WWJMRD 2019; 5(9): 10-13
www.wwjmrd.com
International Journal
Peer Reviewed Journal
Refereed Journal
Indexed Journal
Impact Factor MJIF: 4.25
E-ISSN: 2454-6615

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Emission from engines: Impacts and solutions

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Abstract
Increasing levels of pollution caused by emissions from internal combustion engines have become a burden for car manufacturers. Hybrid engines have been shown to outperform traditional engines in terms of fuel efficiency and reduced emissions. The internal combustion engine has opened a new era for the development of economy, science and technology of mankind, but it also caused many negative impacts on human health and ecological environment, toxic emissions. During operation, internal combustion engines release substances such as CO, CO2, NOx, HC, Pb, CFC and sulfur compounds. Currently, not only our country but the world has banned the use of leaded gasoline (Pb) - an additive to increase the octane index with high toxicity. In addition to direct pollution, these wastes, when released into the air, will be analyzed or synthesized to create different compounds that can cause cancer to humans and change the ecological environment and gas. Common pollutants include HC, CO, NOx, particulate matter-PM (Particulates Matter). In some cases, CO2 is also included in this group because it is a gas formed under the effect of a greenhouse effect.

Keywords: environment, pollution, emission

1. Introduction

According to data from the Vietnam Register, before 2010, the country has about 20 million motorcycles and motorcycles, in 2010 it has increased to about 24 million vehicles and by 2015, forecasts the number of motorcycles circulated in About 31 million vehicles. Only half of these vehicles are exposed to a large amount of toxic gases, many of which cause the greenhouse effect, to cause diseases such as: Respiratory infections due to bacteria, asthma, chronic bronchitis, rhinitis ...In particular, the noise generated by traffic activities also plays a major role in pollution. There are 60-80% of the causes of engine noise such as exhaust pipe, vehicle vibration, car door closure, car horns, vehicle brakes, tire interference, etc. Noise causes great harm to the whole body in general and the hearing organ in particular. Strong noise, often causing headaches, dizziness, mental instability, and tiredness ...The report also shows that the emission of road vehicles depends very much on the quality of vehicles. For vehicles such as automobiles and motorbikes used for many years of low quality, low fuel efficiency, high toxicity levels, dust in exhaust gases ... cause serious pollution. In particular, motorcycles are the main source of pollutant gases, especially CO and VOC emissions ... Trucks and buses all waste more NO2. The amount of pollutants, pollutants ... is increasing every year with the growth in the number of road vehicles. Specifically, the concentration of dust in the air in cities such as Hanoi, Ho Chi Minh, Hai Phong, Da Nang ... at the intersections is 3-5 times higher than the standard allowed; Daily concentrations of CO and NO2 in some large intersections exceeded the permissible standards of 1.2-1.5 times. In residential areas, the level of pollution is two to three times lower than the roads. However, for residential areas located in large urban areas that are significantly affected by traffic, the level of pollution still exceeds the permitted level of the Vietnamese standard, as marked in Ha Noi, Vinh Phuc, Binh Duong. In contrast, in the small and medium-sized metropolitan residential areas, the measured air quality is quite good. According to the National Petroleum Association, domestic petroleum consumption in 2015 is about 16.4 million m^3 /year (an increase of about 6% compared to 2014), of which about 50% is consumed for vehicles. In addition, according to experts, Vietnam has the largest increase in gasoline consumption in the region. In the period from 1994 to 2013 (over a period of 20 years), fuel consumption in

Vietnam increased by 7.5% per year. With this assumption, the rate of growth from now to 2020 will be 7.5%. Vietnam will consume more than 23.5 million m^3/year by 2020. As such, transportation activities continue to put enormous pressure on the environment, especially the air environment in urban areas. Two big cities such as Hanoi and Ho Chi Minh City get up to 30% of total motorcycles, motorcycles and 50% of cars nationwide. This will require synchronous solutions in the management and control of waste in urban areas in the near future. Prior to the urgent need to reduce the pollution caused by diesel exhaust, people have been studying to find ways to reduce toxins while discharging diesel engines. Almost all measures are aimed at improving the quality of combustion in the engine to reduce the amount of toxins produced by fires. The measures used today are:

In general, all the measures being used today have their own difficulties such as: For the method of finishing the engine structure or adjust the parameters, when reducing the amount of CO, S, smoke In exhaust gas, it increases NO_x and otherwise. The method of using neutralizing gas or exhaust gas exhaust does not improve engine power, costly to exploit. Using clean fuels is expensive. Under conditions of re-use of old engines such as in our current situation, it is necessary to use the method of reducing emission pollution but still ensure the economics of the engine that is to ensure the power consumption. Moreover, there is limited impact on engine structure. The use of water-based emulsion as a fuel is limited to a mixture of water-based emulsion which is unstable and easy to separate. Effective reduction of environmental pollution is very effective, this is the research direction of the topic. In general, solutions to reduce air pollution can be divided into four main groups.

+ The first group: Well organizing the combustion process to reduce pollution by substances such as NOx, CO, HC right at the source (in the cylinder). This group includes measures related to the optimization of the structure of parts, assemblies and systems that affect the combustion process:

The design of the piston head and lid creates a tornado effect, increases the ability to mix fuel and air better, the combustion takes place faster - often applied to diesel engines and direct injection of gasoline; use turbocharger, increase the diameter of the valve, reduce the load loss to increase the intake efficiency; calculating the design of early time of optimal disposal trend; using electronically controlled fuel injection systems, increasing injection pressure, choosing single or multi-point injection ...

Although these are very effective measures, they alone cannot help the engine meet the increasingly stringent pollution standards.

+ The second group: Treatment of exhaust gases. These are measures to ensure the content of toxic substances in the exhaust gas before being discharged into the environment must be smaller than the permitted limits specified in the laws. There are many different technologies for treating emissions: 3-way catalytic exhaust (neutralizing the 3 basic components of CO, HC and NOx); PM filter, Oxidized exhaust processor for diesel engine, Accumulated NOx processor ...).

+ The third group: Use a combination of auxiliary systems. To promote the effectiveness of the two groups of solutions as well as to limit the excessive emissions of the engine in some working modes, it is necessary to use additional systems such as: Closed loop control system (gas reflux); intake air temperature assurance system; air injection system (oxygen) to support the reaction on the exhaust path; Self-diagnostic system - OBD (OnBoard Diagnostics)...

+ The fourth group: Solutions related to fuel. Fuel has a significant influence on the exhaust pollution characteristics of internal combustion engines. There are many solutions to reduce pollution related to fuel such as: Ensuring the compatibility between engine and fuel (the higher the compression ratio, the higher the octane gasoline use); improve fuel quality (less impurities and toxic additives); use green fuels and alternative fuels; use of additives in fuel, ...

2. Technical solutions

Recirculation technology called EGR is used quite early in reducing emissions in automobile engines. The goal of the EGR is to reduce the concentration of pollutants by recirculating the exhaust gas back into the engine's intake system under load conditions. In diesel engines, the effect of this emission is to reduce the combustion temperature of the passage. In addition, the circulating gas also increases the specific heat of the air, so the temperature of the fire decreases. The goal of lowering these parameters is to prevent the production of toxic substances by burning fuel, reducing the concentration of the substance in the exhaust gas. In fact, the higher the temperature, Out as much. In addition to temperature, many factors affect the formation of such substances as the combustion chamber pressure, ignition time, fuel mixture, inlet temperature or refrigerant temperature. For example, reducing compression ratio and slow ignition in high-performance engines will reduce the amount of pollutant produced, however, this will reduce the maximum power and performance of the vehicle.

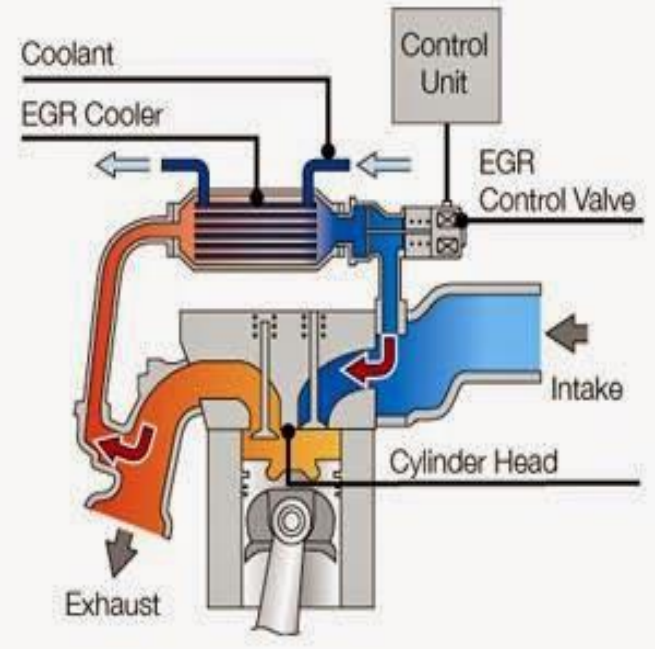

Fig.1: EGR system

The principle of operation of the EGR is to use a connecting pipe between the discharge manifold and the collector called an external exhaust gas recirculation. A control valve will be responsible for regulating the number

of openings and airflow control. The exhaust gas circulates before being mixed with the intake air cooled by otherwise it increases the intake air temperature, affecting the engine power. On gasoline engines on car models, about 5-15% of the emissions are returned to the combustion chamber via the EGR. The 15% level is the limit to the motivation to work normally. Although EGR slows down the combustion process, this can be overcome by adjusting the ignition timing. On modern diesel engines, the EGR is cooled by a heat exchanger to increase the amount of recirculated gas. The main effect of circulating gas emissions on diesel engines is to increase the specific heat of the mixture, thereby reducing the combustion temperature, improving efficiency and reducing fuel consumption. Today, the EGR is no longer as common as catalytic emissions, but on older diesel or diesel models, it is still a good technology. Filter system with the most effective measures to minimize the emission of engine exhaust is the manufacture. Volvo Trucks' CRT system, for example, allows for 80-90% reduction in the rate of carbon oxide, hydrocarbons and nitrogen oxide and hardening of the exhaust gas.

Through gas recirculation, the fuel is almost burned out in the cylinder. After that, the catalytic filter system will neutralize the remaining amount of pollutants, reduce harmful emissions. In theory, if the fuel was burned completely, the optimum ratio between gasoline and air was 14.7:1 (that is, to burn a pound of gasoline needs about 0.45 kg of air). Actual gasoline rates vary with driver. Sometimes this mixture can be higher than 14.7 or maybe lower (more gas needed). Playing an important role in turning harmful gases into gases that do not affect the environment is oxygen. This amount of oxygen is controlled by the computer. The third layer is the emission control system and uses this information to regulate the fuel injection system. An air sensor mounted between the neutralizer and the engine (closer to the engine). This sensor informs the computer about the amount of oxygen left in the exhaust gases. The computer will increase or decrease the amount of oxygen in the exhaust by adjusting the proportion of gas mixture and fuel. This control scheme allows the computer to ensure that the fuel-air mixture ratio in the engine is near the optimum level. And it also ensures enough oxygen in the exhaust to allow the oxidative catalyst to burn off excess hydrocarbons and carbon oxides after the engine explodes. The neutralizer works great in reducing pollution and, in essence, its effectiveness can be further increased. One of the biggest shortcomings of this system is that it only works at a high enough temperature. The startup time after a cold night, the neutralizer is almost inactive. A simple solution to this problem is to attach it closer to the engine. That means bringing the emissions to the neutralizer faster. But that would lead to a reduction in the life of the emission neutralizer. In order to replace the ceramic, a filter using a metal, heat resistant, is now being manufactured.

To overcome the disadvantage of Catalytic Converter technology requires high operating temperature only gasoline engine meet. Selective catalytic reduction technology operates at low temperatures, starting at 227ºC, optimized at temperatures between 357ºC and 447ºC, which are manufactured exclusively for diesel engines. The catalytic reduction used here is the NH_3 solution, which is actually a reagent involved in the chemical reaction and is degraded during the chemical reaction. Catalyst converter technology is not impaired.

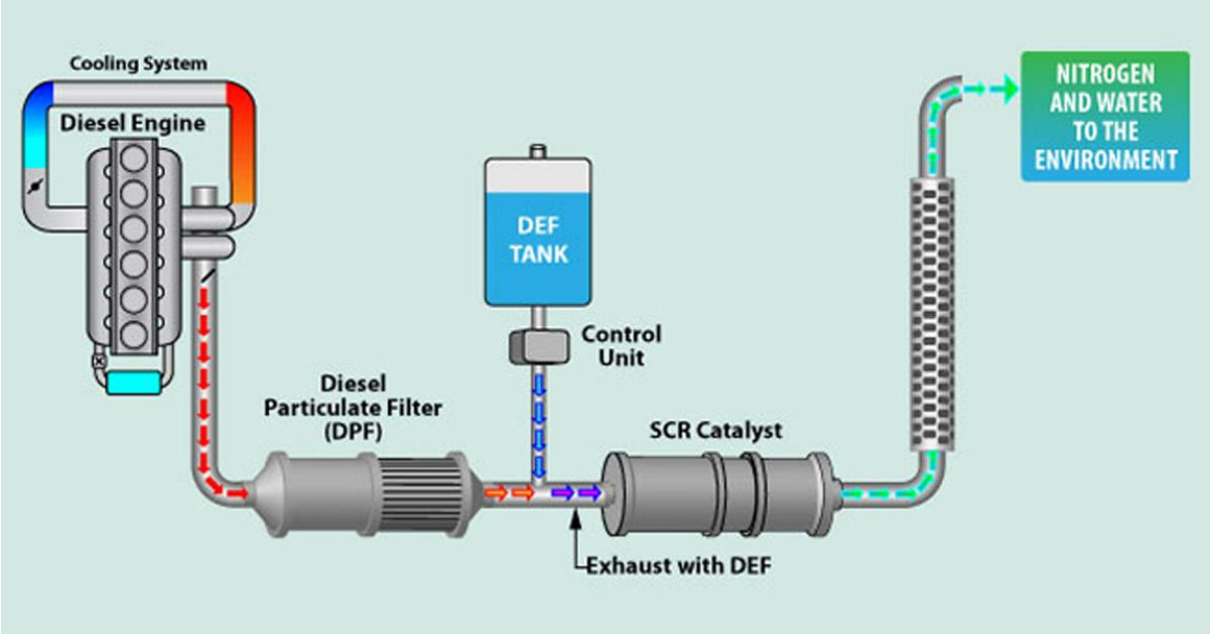

Fig.2: SCR system

Diesel vehicles fitted with SCR technology must be equipped with tanks and sometimes NH_3 solutions. The solution is marketed as Diesel Exhaust Fluid (DEF) with 32.5% urea, 67.1% pure water and 0.4% other additives. According to the supplier, SCR technology filters 90% NO_x. According to the EPA, diesel vehicles equipped with SCR technology combined with EGR and Catalytic Converter technologies meet US emissions standards in 2010. Because SCR systems are equipped with bulky URE tanks and injection systems, they are only available in 3-liter or more diesel engines.

A team of researchers in Vietnam has conducted research on the preparation of catalysts containing γ-Al2O3 catalysts. The carrier is then stabilized to enhance thermal

and hydrothermal strength, reducing the sintering effect due to the influence of temperature and steam. The active phase is a transition metal nanoparticle that has been studied to disperse evenly over the carrier and to simultaneously evaluate the oxidation activity of the catalysts for n-hexane hydrocarbons. From then on, select some suitable monolith frames to make catalysts for treating exhaust gases. The coating process carried on the monilith frame was thoroughly studied. After coating the carrier on the monilith, the active phase of the catalyst is carried onto the carrier and processed for inclusion in the active form. From these monilith-based catalysts, the casing is made, installed, tested on the engine. At the same time propose solutions to improve the structure and operating mode of diesel engines to contribute to meet the requirements, emission standards of the engine. The results show the success in fabrication of catalysts for oxidation of HC, CO; catalyst for NOx processor. The conversion is successful and increases the thermal stability, hydrothermal strength of the catalyst carrier by adding La and Si. Investigate, select and successfully bring the active metal Pt, Pd on the catalytic converter. Successfully fabricated the nano-meso H-ZSM-5 capillary for NOx removal is also shown. The test results evaluating the effectiveness of the emission processors show that: With a bus engine: HC emissions were reduced by 85%, NOx by 85%, CO by 80%, and PM by 81% compared to the original engine without the system. The 100h runtime test shows that after a long run, the engine power is reduced by about 5% and the fuel consumption is increased by 5%. The emission quality varies, as follows: HC, CO and NOx components increase by 2.5%, 4% and 5%, respectively, while the smoke emission decreases by 5% compared to the previous run. With marine engines: 85% reduction in NOx emissions. With generators, when combined with SCR - DOC - DPF emission reductions, NOx emissions are reduced by up to 68% compared to original engines. PM emissions also decreased by 67%. HC and CO emissions fall by 46% and 34%, respectively.

References

1. https://most.gov.vn/cchc/tin-tuc/493/6633/nghien-cuu-cong-nghe-che-tao-bo-xu-ly-khi-thai-tu-dong-co-dot-dau-diezen-bang-xuc-tac-nano.aspx
2. Frank, W., Hüthwohl, G. Maurer, B.: SCR-Technologie für Nutzfahrzeuge. Purem Abgassysteme GmbH, MTZ 9/2004, S. 632
3. Lambert, Ch., Hammerle, R., Mc Gill, R., Khair, M., Sharp, Ch.: Technical Advantages of Urea SCR for Light-Duty and HeavyDuty Diesel Vehicle Applications. Ford Research, Oak Ridge National Laboratory, Southwest Research Institute, SAE Paper 2004-01-1292
4. Hinz, A., Jarvis, T., et al.: Field Test Trucks Fulfilling EPA ’07 Emission Levels On-Road by Utilizing the Combined DPF and Urea-SCR System. Volvo, Johnson Mattey, Chevron, Bosch, SAE Techn. Paper 2006-01-0421.
5. Arrowsmith, D., Bott, A., Busch, Ph.: Development of a Compact Urea-SCR + CRT System for Heavy-Duty Diesel Using a Design of Experiments Approach. Eminox Ltd., SAE Techn. Paper 2006-01-0636.
6. Rusch, K., Kaiser, R., Hackenberg, S.: DPF SCR Combinations Integrated Systems to Meet Future LDV Emission Limits. Arvin Meritor, SAE Techn. Paper 2006-01-0637.
7. Hümekes, E., Neubauer, T., Roth, S., Patchett, J.: Selective Catalytic Reduction (SCR) for Mobile Application – Heavy Duty Diesel. Engelhard. 4th International Exhaust Gas and Particulate Emissions Forum, AVL, Ludwigsburg, 109 March 2006.
8. Jacob, E., Müller, R., Scheeder, A., Cartus, T., Dreisbach, R., Mai, H.-P., Paulus, M., Spengler, J.: High Performance SCR Catalyst System: Elements to Guarantee the Lowest Emissions of NOx. 27. Internationales Wiener Motorensymposium, Bd.2 2006.
9. Cartus, T., Schüssler, M., Herrmuth, H., Giovanella, M.: SCR and DPF – From Concept to Production. Mastering Complex, MutliDimensional Challenges. 28. Internationales Wiener Motorensympo-sium. Bd.1 2007
10. Willems, F., Cloudt, R., van den Eijnden, E., van Genderen, M., Verbeek, R., de Jager, B., Boomsma, W., van den Heuvel, I.: Is Closed-Loop SCR Control Required to Meet Future Emission Targets? SAE Techn. Paper 2007-01-1574.