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Turbo Diesel Engine Exhaust: Advancement at the cost of health –A Review

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Abstract

Technology and advancement are two sides of the same coin, with one comes the other into play. We are living in advanced world leading to development, progressing at a higher pace and with this advancement, we have invited problems for ourselves .With the enhancement in lifestyle, living standard leads to population explosion which consequently leads to increase in number of transportation vehicles. Increase in transportation vehicles are sign of development but on the other hand this rapid increase also leads to problems like pollution, traffic, exploitation of resources. These vehicles include cars, buses, ships, bikes, trains etc. All of these transportation vehicles derive their power from engines. As of the transforming technologies, the engines have also been updated but till now there is no engine which has 100% efficiency. According to thermodynamics any system should give an output as corresponding to the given input. But due to the lack of efficiency the output is as "power with exhaust". The exhaust is the prominent problem which contributes to pollution. The engines used in cars are internal combustion engine or IC engines. The main pollutant of IC engines are CO, NO_x (derivatives of Nitrogen Oxide), partially burned hydro-carbons (HC), particulate matter etc. These pollutants affect our body both directly and indirectly. The problems like Green House Effect and Global Warming are also into play because of the effects of exhaust pollution.

Keywords- *Transportation Vehicle, Engines, Exhaust, Pollution, Pollutant etc.*

Introduction

The impact of internal combustion engines, Otto, and diesel engines on the environment and our lifestyles has been considerable. In Europe, research and development work on these engines within the last two to three decades has been strictly focusing on engine performance in terms of power output, fuel economy and reliability but not on engine emissions. During recent decades, pronounced interest has focused on exhaust emissions and their impact on health and the environment **[1,4]**. Due to the rapid increase in the number of vehicles in use, especially in urban

areas, engine emissions have become suspected culprits for some of the health effects observed in urban populations **[5]**. Undesirable emissions in internal combustion engines are of major concern because of their negative impact on air quality, human health, and global warming. Gasoline and diesel fuels are mixtures of hydrocarbons, compounds which contain hydrogen and carbon atoms. In a "perfect" engine, oxygen in the air would convert all the hydrogen in the fuel to water and all the carbon in the fuel to carbon dioxide. Nitrogen in the air would remain unaffected. In reality, the combustion process cannot be "perfect," and automotive engines emit several types of pollutants **[6]**. Most of the interest in emissions has been focused on passenger cars and other light-duty vehicles, because these categories of vehicles exist in much greater numbers than the heavy duty vehicles. Vehicle emissions are usually divided into categories of regulated and unregulated pollutants. Regulated pollutants consist of carbon monoxide (CO), nitrogen oxides (NO, mainly nitrogen monoxide and nitrogen dioxide), unburned fuel, or partly oxidized hydrocarbons (HC), and particulates. These pollutants are specified by law in most of the industrially advanced countries. Unregulated pollutants are defined as compounds that are not specified by law. However, these unregulated pollutants may well belong to the group of unburned hydrocarbons, but not as individual compounds **[7]**. Diesel exhaust is a complex mixture of combustion products of diesel fuel; the exact composition of the mixture depends on the nature of the engine, operating conditions, lubricating oil, additives, emission control system, and fuel composition **[8, 9]**.Diesel engines typically are classified by their service requirements, and the operating conditions for light- and heavy-duty diesel engines differ with respect to engine speed, expected load, fuel composition, and engine emission controls. Light-duty vehicles, such as automobiles and light trucks, typically operate at higher speeds than do heavy-duty vehicles, such as trucks. Depending on operating conditions, fuel composition, and engine-control technology, light- and heavy-duty diesel engines, respectively, can emit 50 to 80 times and 100 to 200 times as much particulate mass as typical catalyst-equipped gasoline engines **[10]**.

Sources of exhaust pollution

AUTOMOBILE DIESEL ENGINES: Diesel engines have been used in heavy duty applications for a very long time now; it is only recently that it has become very popular in light duty application due to their higher fuel efficiency. Higher fuel efficiency in the diesel engines is achieved due to the high compression ratios along with high oxygen concentration in the combustion chamber. However, these same factors results in high NOx emission in diesel engine. The main pollutants of diesel engines are NOx and particulate matter (PM). The mechanism of formation of Nitrogen oxides and particulate matter inside the combustion chamber of diesel engines are contradictory and the simultaneous reduction of both at the same time is very difficult **[11]**. Diesel emissions consist of a non polar fraction (57%), a moderately polar fraction (9%), and a polar

fraction (32%) **[12, 13]**. The inorganic fraction of the particulate emissions consists primarily of small elemental carbon particles, ranging from 0.01 to 0.08 μm in diameter. Organic and elemental carbon account for approximately 80% of the total particulate matter mass. The remaining 20% is composed of sulfate (mainly sulfuric acid) and some inorganic additives and components of fuel and motor oil. In general, the organic compounds identified in diesel exhaust emissions contain hydrocarbons, such as alkanes and alkenes, hydrocarbon derivatives, aldehydes, polyaromatic hydrocarbons (PAHs), PAH derivatives, multifunctional derivatives of PAHs, heterocyclic compounds, heterocyclic derivatives, and multifunctional derivatives of heterocyclic compounds**[14,15]**.

SHIP DIESEL ENGINES: The motivation for this research stems from the maritime community's interest in reducing air pollution from ships, specifically from diesel engines on board ships, sparked by regulatory activities of the U.S. Environmental Protection Agency (U.S. EPA), the California Air Resources Board (CARB), and the International Maritime Organization's (IMO) development of MARPOL Annex VI - "The Prevention of Air Pollution from Ships". The problem of estimating and controlling air pollution from ocean-going ships carrying international cargo is particularly complex **[16]**.Recent studies show that ship emissions represent more than 14 percent of nitrogen emissions from global fuel combustion sources. The same study also dispelled the notion that ship emissions are always "diluted" away. The current international policy efforts (by IMO) to reduce emissions from ship propulsion systems (NOx and SOx) mark the first efforts to define a policy framework addressing these emissions. Ship emission are significantly larger than previously consider - on the order of domestic nitrogen and sulfur emission inventories from the largest emitting nations. Moreover these emission are not constrained to remote ocean regions or distributed homogeneously; rather ship emission are concatenated along well-defined trade routes between highly populated regions where regional air quality is prime concern**[17]**.

Effects on human health

CARCINOGENICITY:

Exposure to diesel exhaust particulates is reasonably anticipated to be a human carcinogen based on limited evidence of carcinogenicity from studies in humans and supporting evidence from studies in experimental animals and mechanistic studies **[18]**. There is limited evidence for the carcinogenicity of diesel exhaust from studies in humans. Occupational exposure to diesel exhaust particulates was associated with elevated lung-cancer rates in the majority of studies, principally in transportation or construction workers exposed to diesel exhaust **[19, 20, 21]**. The increased risk was not readily explained by confounding from smoking or exposure to asbestos. However, only some studies used quantitative or semi-quantitative assessments of exposure, and many studies used inadequate measures of exposure. Since diesel exhaust particulates were listed in the Ninth Report on Carcinogens, additional

epidemiological studies have been identified. A meta-analysis reported that exposure to diesel exhaust increased the relative risk for lung cancer, and additional cohort and case-control studies reported relative risks in the range of 1.2 to 2.21**[22,33].** Vehicles emit numerous carcinogenic chemicals. Diesel contains benzene, formaldehyde, and 1, 3-butadiene—all three are well recognized carcinogens. EPA estimates that vehicle emissions account for as many as half of all cancers attributed to outdoor air pollution **[34]**.

ASTHMA:

Chemicals in vehicle exhaust are harmful to asthmatics. Exhaust can adversely affect lung function and may promote allergic reactions and airway constriction **[35-39]**.All vehicles, especially diesel engines, emit very fine particles that deeply penetrate lungs and inflame the circulatory system, damaging cells and causing respiratory problems **[40]**.Inhalation of vehicle emissions, even for short periods, may be harmful to asthmatics. One study found that children are 40 percent more likely to have an attack on high outdoor pollution days. Asthmatic children are particularly sensitive to air pollution. They are 40 percent more likely to have an attack on high outdoor pollution days **[41].**Children living near high traffic flows are more likely to have more medical care visits per year and a higher prevalence of most respiratory symptoms **[42-44]**.

CARDIOVASCULAR DISEASE:

Mortality and hospital admissions for myocardial infarction, congestive cardiac failure and cardiac arrhythmia increase with a rise in the concentrations of particulate and gaseous pollutants **[45]**. As concentrations of airborne particles increase, those with cardiovascular disease may experience increasing severity of symptoms, rates of hospitalization, and mortality **[46]**.The risk of having a heart attack is greater for people exposed to pollution from heavy traffic, as well as for those living near air-polluted roadways **[47]**.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE: Chronic obstructive pulmonary disease (COPD) refers to a group of diseases that cause airflow blockage and breathing problems. It includes emphysema, chronic bronchitis, and in some cases, asthma **[48, 49]**.Vehicle emissions are particularly harmful to COPD patients. Significant associations have been found between increased ozone levels and a range of adverse effects on the lungs and several studies have shown an increased risk of hospital admission associated with high levels of ozone **[50, 51]**.

Discussions

As stated in review paper the different ways in which our body is affected by the exhaust effect of pollution. Problems like cancer, asthma, cardiovascular disease, chronic obstructive pulmonary disease etc. The problems are mainly with respiratory system as the process of inhalation is directly in contact with the atmosphere. The problems are due to pollutants CO, NO_x, partially burned hydro-carbons (HC), particulate matter etc. present in the exhaust of engines.Oxides of nitrogen also occur in amounts

that would be dangerous to health, and mixing of these gases is essential in preventing the unhygienic atmospheric conditions **[52]**. The risk of suffering from heart attack is greater for people exposed to heavy traffic and those living near polluted roadways. One of the studies have proven the fact that exposure to traffic has tripled the risk of a heart attack within an hour after **[53, 54]**.Studies reveal that children in communities with higher levels of urban air pollution have decreased lung function growth rates, and children who spend more time outdoors have even larger deficits **[55]**.

Conclusions

The rapid increase in exhaust pollution needs to be looked upon firmly in order to reduce the bad impacts on health of human beings and nature. Technologies like Substrate and Coating, Three-Way Catalysts (TWC), Oxidation Catalysts, Diesel Particulate Filter (DPF) etc. are working in direction to advance new ways to minimize the problem of this exhaust pollution. Green House Effect and global warming are also major topics to think upon, arising due to increase in exhaust pollution through vehicles. Melting of glaciers, floods, tsunamis, hurricanes are few of the effects of global warming. To get control over the problem of exhaust pollution we have to break more stones and seek every hook to cure it. In order to make this world a better place to live in, for you and for me. Lets breathe in a more fresh air, Lets drink clean and fresh water and Lets try to build up an environment that's help us foster our lives and provide our future generations with a clean, green and a healthy atmosphere to cherish.

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