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Urea Injection System a Nox Reducer – A Review

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Abstract: *Increased usage of diesel vehicles and equipments are big challenges in terms of pollution and depleting diesel fuel recourses. Significant improvements in diesel emission levels have been achieved in the last 20 years. Development of diesel engine to meet new emission regulations and adopt renewable fuels is a challenging research objective. Automobile industries worldwide are continuing efforts to control emission associated issues both on road and off road diesel vehicles with developed technology for cleaner diesel fuels, quick responding electronic control units, advanced engine design and effective after treatment of exhaust. Some of the NOx control techniques are discussed in this paper.*

Keypoints: *Diesel engine, NOx, Urea Solution.*

I. Introduction

Commercial deployment of urea-SCR systems depended on the development of not only the catalyst, but also the urea dosing and injection system. The increase in NOx conversion efficiency of SCR systems that has been seen since the launch of SCR technology on diesel engines around is largely owed to advances in SCR control and urea injection. The main functions of the urea dosing and injection system include:

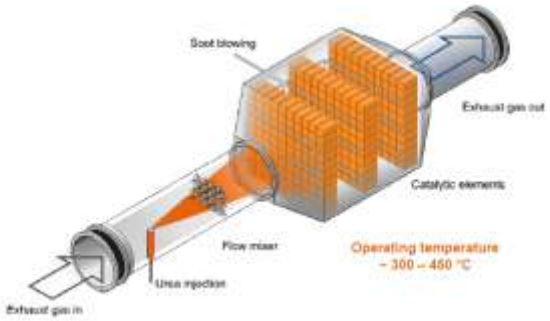
- Dosing of the precise amount of urea necessary for the SCR reactions with NOx, and
- Mixing urea and ammonia thoroughly with the exhaust gas.

The amount of injected urea must match the ammonia demand corresponding to the amount of NOx entering the catalyst and the NOx conversion efficiency at given operating conditions (catalyst temperature and space velocity). If the amount of ammonia is insufficient, a fraction of NOx that otherwise could be reduced will remain unconverted, resulting in a NOx conversion penalty. If the amount of injected ammonia is more than can be consumed in the SCR reactions, it will cause an unacceptably high ammonia slip. In systems that include an ammonia slip catalyst, some of the ammonia may be oxidized back to NO, thus decreasing the effective NOx conversion.

Literature review:

K. Chithambaramasari conclude that that urea injection in the exhaust gives a reduction of about 82% of NOx. Thus this method was found to be an effective method for controlling NOx from Diesel Engines.[1] Also S.Ghosh said that Injection of aqueous solutions of urea in the tail pipe of a diesel engine fuelled with Pongamia pinata methyl ester (PPME) for the reduction of oxides of nitrogen (NOx) was carried out in a four stroke, single cylinder, water cooled, constant speed diesel engine.[2] Robert H. Hammerle show that ∼99% NO*x* conversion was obtained as low as 150 ◦C but above 350 ◦C, the conversion became negative because of the additional formation of NO and NO2 from the oxidation of nitrogen-containing compounds. He also found that NO*x* conversion activity of 2% Pt-SG is strongly dependent on water content rather than on urea amount and the presence of 7% oxygen in the feed lowers the maximum NO*x* conversion temperature from 250 to 150 ◦C.[3] Ioannis Gekas shows that it is possible to have a NOx conversion above 80% with ammonia slip below 10 ppm using 30 liters of 130 cpsi catalysts for a 12 diesel engine. By increasing the cell density to 300 cpsi it is possible to reduce the catalyst volume by 2/3 down to 20 liters for the same engine.[4] Gurumoorthy S Hebbar said that development of diesel engine to meet new emission regulations and adopt renewable fuels is a challenging research objective. Automobile industries worldwide are continuing efforts to control emission associated issues both on road and off road diesel vehicles with developed technology for cleaner diesel fuels, quick responding electronic control units, advanced engine design and effective after treatment of exhaust. Some of the NOx control techniques.[5]

2. WORKING PRINCIPLE



II. Control Of No

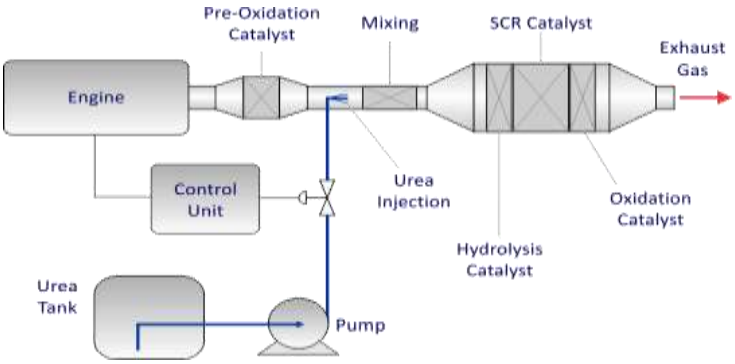
There are many techniques being tried to control Nox emission from diesel engine. The following methods
may be employed either as a single technique or as a combination.

- Modification of engine operations
- Changes in the engine design
- Modification of fuels
- After treatment of exhaust gases

After Treatment of Exhaust Gas by Injecting Urea Solution

In the after treatment method, Urea solution is sprayed in the exhaust stream which is at a temperature of 300°C to 450°C. At this high temperature of exhaust gas, the urea starts to decompose and form ammonia. The ammonia acts as reduction against and converts the oxides of Nitrogen (NO and NO2) into free Nitrogen (N2) and water vapour (H2O). The following are the chemical reaction taken place.

III. Experimental Setup



Diesel Engine – It is the main part of our project , on which we are applying Uria Injection technique . Diesel emissions include also pollutants that can have adverse health and/or environmental effects. Most of these pollutants originate from various non-ideal processes during combustion, such as incomplete combustion of fuel, reactions between mixture components under high temperature and pressure, combustion of engine lubricating oil and oil additives as well as combustion of non-hydrocarbon components of diesel fuel, such as sulfur compounds and fuel additives. Common pollutants include unburned hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NOx) or particulate matter (PM).

Uria Tank – It is a reservoir , in which the mixture or urea and water is stored . urea solution should be prepared for different concentration varying from 5% to 50% by weight in the order of 5%. By adjusting the 3 way control valve and selecting the needle the flow rate of urea solution should be fixed and maintained constant for a set of experiment.

Control Unit –The Urea Metering Module is a high-accuracy unit for injecting urea into the exhaust aftertreatment system. A control module calculates the exact dosing rate of urea based on various engine

conditions, and the urea mixes with air from the vehicle compressed air system. Atomized urea is then sent through the Injection Nozzle into the exhaust system, upstream of the SCR catalyst.

Uria Pumping Unit – The pumping unit supplies urea solution to multiple dosing units .In large multiple engine installations it is possible to simply increase the number of pumps in order to deliver the desired amount of urea . All piping is made of stainless steel . Preferably accommodated close to the urea tank

Injection Nozzle -The Injection Nozzle is a robust component that delivers atomized urea and air mixture upstream of the SCR catalyst. The design allows injection in the center of the exhaust gas flow, which minimizes the risk of deposits. A relatively large orifice sizing in the nozzle also provides exceptional tolerance to contaminants.

Scr Catalyst- Selective catalytic reduction (SCR) is an after treatment process. A SCR system attempts to reduce oxides of nitrogen (NOx) back to harmless nitrogen and elemental oxygen that are constituents of air. It permits the NOx reduction reaction to take place in an oxidizing atmosphere. It is called "selective" because the catalytic reduction of NOx with ammonia (NH3) or urea as a reductant occurs preferentially to the oxidation of NH3 or urea with oxygen.

IV. Conclusion

From the investigations it may be Concluded that urea injection in the exhaust gives a reduction of about 82% of NOx. The amount of N_2O produced during NOx reduction in the presence of oxygen and water and urea is strongly dependent on the tempereature and the concentration of water in the feed. Thus this method was found to be an effective method for controlling NOx from Diesel Engines.

References

1) Reduction Of Nox In D.I. Diesel Engine Emission By Urea Injection K. Chithambaramasari,* N. V. Mahalakshmi** & K. Jayachandran***
2) Nox Reduction By Using Urea Injection And Marine Ferromanganese Nodule As Scr Of A Diesel Engine Fulled With Pongamia Pinnata Methyl Ester S.Ghosh, S.N. Chaudhuri, D. Dutta
3) Nox Reduction By Urea Under Lean Conditions Over Single Step Sol–Gel Pt/Alumina Catalyst Erol Seker , Nail Yasyerli , Erdogan Gulari ,∗, Christine Lambert , Robert H. Hammerle
4) Urea-SCR Catalyst System Selection for Fuel and PM Optimized Engines and a Demonstration of a Novel Urea Injection System Ioannis Gekas, Pär Gabrielsson and Keld Johansen
5) Nox From Diesel Engine Emission And Control Strategies—A Review, Gurumoorthy S Hebbar