

Pollution Control in S.I. Engine Using Nano-Technology for Green and Clean Environment

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Abstract: Automobile plays a critical role in contribution to the pollutants. Pollution is predominately emitted thru the exhaust of motorized cars and additionally the combustion of fossil fuels. Pollution management is the important for future era to regulate cytotoxic emissions like CO, NO_x and HC. There are tactics of manage of pollutants particularly, pre-pollution manipulate and post pollution manage. This studies work is primarily based totally on the submit pollutants control technique the use of nano-particle as a catalyst. An assessment on nano-particle exposed that the ratio of surface region of nano-particle to the quantity of the nano-particle is inversely proportional to the radius of the nano-particle. Copper turned into thought of for this evaluation work due to the fact it's far less expensive than platinum, palladium and rhodium. This paper opens an access to study the modifications inside the attention of exhaust emissions due to the nano-fabric coating.

Keywords: Automobile, Catalytic converter, Nano-particles, Pollution, Spark-ignition engine.

I. INTRODUCTION

One of the intense issues facing the globe is that the forceful increase in environmental pollution by burning engines. All transport vehicles; each SI (Spark Ignition) and CI (Compression Ignition) area unit equally answerable for emitting completely different reasonably pollutants [1]. Some of the number one kinds having direct hazardous consequences such as, carbon mono oxide, hydrocarbons, nitrogen oxides, and so on. Other the secondary pollutants which go through a series of reactions within the ecosystem and come to be unsafe to health [12]. The emissions exhausted into the surroundings to pollute the ecosystem and cause global warming, acid rain, smog, odours breathing and distinctive health dangers. A pollutant is a phenomenon which modifications the stability of the environment and nature under normal condition [3]. Carbon-dioxide is not considered as a pollutant in nature recycles. If CO₂ exceeds 5000ppm, then it becomes a fitness threat. In addition to air pollutants, there may be additionally water pollutants

because of different factors, which incorporates waste disposal, oil spills, and leakage of fertilizers, herbicides and insecticides, by-products of industrial approaches and combustion and extraction of fossil fuels. Contaminants are normally found combined in the air, water and soil. Thus, we need awareness our studies and improvement efforts increasingly to screen, detect and, if possible, take away the contaminants from the air, water and soil. In this context, nanotechnology gives a huge range of skills and technologies to improve the best of current surroundings. It is also beneficial in enhancing the overall performance of conventional technologies used in cleanup manner.

Because of their small size, nano-particles have very high surface area compared with their bulk equivalent. Thus nano-particles are being explored as a way to remove or break toxic substances from the environment. Nano-particles are extra reactive and react to a more volume due to their small size [5]. Nano-particles have greater surface to be had for chemical interactions. Nano-particles can also showcase higher chemical reactivity because of unusual crystal shapes and lattice order.

A. Environmental Impacts of Vehicle Emissions

1. Hydrocarbons [5] (HC):

An elegance of burned or partly burned gas, hydrocarbons are toxins. These pollutants react with nitrogen oxides inside the presence of daylight to form ground stage ozone, a number one ingredient in smog. Though beneficial within the upper environment, at the ground level this fuel irritates the breathing device, inflicting coughing, choking, and decreased lung capability.

2. Nitrogen Oxides [5] (NO_x):

As a result of the high temperatures occurring throughout combustion, nitrogen combines with oxygen from the air forming oxides of nitrogen (NO, NO₂, N₂O and so etc.). These gases are recognized to be accountable for acid deposition thru the formation of nitric acid. Nitrogen dioxide (NO₂) is toxic even in small concentrations and is understood to cause and

aggravate human respiration sicknesses. Nitrous oxide (N_2O) additionally contributes without delay to worldwide warming and is answerable for around 7% of the enhanced greenhouse effect.

3. Carbon Monoxide [5] (CO):

Produced all through the unfinished combustion of carbon compounds together with fossil fuels, this gasoline is known to be deleterious to human fitness. During breathing it comfortably combines with haemoglobin within the blood as a result hindering the frame's potential to take up oxygen. It is concept therefore to worsen respiratory and coronary heart sickness.

Air pollution can be re-mediated using nanotechnology in numerous methods. One is through the usage of nano-catalysts with multiplied surface region for gaseous reactions. Catalysts work by speeding up chemical reactions that transform harmful vapours from cars and industrial plants into harmless gases. Catalysts currently in use include a nanofiber catalyst made of manganese oxide that removes volatile organic compounds from industrial smokestacks. Other methods are still in development.

II. METHOD OF POLLUTION MANAGEMENT

The two methods for pollution control from the tail pipe of C.I. Engines are the pre-pollution and post pollution control methods [6].

Pre Pollution management technique means that emission of engine will reduce before the combustion process. A different methods are listed below:

- Air fuel ratio
- Fuel Additives
- Fuel characteristic
- Special Combustion Chamber Design
- EGR system
- Fuel Injector Design

Post Pollution control method mean an emission of engine will reduce after the combustion process.

- Catalytic converter [7]
- Exhaust manifold reactor
- After burner

III. CATALYTIC CONVERTER

Catalytic converter has long past via many tactics and brilliant evolution for the past 30 years. It is stated to be one of the best devices to fight in opposition to the overpowering pollutant contents in our surroundings, as it reduces nearly 80% of the harmful gases as a consequence of the incomplete combustion of the engine. Catalytic converter is a stainless-steel field established somewhere alongside the exhaust pipe of the engine and in the container is a porous ceramic structure via which the exhaust gasoline flows [8]. In maximum converters, the ceramic is an unmarried honeycomb structure with many float passages. The passages contain of many shapes, inclusive of rectangular, triangular, hexagonal and sinusoidal. Early converters used loose

granular ceramic with the gasoline passing among the packed spheres. Since its miles tough to preserve the spheres in region, many converter developers opted for ceramic monolith which gives numerous advantages. Among these advantages are smaller volumes, decrease mass and greater ease of packaging [9].

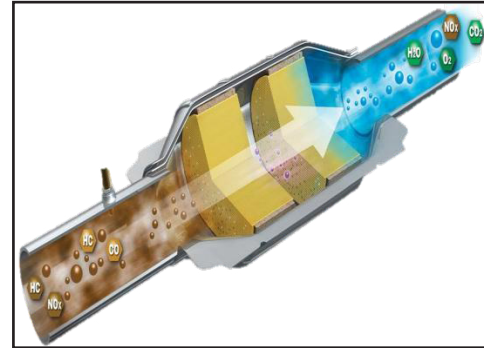


Fig. 1: Workflow of Two Way Catalytic Converter

IV. TYPE OF CATALYTIC CONVERTER

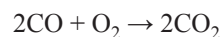
Catalytic Converters are important post-combustion after treatment devices mounted in the exhaust system of engines to reduce engine out exhaust emissions and are classified as:

A. Oxidation Converter / 2-Way Catalytic Converter

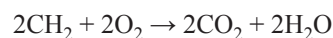
This kind is also known as a two-way catalytic converter, due to the fact it is able to simplest perform with hydrocarbons and carbon monoxide. The oxidation catalyst converts carbon monoxide and hydrocarbon to CO_2 and H_2O at drastically low temperatures and at higher conversion performance than the thermal reactors. The required oxygen for oxidation reactions is made available both through running engine lean and by means of injecting secondary air beforehand of the catalytic converter when engine is operated rich. Vehicles employing the oxidation catalysts have been normally tuned rich for better NO_x manipulate and secondary air injection turned into hired.

A Two-way [or “oxidation”] catalytic converter has two simultaneous tasks [11]:-

Oxidation of carbon monoxide to carbon dioxide [12]



Oxidation of hydrocarbons (unburnt and partially burnt fuel) to carbon dioxide and water [12]



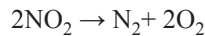
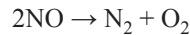
B. Reduction Converter / 3-Way Catalytic Converter

In the present day reduction catalytic converter, unburned fuel residues are oxidized with oxygen to produce CO_2 and H_2O , NO_x are converted to ubiquitous nitrogen, and toxic CO is oxidized with oxygen to carbon dioxide. NO_x emissions are produced in the engine combustion chamber when it reaches extremely high temperatures more than 2,500 degrees

Fahrenheit, approximately [11].

Level one – Reduction Catalyst

The subsequent reactions happen once the exhaust gases jump over the reduction catalyst.



Level two – Oxidation Catalyst

The following reactions happen once the exhaust gases jump over the chemical reaction catalyst:

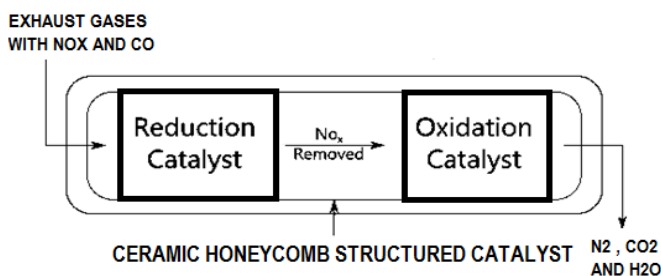
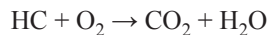
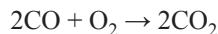


Fig. 2: Block Diagram of 3-Way Catalytic Converter

V. CATALYTIC CONVERTERS WITH NANO-PARTICAL COATING

Nanotechnology offers nice potential in providing innovative approach towards reducing the pollution in air, water and land. It's conjointly useful in rising the performance of usual technologies hired in cleanup technique. Metal nano particles, specially the highly-priced metals together with gold, platinum and palladium are an increasing number of getting used as catalysts in diverse commercial and environmental applications. The price at which the automobile industry is hampering the surrounding makes the software of nano-generation obligatory to avoid similarly damage. Malfunction of the engine structures like the gas injection machine reasons an increase within the exhaust emissions. The exhaust emissions from the automobiles encompass gases like Carbon dioxide, Nitrogen oxide, Carbon monoxide, unburnt hydrocarbons and lead. A complete assessment on the application of nanotechnology in car pollution prevention become explained. Initially, the important aspects of ecological pollution problems due to automobile industry were discussed and then the application of nanotechnology towards the prevention and control of these problems were presented [14].

During the conversion of toxic to non-toxic gases nanotechnologies play a crucial role. The effect of catalysts normally relies upon on the size of the surface. If the fabric used for the catalytic characteristic is scaled to the nanometre range, the precise surface will increase significantly. The composition and shape are chosen such that exhaust gases have interaction

optimally with the catalytically active coating, and their chemical transformation into innocent materials is expanded. The catalyst will increase the speed of reaction by sorption of reactants in such a kind that the energy of activation for reaction is reduced way below its worth in unanalyzed reaction. Copper became taken into consideration for this research work as it is less expensive than platinum, palladium and rhodium. Catalytic converters with a spray of copper nano-particle on copper sieve lead to a lot better performance of vehicles and reduced pollution in atmosphere [5].

Why nano copper [14]

- The use of platinum, palladium and rhodium are very steeply-priced due to shortage of these metals.
- Copper is low value catalyst composition and has superior sturdiness than platinum and palladium.
- Rhodium and palladium is the huge individuals to smog.
- The emission will be reduced due to increased surface area for catalysis.
- Better poison resistance and suitable reactor design for low pressure drops and improved performance.

VI. RESULT AND CONCLUSION

This analysis paper focuses on the utility of the nano-particles within the space of automobile pollution management. The change of particle size from micro to nano causes vital change in the material properties. Nowadays coating of nano-debris on the catalytic converter of automobiles will assist in decrease the level of exhaust emission attention and thereby, reduce the pollution stage in environment. An evaluation on nano-particle uncovered that the ratio of surface area of nano-particle to the volume of the nano-particle is reciprocally proportional to the radius of the nano-particle. Therefore, when decrease of the radius of the nano-particle, this magnitude relation can increase resulting in Associate in nursing hyperbolic rate of reaction and also the concentration of the pollutants is decrease.

Copper metal was designated for the analysis work because it is cheaper than platinum, palladium and rhodium conjointly it adsorbs the reactants molecule powerfully enough to hold and active the reactants but not so strongly that the product can't breakaway also the diffusion of reactants and products into and out of the pore structure of copper took place efficiently. Due to this, the pollution level for the exhaust emission of S.I. engine was found to be reduced.

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