition enginedesigned to run on gasoline has been tested with pure gasoline, LPG (Isobutene), andgasoline blended with ethanol 10%, 15%, 25% and 35% by volume. Also, the gasolinemixed with kerosene at 15%, 25% and 35% by volume without any engine modificationshas been tested and presented the result. Brake thermal and volumetric efficiencyvariation with brake load is compared and presented. CO and CO2 emissions have beenalso compared for all tested fuels [23]. Dr. A. R. A. Habbo, Raad A. Khalil, Hassan S. Hammoodi presented a paperon Effect of Magnetizing the Fuel on the Performance of an S. I. Engine. The aim of thisstudy was to investigate the effect of the magnetized fuel on the performance of sparkignition engine. The engine performance was observed by examining the engine brakepower (BP) , thermal efficiency , specific fuel consumption (SFC) and exhaust emissions. The fuel is subjected to a magnetic field which is placed to fuel supply line to magnetizethe fuel before admitted to the engine cylinder. The results show a significantimprovements in engine performance, the thermal efficiency and engine power increasedby (4 %) and (3. 3 %) respectively when a magnetic coil of 1000 Gauss is used, and areduction in the specific fuel consumption by (12. 8 %) was achieved [24]. 8Shailesh Kumar Trivedi, Abid Haleem in their paper computed the availableand unavailable energy using first and second law of thermodynamics for wet ethanoloperated homogeneous charge compression ignition (HCCI) engine for cogenerationapplication. This paper also presents the evaluation of effect of ambient temperature, turbocharger compressor pressure ratio and effectiveness of regenerator on the first andsecond law efficiencies of the system. The numerical computational analysis of thesystem indicates that the first and second law efficiencies are decreasing with ambienttemperature as the increase in ambient temperature increases the charge intaketemperature which leads to reduced work output and it finally results in reducedefficiencies [25].

Peerawat Saisirirat, Anthony Dubreuil, Fabrice Foucher,

Christine

Mounaïm-Rousselle, Somchai Chanchaona studied of HCCI Combustion forHydrocarbon-Ethanol Mixture.. The heat release rate-time history from cylinder pressuredata analysing shows the interesting characteristics of each fuel depends on its kineticsmechanism. This study is concentrated on the HCCI combustion for n-heptane/ethanolmixture.. The effects of ethanol fraction to combustion characteristics were explainedwith this approach. The results show why the cool flame approaches to the main heatrelease when ethanol fraction is increased. In the future work, the planar laser inducedfluorescence (PLIF) technique will be applied to the experimental work to fulfil theunderstanding of HCCI combustion [26]. Rodrigo C. Costa, José R. Sodré compared the performance and emissions froma production 1. 0-l, eight-valve, and four-stroke engine fuelled by hydrous ethanol (6. 8%water content in ethanol) or 78% gasoline-22% ethanol blend. The results showed thattorque and BMEP were higher when the gasoline-ethanol blend was used as fuel on lowengine speeds. On the other hand, for high engine speeds, higher torque and BMEP wereachieved when hydrous ethanol fuel was used. Hydrous ethanol produced higher thermalefficiency and higher SFC than the gasoline-ethanol blend throughout all the engine speedrange studied. With regard to exhaust emissions hydrous ethanol reduced CO and HC, butincreased CO2 and NOX levels [27]. Er. Milind S Patil, Dr. R. S. Jahagirdar, Er. Eknath R Deore conductedresearch on 3. 75 kW diesel engine AV1 Single Cylinder water cooled, Kirloskar Make to9test blends of diesel with kerosene and Ethanol. This paper presents a study report on theperformance of IC engine using blends of kerosene and ethanol with diesel with variousblending ratio. Parameters like speed of engine, fuel consumption and torque weremeasured at different loads for pure diesel and various combination of dual fuel. BreakPower, BSFC, BTE and heat balance were calculated. Paper represents the test results forblends 5% to 20% [28]. C. Anada Srinivasan and C. G. Saravanan in their study, the effects of ethanoland unleaded gasoline with 1, 4 Dioxan blends on multi-cylinder SI engine wereinvestigated. The test fuels were prepared using 99. 9% pure ethanol and gasoline with 1, 4Dioxan blend, in the ratio of 50+5 1, 4 Dioxan, E 60+101, 4 Dioxan, the rest gasoline. Inthis work, the performance and emission tests were conducted in a multi-cylinder petrolengine. The experimental results reveal the increase in brake thermal efficiency for theblends when compared to that of sole fuel. In this investigation, the emission tests aremade with the help of AVL Di Gas analyzer, in which CO, CO2, HC, NOX areappreciably reduced and O2 is increased for all the blends when compared to sole fuel[29]. S. Y. Liao, D. M. Jiang, Q. Cheng, Z. H. Huang, and Q. Wei conductedexperimental study in a closed combustion chamber to investigate combustioncharacteristics of ethanol-gasoline blends at low temperature, which is related to the cold-start operation of engines fueled with ethanol-gasoline. The result shows that, for anethanol-gasoline engine, it must not be overfueled to realize a reliable cold start, as is thecase for a gasoline engine at the same temperature, especially at a temperature rangearound ethanol's boiling point, because ethanol addition into gasoline results in theimprovement of blend evaporation. It is shown that, for ethanol-gasoline blends withethanol content below 30%, the suitable fuel-air ratio to realize fast flame propagation isabout 1. 3 [30]. Suri Rajan and Fariborz F. Saniee investigated the miscibility characteristics ofhydrated ethanol with gasoline as a means of reducing the cost of ethanol/gasoline blendsfor use as a spark ignition engine fuel. For a given percentage of water in the ethanol, theexperimental data shows that a limited volume of gasoline can be added to form a stablemixture. Engine experiments indicate that, at normal ambient temperatures, a10water/ethanol/gasoline mixture containing up to 6 vol% of water in the ethanol constitutesa desirable motor fuel with power characteristics similar to those of the base gasoline[31].

Wei-Dong Hsieha, Rong-Hong Chenb, Tsung-Lin Wub, Ta-Hui Lina

conducted the study to experimentally investigate the engine performance and pollutantemission of a commercial SI engine using ethanol–gasoline blended fuels with variousblended rates (0%, 5%, 10%, 20%, 30%). Results showed that with increasing the ethanolcontent, the heating value of the blended fuels is decreased, while the octane number ofthe blended fuels increases. It was also found that with increasing the ethanol content, theReid vapor pressure of the blended fuels initially increases to a maximum at 10% ethanoladdition, and then decreases. Finally, it was noted that NOx emission depends on theengine operating condition rather than the ethanol content [32]. Hsi-Hsien Yang , Ta-Chuan Liu , Chia-Feng Chang , Eva Lee investigated theemission characteristics of regulated air pollutants and carbonyls from motorcycles usinggasoline blended with 3% ethanol (E3) and gasoline (E0) in this study. Nine motorcycleswere operated on a chassis dynamometer and driven according to the ECE driving cyclefor air pollutant measurements. In addition, durability testing was performed on twobrand-new motorcycles of the same model, using E3 in one and E0 in the other, to assessthe effects of E3 usage on motorcycle emissions. The results show that average emissionfactors of CO and THC decreased by 20. 0% and 5. 27%, respectively using E3 fuel. However, NO and CO emission increased by 5. 22% and 2. 57% [33].

John M. E. Storey, Teresa L. Barone, Kevin M. Norman, and Samuel A.

Lewis, Sr did the research t find the effects of gasoline ethanol blend on direct injectionSI engine. In addition to changes in gasoline engine technology, fuel composition mayincrease in ethanol content beyond the 10% allowed by current law due to the RenewableFuels. In this study, authors presented the results of an emissions analysis of a U. S.-legalstoichiometric, turbocharged DISI vehicle, operating on ethanol blends, with an emphasis ondetailed particulate matter (PM) characterization [34]. V.

Arul Mozhi Selvan, R. B. Anand and M. Udayakumar carried out anexperimental investigation to establish the performance and emission characteristics of a11compression ignition engine while using cerium oxide nanoparticles as additive in neatdiesel and diesel-biodiesel-ethanol blends. In the first phase of the experiments, stabilityof neat diesel and diesel-biodiesel-ethanol fuel blends with the addition of cerium oxidenanoparticles are analyzed. The tests revealed that cerium oxide nanoparticles can be usedas additive in diesel and diesel-biodiesel-ethanol blend to improve complete combustionof the fuel and reduce the exhaust emissions significantly [35].

Radivoje Peši

, Snežana Petkovi

, Golec Kazimierz, Emil Hnatko, Stevan

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conducted a research on Biofules and delusions of the Kyoto Protocol. The nextstage of power train and fuel strategy involves using new high economy combustionengines that can be run with partially renewable fuels and used worldwide. This paperanalyses delusions of the " Kyoto protocol" and presents the results of our own research ofcetane characteristics, bio-diesel fuel and technological solutions for maximal energyefficiency engines with minimal adverse effects on environment [36]. Shane Curtis, Mark Owen, Terrence Hess and Scott Egan did the investigationof effect of ethanol blends on SI engine. The objective of this research was to determinethe effect of ethanol blending on the performance and emissions of internal combustionengines that are calibrated to run on 100% gasoline. Experimental tests were performedon an engine using pure gasoline, 10% ethanol and 20% ethanol blends. The results of thestudy show that 10% ethanol blends can be used in internal combustion engines withoutany negative drawbacks. The fuel conversion efficiency remains the same, while COemissions are greatly reduced. 20% ethanol blends decrease the fuel conversion efficiencyand brake power of an engine, but still reduces CO emissions [37]. R. Scott Frazier investrigated the effects of ethanol gasoline blend in smallengines. In many parts of the United States, the use of ethanol/gasoline fuel blends is verycommon. The state of Oklahoma only recently began using 10 percent blended fuels(E10) in many service stations. Along with this new fuel availability are customerconcerns regarding compatibility with small engines such as lawn mowers and trimmers. The following presents information so consumers can decide if using ethanol blendedfuels is appropriate for them. Also included are some basic suggestions to mitigate somepossible problems that might exist [38]. 12