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RESEARCH ARTICLE

A REVIEW ON EMISSION NORMS AND ITS CONTROL ACTIONS

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ABSTRACT

Hydrogen have the potential that can replace fossil fuels which is the primary source of environmental pollution. Hydrogen should be stored in high pressure reservoirs for any practical purpose. In this work hydrogen leak from a high pressure vessel by means of a 2mm tube length and 4.8mm diameter of pipe in atmospheric air is simulated using FLUENT 13. A strong shock wave is formed during the flow of high pressure hydrogen in a tube filled with atmospheric air which leads to heating of hydrogen behind the shock wave. This is mainly because of compression effect and which leads to an auto ignition. The simulated results are not in agreement with the results obtained by Yamada Eisuke *et al*. (2010).

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INTRODUCTION

India is the fourth highest emitter of carbon dioxide in the world, accounting for 7 per cent of global emissions in 2017.India's emissions look set to continue their strong growth by an average of 6.3 per cent in 2018, with growth across all fuels-coal (7.1 per cent), oil (2.9 per cent) and gas (6.0 per cent).Delhi ranks first in the most Air polluted city on the global level and it is true that Delhi has very high rate of AIRPOLLUTION. Emissionisg as existing to the atmosphere via a flue. Exhaust gas, flue gas generated by fuel. The pollution in our country majorly in states like Delhi, Maharashtra is caused due to cars. Indian vehicles, per trip, produce 4 to 8 times more pollutants and consume more carbon foot prints, then free flowing cars. Due to this 50%of people are suffering from asthma and other respiratory disorders. This leads to the acid rain which can cause skin diseases and in recent the marble of the great monument TAJ MAHAL is getting black spots because of the acid rain. If these emissions are not controlled then definitely it will affect to the human life very dangerously.

Bharat Stagenorms: These are the emission standard instituted by the government of India to regulate the output that is cause by the internal combustion engine, including the motor vehicle.

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The Indian stage norms are completely based on the European norms which were introduced in 2000 in INDIA. Progressively more stringent norms have been rolled out since then. All new vehicles manufactured after this implementation of the norms have to be compliant with the regulation.

ERUO NORMS

Euro 1

July 1992 (January 1993)

Applies to all new cars registered from 1 January 1993.

Benefits: The Euro 1 standard heralded the introduction of catalytic converters and unleaded petrol for all cars.

Euro 1 Emission Limits

- **CO** – 2.72 g/km (petrol and diesel)
- **HC+ NOx** – 0.97 g/km (petrol and diesel)
- **PM** – 0.14 g/km (diesel only)

Euro 2

January 1996 (January 1997): Applies to all new cars registered from 1 January 1997.

STANDARD	REFERENCE	YEAR
BHARATH STAGE 1	ERUO 1	2000
BHARATH STAGE 2	ERUO 2	2005
BHARATH STAGE 3	ERUO 3	2010
BHARATH STAGE 4	ERUO 4	2017
BHARATH STAGE 5	ERUO 5	SKIPPED
BHARATH STAGE 6	ERUO 6	2020

Benefits: Euro 2 standards introduced different emissions limits for petrol and diesel engines and reduced the acceptable levels of all four major emissions across the board.

Euro 2 emission limits (petrol)

- **CO** – 2.2 g/km
- **HC+ NOx** – 0.5 g/km
- **PM** – no limit

Euro 2 emission limits (diesel)

- **CO** – 1.0 g/km
- **HC+ NOx** – 0.7 g/km
- **PM** – 0.08 g/km

Euro 3

January 2000 (January 2001)

Applies to all new cars registered from 1 January 2001.

Benefits: Introduced separate limits for hydrocarbons and nitrogen oxide emissions for petrol engines, and a separate nitrogen oxide limit for diesel engines.

Euro 3 emission limits (petrol)

- **CO** – 2.3 g/km
- **HC** – 0.20 g/km
- **NOx** - 0.15
- **PM** – no limit

Euro 3 emission limits (diesel)

- **CO** – 0.64 g/km
- **HC+ NOx** – 0.56 g/km
- **NOx** – 0.50 g/km
- **PM** – 0.05 g/km

Euro 4

January 2005 (January 2006)

Applies to all new cars registered from 1 January 2006

Benefits: Significant reduction in the permissible limits for particulates and nitrogen oxides in diesel engines. Some new diesel-engined cars gained diesel particulate filters (DPFs) that trap 99% of particulates.

Euro 4 emission limits (petrol)

- **CO** – 1.0 g/km
- **HC** – 0.10 g/km
- **NOx** – 0.08
- **PM** – no limit

Euro 4 emission limits (diesel)

- **CO** – 0.50 g/km
- **HC+ NOx** – 0.30 g/km
- **NOx** – 0.25 g/km
- **PM** – 0.025 g/km

Euro 5

September 2009 (January 2011)

Applies to all new cars registered from 1 January 2011

Benefits: Heralded the introduction of diesel particulate filters (DPFs) for all diesel cars. A particulates limit was also introduced for direct-injection petrol engines. An additional limit on the number of particles emitted by diesel engines was also introduced for cars registered from 1 January 2013.

Euro 5 emission limits (petrol)

- **CO** – 1.0 g/km
- **HC** - 0.10 g/km
- **NOx** – 0.06 g/km
- **PM** – 0.005 g/km (direct injection only)

Euro 5 emission limits (diesel)

- **CO** – 0.50 g/km
- **HC+ NOx** – 0.23 g/km
- **NOx** – 0.18 g/km
- **PM** – 0.005 g/km
- **PM** – 6.0x10 ^11/km

Euro 6

September 2014 (September 2015)

Applies to all new cars registered from 1 September 2015.

Benefits: A 67% reduction in the permissible levels of nitrogen oxides in diesels and the introduction of a particle number limit for petrols.

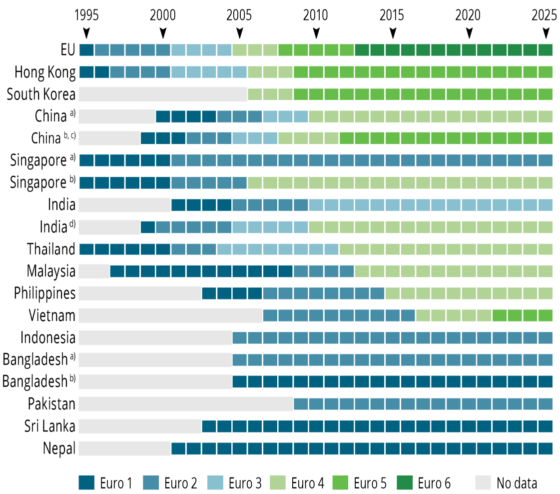
Car makers are using two methods to meet these strict diesel limits. The first is selective catalytic reduction, which involves a liquid that converts nitrogen oxide into water and nitrogen being squirted into the car's exhaust. Alternatively, an exhaust gas recirculation system is fitted, which replaces some of the exhaust gas with intake air to reduce the amount of nitrogen that can be turned into NOx.

Euro 6 emission limits (petrol)

- **CO** – 1.0 g/km
- **HC** – 0.10 g/km
- **NOx** – 0.06 g/km
- **PM** – 0.005 g/km (direct injection only)
- **PM** – 6.0x10 ^11/km (direct injection only)

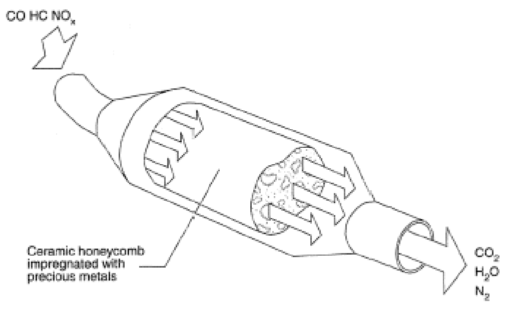
Euro 6 emission limits (diesel)

- **CO** – 0.50 g/km
- **HC+NOx** –0.17g/km
- **NOx** – 0.08 g/km
- **PM** – 0.005 g/km
- **PM** – 6.0x10 ^11/km



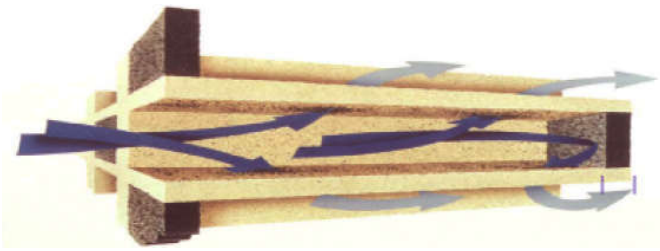
Exhaust emission from internal combustion

Three way catalysts: Three way Catalysts are the main auto catalyst technology used to control emissions from gasoline engines. The catalyst uses a ceramic or metallic substrate with an active coating incorporating alumina, ceria and other oxides Three-way catalysts operate in a closed-loop system including a lambda or oxygen sensor to regulate the air-to-fuel ratio on gasoline engines. The catalyst can then simultaneously oxidize CO and HC to CO2 and water while reducing NOx to nitrogen.



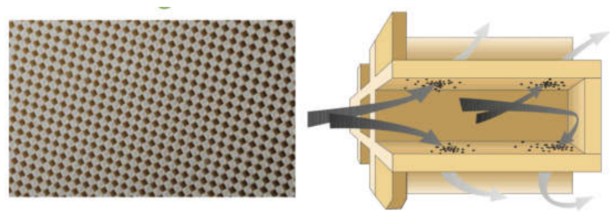
Control Technologies For Particulate Matter

Diesel particulate filter: Diesel Particulate Filters (DPFs) have been applied to production vehicles since 2000 and have become standard equipment on all new diesel cars in Europe since the introduction of the Euro 5 norm. In wall-flow filters, particulate matter is removed from the exhaust by physical filtration using a honeycomb structure similar to a catalyst substrate but with the channels blocked at alternate ends. The exhaust gas is thus forced to flow through the walls between the channels and the particulate matter is deposited as a soot cake on the walls. Such filters are made of ceramic, silicon carbide or aluminium titanate honeycomb materials.



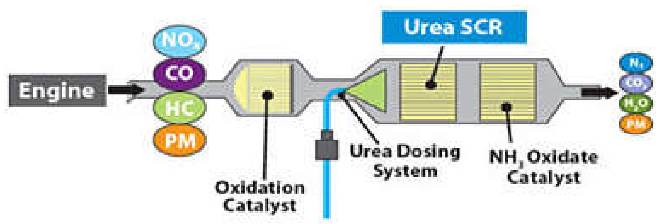
Diesel particulate filter

Gasoline particulte matter: Gasoline particulate filters (GPF) are an emission after treatment technology based on diesel particulate filters (DPF), developed to control particulate emissions from gasoline direct injection (GDI) engines. The filters utilize wall-flow substrates first developed for diesel particulate filters. The GPF regenerates passively, but an active regeneration assist is needed to prevent filter plugging during low temperature duty cycles. Ash has an impact on GPF performance and—if the GPF is coated with a three-way catalyst—can be a source of catalyst poisoning.



Gasoline particulte matter

Nox Control Technologies: Selective Catalyst Reduction is an exhaust after treatment emission control system used to clean oxides of nitrogen (N0x) in the in the exhaust The efficiency of SCR for NOx reduction also offers a benefit for fuel consumption.

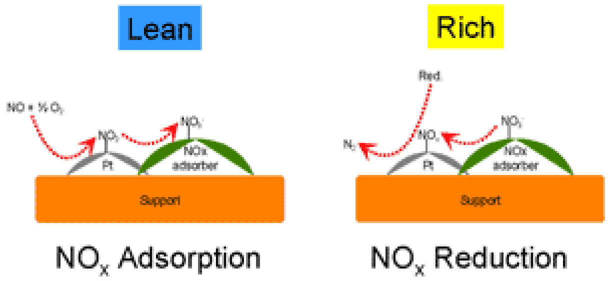


Selective catalysts reduction system

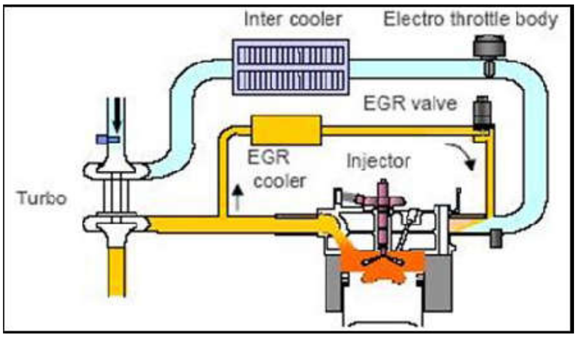
It allows diesel engine developers to take advantage of the trade-off between NOx, PM and fuel consumption and calibrate the engine in a lower area of fuel consumption than if they had to reduce NOx by engine measures alone. Particulate emissions are also lowered and SCR catalytic converters can be used alone or in combination with a particulate filter.

Once the exhaust system is warm enough, SCR provides high levels of NOx reduction, when appropriate amounts of ammonia reductant are injected into the exhaust stream.

Nox adsorber (or) lean nox traps: Lean NOx traps adsorb and store NOx under lean conditions. The function of the NOx storage element is fulfilled by materials that are able to form sufficiently stable nitrates within the temperature range determined by lean operating engine points. When this storage media reaches its capacity, it must be regenerated. This is accomplished in a NOx regeneration step. In such a regeneration, the stored NOx is released by creating a rich atmosphere. The rich running portion is of very short duration. The released NOx is quickly reduced to N2 by reaction with CO on a precious metal that is incorporated into this unique single catalyst architecture.



NO xadsorber system



Exhaust Gas Recirculation System

Exhaust gas recirculation system: The device used to recirculate the unburnt fuel which pass out in the exhaust and again mixes less than 10% of unburnt fuel in the intake manifold. The main aim of the EGR system is to reduce NOx production.

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