Testing of Diesel Exhaust Fluid in Diesel Engine

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Abstract— In this manuscript, Nowadays exhaust emission control from internal combustion engines have become one of the most important challenges. Oxides of nitrogen (NOx) are one of the major hazardous pollutants that come out from diesel engines. There are various techniques existing for NOx control but each technique has its own advantages and disadvantages. Technologies available for NOx reductions either increase other polluting gas emission or increase fuel consumption. The objective of this paper is to determine the maximum reduction of NOx emissions by varying concentration of urea solution with reduction catalyst. An aqueous solution of urea was injected in engine exhaust pipe for reducing NOx emissions in single cylinder light duty stationery DI diesel engine fuelled with diesel and diesel-(10%) ethanol blend. A concentration of urea solution varying from 30 to 35% by weight with constant flow rates and tested with fitting Titanium dioxide (TiO2) coated catalyst which controls by products of ammonia and water vapour. Results indicated that a maximum of 70 % of NOx reduction was achieved an engine fuelled with diesel ethanol blend and constant flow rate of 0.75 lit/hr with an urea concentration of 35% and 66% NOx of reduced with neat diesel using Titanium dioxide catalyst in Selective Catalytic Reduction system. A diesel exhaust fluid (DEF) injector assembly is provided for use in an engine exhaust after-treatment system. The DEF injector assembly may also include a valve that opens and closes the fluid outlet of the injector body. An exemplary DEF injector assembly further includes an impact structure with an inclined impact surface that disperses and distributes the injected DEF into the engine exhaust streak.

Keywords: Engine Emission, SCR, NOx, Urea

I. INTRODUCTION

Diesel exhaust fluid is an anti-polluting agent that curbs and reduces harmful Nitrogen Oxide (NOx) emissions from a diesel powered Internal Combustion Engine. The fluid is made up of two chemicals combined in a fixed volumetric proportions namely, 67.5 % of de-mineralized water and 32.5% of high quality urea to form an aqueous solution. The diesel exhaust fluid is standardized as aqueous urea solution or AUS32 by International Organization for Standardization 22241 (ISO). This consumable fluid is used in concurrence with Selective Catalytic Reduction or SCR technology utilized in diesel run vehicles to reduce harmful pollutants emitted from the exhausts.

The diesel exhaust fluid is stored in a separate tank that is connected to the exhaust line and is activated immediately whenever the engine is in operating condition. Since, diesel engines can be run on very lean air to fuel ratio in order to ensure complete combustion of fuel neglect. The generation and propagation of soot and unburn chemicals into the exhaust, the extra air used for this lean combustion leads to higher concentration of nitrogen in the engine cylinder. This can lead to production of Nitrogen Oxide (NOx) chemicals, which is therefore reduced by the inclusion of diesel exhaust fluid breaking down the NOx into simpler and less polluting water and nitrogen by-products. The major pollutant emissions of the diesel engines are NOx , particulate matters, smoke and soot particles. Although all other emissions, NOx is one of the most important emission from diesel engine. It plays an important role in the atmospheric ozone destruction and global warming.

A. Component of Diesel Exhaust Fluid Assembly:

- urea tank
- def deposition unit
- Nozzles
- Def pump
- Muffler
- control system (dosing control)
- SCR catalyst converter
- engine exhaust

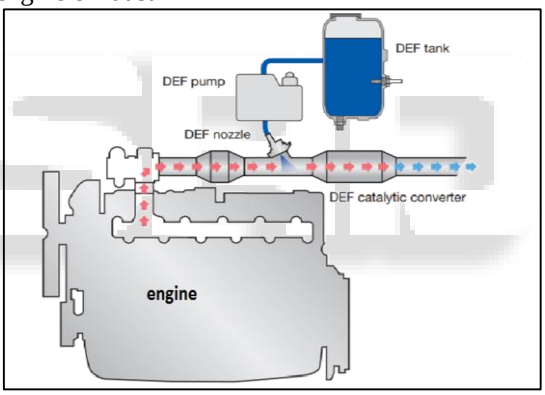

Fig. 1: Component Setup of DEF system

Fig. 2: Actual setup of modified carburettor.

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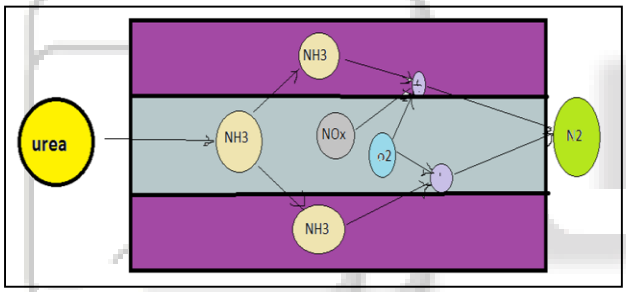
II. WORKING

As schematic sketch of Diesel Exhaust Fluid system shown consists urea tanks in which a Ad Blue (DEF) is produced from a high purity urea solution. Urea is produced by the synthesis of ammonia and CO2 (carbon dioxide). Technical urea is found in such products as shampoos, cosmetics and glues. Urea used in Ad Blue is of a different quality grade then that used for fertilizers. so Small quantities of diesel exhaust fluid (DEF) are injected throughout a nozzles which flow previously controlled in dosing control system this solutions injected into the exhaust upstream of a catalyst, where it vaporizes and decomposes to form ammonia and carbon dioxide. The ammonia (NH3) is the desired product which in conjunction to the SCR catalyst, converts the NOx to harmless nitrogen (N2) and water (H2O). A fine mist of DEF is injected into the exhaust while the engine is running the heat from the exhaust converts the DEF into ammonia. When the ammonia, mixed with exhaust gases, reaches the SCR catalyst, the NOx emissions are broken down, The Diesel Particulate Filter (DPF) then captures soot to incinerate it during regeneration cycles, Water vapour, nitrogen and reduced emissions exit the exhaust system, then finally some amounts of pollution less exhaust we get,

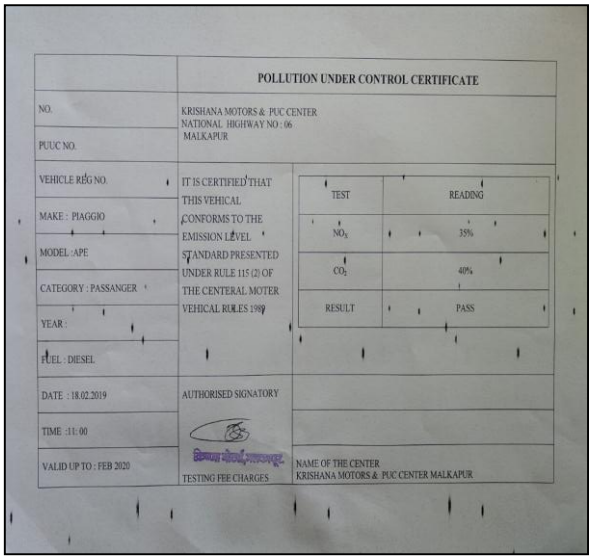
III. CONVERSION PROCESS NOX TO N_2



1) Step 1:
DEF Becomes Ammonia and Isocyanic Acid: (NH2)2CO → NH3 + HNCO
2) Step 2:
The Isocyanic Acid chemically breaks down with water into Carbon Dioxide and Ammonia:
HNCO + H2O → CO2 + NH3 overall which is this:
(NH2)2CO + H2O → 2NH3 + CO2
3) Step 3:
At this point during the chemical reaction Ammonia will, in the presence of oxygen and a catalyst, will reduce nitrogen oxides:
2NO + 2NH3 + ½O2 -> 2N2 + 3H2O and 3NO2 + 4NH3 -> 7/2N2 + 6H2O
4) Step 4:
The overall reduction of NOx by urea is:
2(NH2)2CO + 4NO + O2 → 4N2 + 4H2O + 2CO2 and
2(NH2) 2CO + 3NO2 -> 7/2N2 + 4H2O + 2CO2

IV. OBSERVATION REPORT DURING TEST

A. PUC Report When No Adblue Add In Engine


POLLUTION UNDER CONTROL CERTIFICATE

NO.
PUUC NO.
VEHICLE REG NO.
MAKE : PIAGGIO
MODEL :APE
CATEGORY : PASSANGER
YEAR :
FUEL : DIESEL
DATE : 18.02.2019
TIME :11: 00
VALID UP TO : FEB 2020

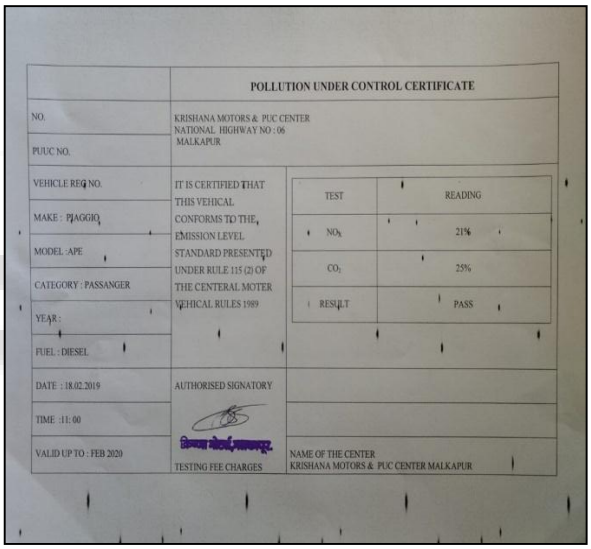
KRISHANA MOTORS & PUC CENTER
NATIONAL HIGHWAY NO : 06
MALKAPUR

IT IS CERTIFIED THAT THIS VEHICAL CONFORMS TO THE EMISSION LEVEL STANDARD PRESENTED UNDER RULE 115 (2) OF THE CENTERAL MOTER VEHICAL RULES 1989

TEST	READING
NO_x	35%
CO_2	40%
RESULT	PASS

AUTHORISED SIGNATORY
TESTING FEE CHARGES
NAME OF THE CENTER
KRISHANA MOTORS & PUC CENTER MALKAPUR

B. PUC report when adblue added in engine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TEST	READING
NO_x	21%
CO_2	25%
RESULT	PASS

AUTHORISED SIGNATORY
TESTING FEE CHARGES
NAME OF THE CENTER
KRISHANA MOTORS & PUC CENTER MALKAPUR

V. ADVANTAGES

Advantages of using DEF
- Fulfils legal requirements for NOx and particulate reduction
- Reduces fuel consumption
- Lower fuel costs (cost of DEF included)
- Lower operating costs compared to Cooled Exhaust Gas Recirculation (CEGR)
- Requires no Exhaust Gas Recirculation (EGR) valve
- Requires no servicing of emission control
- Reduced sensitivity to lower quality diesel (sulphur)
- Environment friendly
- Reduce nox pollution
- Lower particulate matter emission
- Lower cost of operation
- Better fuel economy

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VI. DISADVANTAGES

Disadvantages of DEF

- Requires the addition and handling of DEF
- More components outside the engine

VII. APPLICATION

- power plant
- automobile vehicle
- chemical industries
- refinery
- any exhaust system which create pollution
- Furnace Chimney

VIII. CONCLUSION

In this paper From above we conclude that From above reort we can directly see effect of adding adblue solution in engine (diesel exhaust fluid) from above report nox and co2 level in exhaust pipe are reduced, as well as engine exhaust exit more less pollution ppm of ga, that means pollution in air becomes less

From above report percentage of no_x reduce it means pariticulate exhaust matter are reduces

Thus it indicates that the catalyst used in the test engine commercially effective method for controlling NOx

From above report we conclude that Diesel Exhaust Fluid system are most economical, effective and reliable in heavy diesel engine exhaust system to control pollution

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