

NO_x Reduction Technology for Combustion Systems: A Review

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Abstract – An oxide of nitrogen (NO_x) is more dangerous pollutants coming from combustion product due to higher cylinder temperature in diesel engine. The NO_x may cause the acid rain due to formation of nitric acid during rainy season. The control of NO_x emission using Selective catalytic urea injection system was discussed in details. The researchers reported that urea injection technology with catalytic reduction is very useful to control the NO_x. The various parameters in SCR urea injection system and its effect on capability to reduce the emission was discussed. The urea solution and its effect on catalytic reduction was explored. Also, the challenges of urea injection system was presented here. The most of the researchers found that the urea is very costly and shortage of urea in agriculture sector is one of the disadvantage of urea injection system. This paper reports the recent studies available on SCR urea injection system. This found to be suitable to reduced the emission of oxides of nitrogen about 85%.

Keywords- Urea, Exhaust gas emission, Diesel emission control system.

I- INTRODUCTION

Diesel engines are mostly used as prime mover in automobile sector, agriculture sector and also used in power generators due to the higher thermal efficiency. The disadvantage of three-way catalytic converter is inactivity in lean fuel mixture combustion than stoichiometric combustion engines. The different after treatment systems for reducing tailpipe NO_x emissions are selective catalytic reduction (Urine-SCR), diesel exhaust catalyst, exhaust gas recirculation technique, LNT which have the most promising systems to reduce more than 90% of diesel engine-out NO_x emissions. However, The SCR systems have cost benefit over other technique [1].

This SCR technology act as a catalytic reduction of NO_x with ammonia (NH₃), urea, mono methylamine, etc. The principle of SCR is the injection of aqueous solution of urea in the exhaust pipe of engine. The urea solution was act as a reluctant agent. In early period, ammonia was used as reduction agent. However, the ammonia sleep is hazardous to human being [2].

Praveena Vedagiri et al [15] investigated the combine effect of SCR and nano emulsion fuel to reduce the NO_x. They reported that NO_x was reduced up to 80%. B. Jothi Thirumal et al [16] developed the low cost catalyst for SCR and also used the cerium oxide nanoparticles to reduce the NO_x. They obtained 60% reduction in NO_x.

II- NITROGEN OXIDE REDUCTION TECHNIQUES

This section reviews the various techniques for NO_x reduction available in previous studies.

The following are the NO_x reduction techniques.

2.1 Water Injection at inlet manifold

In early period, water injection in manifold of diesel engine was used to reduce the pollutants. Water lowers the combustion temperature by utilizing the heat of combustion to evaporate. And reduces the oxide of nitrogen emission.

2.2 Urea Injection Techniques

The urea injection technology helps to reduce oxide of nitrogen. This technique reduces the pollutants after combustions. The oxidation catalyst and selective catalytic reduction technology with urea solution were system used in many vehicles to reduce emissions. A urea solution injection system was useds dosing pump that is combined with an electronic control unit. Nearly, 60-70% reduction was possible.[3-8]

III - FUEL MODIFICATION TECHNIQUES

Recently, water emulsion and various additives of NOx reduction ability was successfully used in diesel engine. The additives are metal oxide, carbon based materials and biocompatible additives. The additives have the ability to absorb the oxygen during combustion and donate during combustion hence controlling the combustion process.[8-10]. The alumina is most promising with water as a additives in fuel. The nano particles of cerium oxide, zinc oxide, geophone and graphite oxides are also useful to control various additives [17-20].

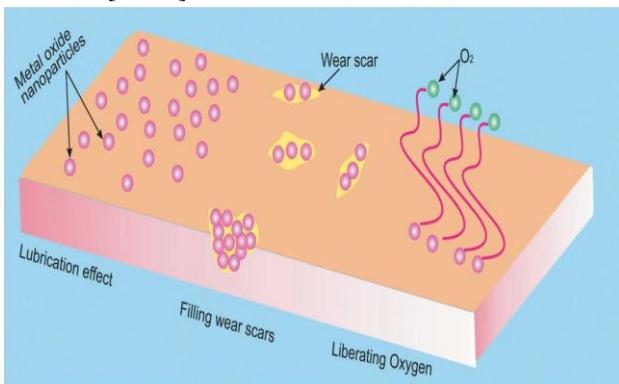


Figure 1: Mechanism of nano particles in combustion [21]

IV - EXHAUST GAS RECIRCULATION

Exhaust gas recirculation were reduced the oxide of nitrogen due to lower combustion temperature in cylinder. In this method, 10-40% exhaust gas was recirculated to inlet manifold [9-14].

V – CONCLUSIONS

From the review it can be concluded that

- Selective catalytic reduction with injection of urea and other fluid can be explored.
- Simultaneously CO also gets decreases.

- With the use of New SCR the most harmful (Hazardous) gases are minimized and Pollution can be controlled greatly. The vehicle performance will be enhanced.
- By using New SCR system in Diesel engine emission are nearer to the BS VI emission norms.

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