A REVIEW ON EXHAUST GAS RECIRCULATION TECHNIQUE ON DIESEL ENGINES USING BIODIESEL FUEL

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ABSTRACT -Nowadays Diesel engines are most commonly used in transportation vehicles, power generators, locomotives and in many industries dueto its reliability, durability and high fuel efficiency. But major challenges in front of usage of diesel engines one is availability of the conventional fuel resources and the second and most important is in view of environmental concern because the emissions from engines are carbon monoxide, carbon dioxide, nitrogen oxide, sulfur dioxide, whichcauses environmentalpollution. In this regard many researchers have been working on alternate fuels and developed emission control techniques.Biodiesel which is produced from vegetable oils and animal fats replaces the scarcity of conventional fuel. Exhaust Gas Recirculation (EGR) is a powerful and proven technique developed to reduce emissions from Diesel engine particularly NOx, using Biodiesel. The aim of present work is to study the EGR technique implemented on diesel engines using biodiesel.

Key words- EGR, Biodiesel, emissions, NOx

1. INTRODUCTION

Diesel engines are most widely used prime movers because of its easy drivability and higher thermal efficiency. though they have many advantages they produce higher levels emissions such as oxides of nitrogen (NO_x) and fine particulate matter which will harmful to human health and also to obey the norms phrased or to meet the emission norms and also to replace the scarcity of conventional fossil fuels without much changes in the existing engine, many researchers have been working in this area developing alternate fuels. Among those biodiesel a replacement to diesel fuel which is produced from vegetable oils.Biodiesel can be directly used in diesel engines without any changes in the engine. Biodiesel mostly fulfills the drawbacks of diesel fuel, which gives lower emissions of Particulate Matter, carbon monoxide (CO) and hydrocarbon (HC) without much loss in the engine performance except higher emissions of NO_x when compared to diesel and was proved by many researchers who worked in this area. In this regard to reduce the higher emissions of NO_x,Exhaust Gas Recirculation (EGR) is a most popular and adopted technique is used. In this technique a portion of the engine's exhaust gas is recirculated back into the intake air which reduces the supply of oxygen rich air. For this purpose a valve which is used to control the flow of gas, allows the flow of gas in to the system and restricts on fully closed when required. The re circulated gas may be passed through the EGR cooler which reduces the temperature of the re circulated gas this in terms reduces the cylinder combustion temperature. The reduction in combustion temperature results in lower peak temperatures and hence the higher density of cooled re circulated gas allows higher proportions of exhaust gas recirculation and on a diesel engine, the re circulated gas may be allowed max up to 50%.

% EGR = Volume of EGR * 100 / Total intake charge into the cylinder

Advantages of EGR

- Reduced NOx
- At part load operation on SI engines a significance reduction in throttling losses
- Engine life Improved as the cylinder wall temperatures reduced particularly exhaust valve life improved.

Disadvantages

- The production of particulates fuel which has combusted partially is increased when EGR is adopted. This has been a big problem with diesel engines, where the trade-off between NO_x and particulates is a close one to calibrators.
- The peak power will reduce since the oxygen available in the cylinder is less.
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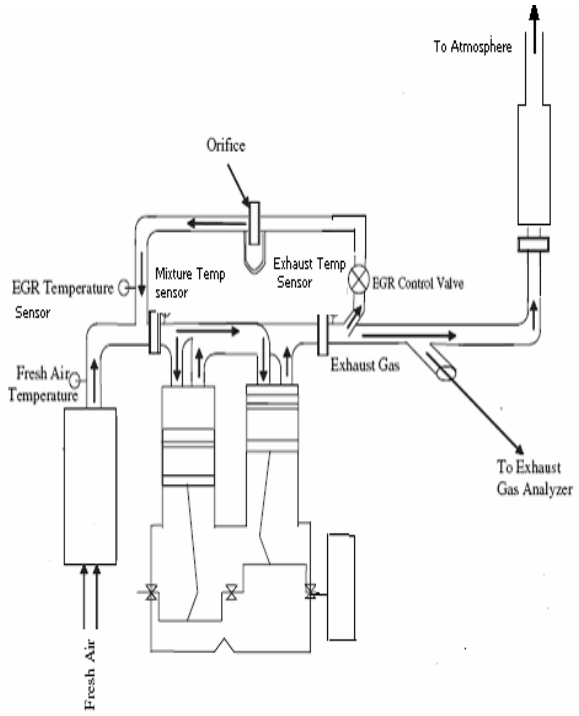

Figure 1.Experimental setup using EGR

2. REVIEW ON PRESENT STUDY

MohdHafizil Mat Yasin, RizalmanMamat, Ahmad FitriYusop, PerowansaParuka, TalalYusaf and GholamhassanNajafi in their experimental investigation on EGR in a diesel engine using palm-biodiesel, they found that the increase in specific fuel consumption for both the EGR and biodiesel and reduction in the engine performance parameters such as engine power, torque and brake thermal efficiency , it is observed that the other emissions such as carbon monoxide and hydrocarbons emissions have decreased with the use of biodiesel and engine operation with palm- EGR results in reduction in NO_x emissions without neglecting engine performance [1].

KavatiVenkateswarlu, BhagavathulaSree Rama Chandra Murthy and VissakodetiVenkataSubbarao in their study "EGR on diesel engine using Di-Tertiary Butyl Peroxide on Diesel-Biodiesel Blends", they found that as the percentage of EGR is increased brake thermal efficiency (BTE) increases first and then decreases while brake specific fuel consumption (BSFC) decreases first and then increases and as per investigation the optimum EGR value 15% at which BTE is maximum and BSFC is minimum.With the increase in percentage of EGR the peak pressure decreases slightly, further, they found that the presence of EGR advances the ignition with increase in percentage of biodiesel. NO_x and exhaust gas temperature decrease with increase in percentage of EGR and further at a fixed EGR, they decrease with the increase in percentage of the biodiesel. Emissionslike CO and HC are found increasing with increase in the percentage of EGR. However at a fixed EGR, they are found decreasing with the increase in percentage of biodiesel. The increase in smoke is insignificant initially, which however increases slightly with further increase in EGR which also increase with the increase in percentage of biodiesel.[2]

K. Rajan , K. R. Senthilkumar, Effect of Exhaust Gas Recirculation (EGR) on the Performance and Emission Characteristics of Diesel Engine with Sunflower Oil Methyl Ester, they have investigated the performance and emission characteristics of diesel fuel and diesel-SFME blends with exhaust gas recirculation system and briefed as Methyl ester of sunflower oil was prepared with lye catalyst NaOH and methanol, the exhaust NOx was reduced about 25% at 20 % biodiesel blends with 15% EGR when it was compared with conventional diesel fuelbecause less oxygen supply required in the recirculated exhaust gases which lowers the flame temperature in the combustion chamber., a notable improve of 4% of brake thermal efficiency and 10 % increase in BSFC at SFME blend with 15% EGR which is due to lower calorific value of the biodiesel fuel.The unburnt emissions like HC and CO were decreased by 5 % and 10 % at 20 % biodiesel blends respectively compared to diesel fuel with EGR and it is observed that smoke emissions were increased, due to incomplete combustion. Operation of Engine with biodiesel while employing EGR compared to diesel,can able to reduce 25 % NO_x, and reduction in brake thermal efficiency and increase in smoke, CO and UBHC. [3]

POOJA GHODASARA, M.S. RATHORE in their investigation on The effect of EGR rates along with biodiesel fuel on performance parameters and exhaust emission,They concluded as , at increasing

EGR rates the Smoke opacity, HC emissions were increased and No_x emissions are decreased , at low EGR rates at low load Brake thermal efficiency increases and increase in EGR rates at higher load it is to be decrease, and they have suggested the optimum EGR which is 15% for NO_x reduction without notable losses in brake thermal efficiency, HC and smoke opacity.[4]

A.Paykani, A. Akbarzadeh and M. T. ShervaniTabar, an Experimental Investigation of the Effect of Exhaust GasRecirculation on Performance and EmissionsCharacteristics of a Diesel Engine Fueled with Biodiesel (COEE-canola Oil Ethyl Ester) and experiments were conducted on four fuels i.e., diesel fuel, B20, B50 and B100 with exhaust gas recirculation they summarized that when the engine operating on biodiesel due to its lower calorific value the brake thermal efficiency decreased when it compared with conventional diesel fuel. Also they stated that the engine performance was inferior when using diesel-COEE blend. In their investigation they also found that the brake thermal efficiency increases at low EGR ratios for four fuels. However, increasing EGR flow rates to high levels resulted in decrease in brake thermal efficiency for both net diesel fuel and COEE blends. They observed that the NO_x emissions increase directly withincreasing biodiesel percentage. Using EGR was aneffective technique to reduce the NO_x emissions. TheNO_x emissions were decreased with increase in EGR flowpercentage for both net diesel fuel and COEE blends.The emissions of CO and UHC were found to be lowerwith increasing biodiesel percentage. Using slightamount of EGR resulted in a trivial decrease in HC andCO emissions. However, Increasing EGR flow rates tohigh levels resulted in considerable rise in CO and HCemissions for both net diesel fuel and COEE blends.[5]

3. CONCLUSIONS

From the present review on Exhaust Gas Recirculation on Diesel Engines using biodiesel it concluded briefly as follows

1. EGR in a diesel engine using palm-biodiesel, found that the increase in specific fuel consumption for both the EGR and biodiesel and reduction in the engine performance parameters such as engine power, torque and brake thermal efficiency.
2. When the engine operation with palm biodiesel- EGR results in reduction in NO_xemissions without neglecting the engine performance.
3. EGR on diesel engine using Di-Tertiary Butyl Peroxide on Diesel-Biodiesel Blends, as the percentage of EGR is increased brake thermal efficiency (BTE) increases first and then decreases while brake specific fuel consumption (BSFC) decreases first and then increases and as per investigation the optimum EGR value 15% at which BTE is maximum and BSFC is minimum. The presence of EGR advances the ignition with increase in percentage of biodiesel.
4. Effect of Exhaust Gas Recirculation (EGR) on the Performance and Emission Characteristics of Diesel Engine with Sunflower Oil Methyl Ester,the exhaust NOx was reduced about 25% at 20 % biodiesel blends with 15% EGR when it was compared with conventional diesel fuel because less oxygen supply required in the recirculated exhaust gases which lowers the flame temperature in the combustion chamber.
5. Effect of Exhaust Gas Recirculation on Performance and Emissions Characteristics of a Diesel Engine Fueled with Biodiesel (COEE-canola Oil Ethyl Ester) , when the engine operating on biodiesel due to its lower calorific value the brake thermal efficiency decreased when it compared with conventional diesel fuel. The brake thermal efficiency increases at low EGR. However, increasing EGR flow rates to high levels resulted in decrease in brake thermal efficiency for both net diesel fuel and COEE blends. It is observed that the NO_x emissions increase directly with increasing biodiesel percentage. Using EGR was an effective technique to reduce the NO_x emissions. The NO_x emissions were decreased with increase in EGR flow percentage for both net diesel fuel and COEE blends.

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