

EFFECTS OF SCR SYSTEM ON NOX REDUCTION IN HEAVY DUTY DIESEL ENGINE FUELLED WITH DIESEL AND ALCOHOL BLENDS

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ABSTRACT

The point of this test work was to investigate the impacts of SCR system on NOx decrease in overwhelming obligation diesel motor fuelled with diesel and liquor mixes. The test was performed in a 6-barrel, turbocharged substantial obligation diesel motor at full load. In the exploratory tests diesel, ethanol, methanol, and butanol were utilized as fuel. The liquor fuel mixes were set up by blending low sulfur diesel at volumetric rates of between 5 to 10%. The test outcomes demonstrated that SCR framework decreases. The NOx outflows 41.6% for diesel fuel. The greatest NOx decrease (42.43%) was accomplished with 10% Methanol– 90% Diesel fuel (D85M15) mix.

KEY WORDS: NOX EMISSION; ALCOHOL; HEAVY DUTY DIESEL ENGINE

I. INTRODUCTION:

The diesel motor is one of the urgent reasons of air contamination such as nitrogen oxides (NO_x), hydrocarbons (HC), carbon monoxide (CO), Carbon dioxide (CO₂), Smoke haziness, and so on. The elimination of oil, powers have driven analysts to discover electively energizes. For improving the nature of the execution and burning different fuel added substances are as of late utilized as a part of the car area. The most examined added substances are oxygenated fuel added substances in diesel motors. Alcohols like as methanol, ethanol, propanol and butanol are favoured as powers since they can be produced by the maturation of sugar from vegetable materials, as corn, green growth, sugar stick and other plant materials involving cellulose.

Liquor energizes have many points of interest, for example, diminish particulate issue (PM), nitrogen oxides (NO_x) and carbon monoxide (CO) debilitate emanations due to the extra oxygen in fuel. There are different investigations about the effects of ethanol, methanol, and butanol on diesel motor burning. Furthermore, outflows. Inquired about the effects of fuel added substances containing methanol (MCA) on the controlled outflows of overwhelming obligation diesel motor.

The slick diesel fuel mixed with methanol levels 6, 7, 10 and 10% by volume individually. Furthermore, the outcomes noticed that the expansion of MCA diminished fumes emanations, for example, NO_x, PM, and PAHs diesel motor outflows. In this

investigation, the impacts of ethanol, methanol, and butanol diesel fuel mixes on NO_x emanations of a 6-chamber, turbocharged overwhelming obligation diesel motor with and without SCR framework was explored. Ethanol, methanol and butanol were mixed with slick diesel fuel at volumetric rates in the vicinity of 5 and 10%.

Material and Method

The exploratory tests were performed on a six-barrel, four-stroke, air-cooled turbocharger diesel motor. The specialized particulars and a schematic graph of test unit have appeared in Table 1 and Figure 1 individually. A pressure-driven dynamometer was utilized to decide the torque. Specialized particulars of dynamometer are given

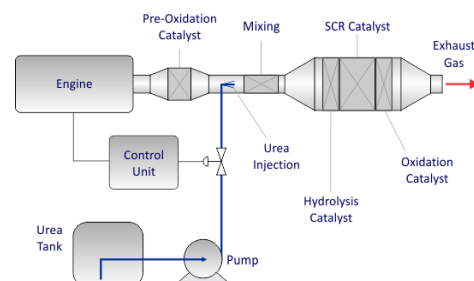


Figure 1: Schematic diagram of test unit.

Table 1: Technical specifications of engine.

Brand	Cummins
Model	ISBE 3.9 E3 B
Type	Electronic cont system
cylinder	6
Bore/stroke	104/122mm
Compression ratio	15.3
weight	475 kg
After treatment	SCR
Peak Torque/Speed (r/min)	1100-1700
Rated Speed	2500 rpm
Displacement	6690cc
Power	174 kW@2500 rpm
Torque	1010Nm @1500 rpm
Oil Cooler	Turbocharger and after cooled

Table 2: Technical specifications of dynamometer

Torque range	200-2100 Nm
Speed range	0-4500 rpm
Body weight	40 kgf
Coupling length	400-650 mm
Torque arm length	300mm

Table 3: FTIR Technical specifications.

FTIR Spectrometer Data	
Sampling rate	2 scans per second (2 Hz)
Data rate	All measured gas components at 2 Hz
Spectral resolution	0.3 cm ⁻¹
Measurement cell	Gas cell heated to 191°C (369.8 °F)
Response time	t10 to t50 within 1 s (fast response version within 350 ms)
Sample flow rate	100 /min per stream (200/min for fast response version)
Detector cooling	Liquid nitrogen, 55 ml/h
Zero/purge gas	Nitrogen/synthetic air, 0.4-1.2 l/min
Compressed air	5-6 bar rel. max. 1000/min per FTIR stream

Table 4: Fuel properties of diesel, methanol, ethanol and butanol

<u>Fuel Properties</u>	<u>Diesel</u>	<u>Ethanol</u>	<u>Methanol</u>	<u>Butanol</u>
Density (kg/l)	0.722	0.644	0.643	0.720
Cetane Number	56	~7	2.8	~20
Viscosity (cSt)	1.7	1.028	0.4545	2.6
Calorific value (kJ/kg)	42,100	23,600	19,100	19,100
Boiling Point	179-360	72	61	112
Stoichiometric air fuel ratio	14	8.1	6.2	10.1

FTIR gadget specialized attributes are displayed in Table 3. In the after-treatment a procedure, particular reactant lessening, which includes the splashing of urea in the tailpipe was consolidated to moderate NOX. The motor is outfitted with SCR aftertreatment framework (Figure 2). demonstrates the schematic outline of SCR framework unit. In the analyses, diesel, methanol, ethanol, and butanol were utilized as fuel. The fuel mixes were set up by blending euro diesel at volumetric rates of 7, 10 and 13%. Methanol-diesel mixes indicated as D95M5, D90M10, and D85M15. Ethanol- diesel mixes indicated as D95E5, D90E10, and D85E15. Butanol-diesel mixes determined as D95B5, D90B10, and D85B15. Before beginning to test, the motor kept running amid 15 min utilizing diesel fuel to achieve working temperature. The fuel mixes were tried between 1500 rpm to 2400 rpm with the interim of 250 rpm in full load conditions. The fuel properties of diesel fuel, ethanol, methanol, and butanol are accounted for in Table 4.

Result and Discussion

The NO_x outflow generally respects to nitrogen monoxide NO and nitrogen dioxide NO₂. NO is generally the most copious NO_x and make more than 75– 95% of aggregate NO_x in diesel motor fumes. Liquor fuel mixes were utilized for facilitating NO_x discharge think about in a diesel motor fitted with SCRframework. The varieties of nitrogen oxides (NO_x) discharges of test energize with motor speed are exhibited in the Figures 3-5. Figure 3 demonstrates the NO_x discharge estimations of methanol fuel mixes with and without SCR framework. In the wake of applying SCR framework, the NO_x discharge is generously diminished by 42.12%, 42.3 and 42.43% than D95M5, D90M10 and D85M15 individually. Figure4 demonstrates the NO_x discharge estimations of ethanol fuel mixes with and without SCR framework. In the wake of applying SCR framework, the NO_x discharge is generously diminished by 41.9%, 42.01% and 42.14% than D95E5, D90E10, and D85E15 individually.

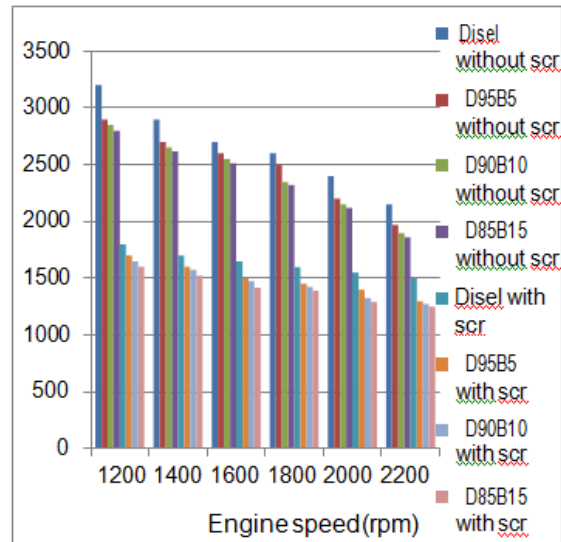


Figure-2 NO_x emission of butanol blends

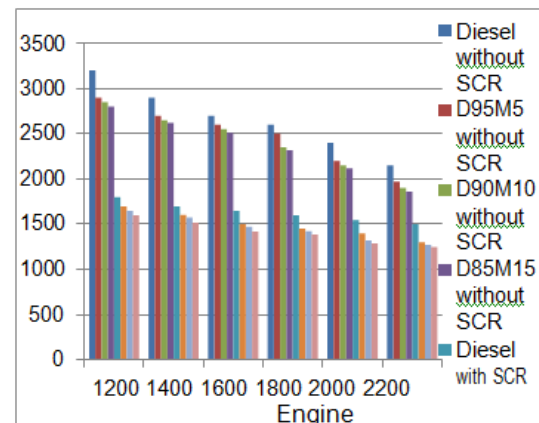


Figure- 3 NO_x emission of methanol blends

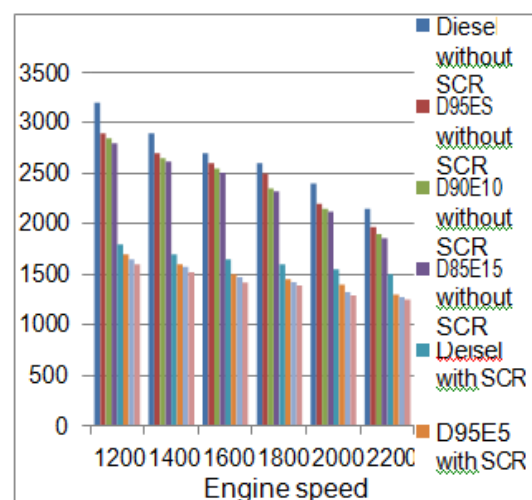


Figure – 4 NO_x emission of ethanol blends

Conclusion

In this work, the NO_x discharge estimations of ethanol, methanol, and butanol added substances on a 6-barrel, turbocharged substantial obligation diesel motor with and without SCR framework was explored. The principal discoveries from this examination are adjusted beneath: In the wake of applying SCR framework for D85M15, D85E15, and D85B15 fuel mixes, the NO_x emanation is significantly lessened by 45.45%, 44.9% what's more, 44.5% than diesel individually. Expansion of ethanol, methanol, and butanol diminish the NO_x emanations as to perfect diesel. The reason of the lessening may be inferable from the expanded oxygen substance and lower cetane number of liquor added substances. The lower cetane number of ethanol, methanol and butanol mixes hastens to longer start deferral and driving potentially to higher ignition temperature amid the premixed burningmode.

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