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The Role of Catalytic Vehicles in the Reduction of Environmental Pollution in Nangrahar City of Afghanistan

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ABSTRACT

Due to the increase in the number of vehicles in the cities, air pollution is one of the serious environmental hazards because it increases the greenhouse gases in the atmosphere and causes climate change. To reduce the bad effects of the gases produced by car engines, the gases are filtered with the help of a catalytic in the silencer of the car (carbon monoxide to carbon dioxide, nitrogen monoxide to nitrogen oxide and hydrocarbons to water vapor) before it leaves the silencer of the car. The catalytic was synthesized in 1895 from various expensive (platinum, rhodium, palladium) materials that work as a result of chemical reactions and have a high price. The purpose of this research is to inform people about the role and value of catalytic in preventing environmental pollution in the eastern zone of Afghanistan. Data was collected through online questionnaire and interviews from 102 participants. The findings of the research show that the catalytic play a vital role in the reduction of environmental pollution in Nangarhar city of Afghanistan. The study revealed that catalytic helps the cars in the prevention of air pollution. The catalytic breaks down dangerous gases into environment friendly gases before they leave the silencer of the car and so has a great role in the reduction of environmental pollution. Similarly, the catalytic is an essential part of the car that has a vital role in the health of the car i.e., the car having the catalytic will be in good condition for a longer period of time, will go with high speed and will use less fuel. Moreover, the use of catalytic is recommended in every car and other fuel consuming machines to avoid environmental pollution.

Keywords: CatalytiC, Environmental Pollution, Greenhouse Gases, Atmosphere

INTRODUCTION

Since the last 40 years, the increase in the number of automobiles has caused air pollution, in which carbon monoxide is the first step in environmental pollution. The major sources of this gas production are automobiles and industrial factory machines. Petroleum materials are used to perform thermodynamic work in the engine of automobiles and other electrical equipment, which causes an increase in greenhouse gases (GHG) in the atmosphere. Most of the transport vehicles burn oil or gases that are released through the silencer and cause environmental pollution. Carbon dioxide, carbon monoxide, nitrogen oxide, nitrogen monoxide, and hydrocarbons are produced in the environment as a result of the combustion processes of automobiles and various machines (Astruc, 2020). According to research, vehicles produce 28% of the total GHG emissions in the United States of America and 19.4% in Europe. Environmental pollution is a major challenge for climate change. It is caused by the production of greenhouse gases (Gladysz, 2002). The combustion processes of automobiles and other machines cause the increase of GHG in the atmosphere, thereby increasing the temperature of the environment and causing environmental pollution, and this process is a major challenge for climate change (Zhang et al., 2021).

In order to prevent environmental pollution and the production of harmful gases to the atmosphere, a device called a catalytic is placed inside the silencer of the vehicle. Catalytic are made of various materials that work with the help of a chemical reaction oxidation and reduction. Catalytic are systems made of various high-value metals (platinum, rhodium, palladium, gold nanoparticles). The catalytic was created by Berzelius in 1895. Estwald defined the catalytic as a substance that changes the total energy of the reaction without accelerating the reaction. It is called a catalytic. There are different types of catalytic. In general, in the year 1975, the catalytic system was activated in order to prevent air pollution in the structure of automobiles (Kritsanaviparkporn et al., 2021). The location of the catalyst in cars is shown in Figure 1.

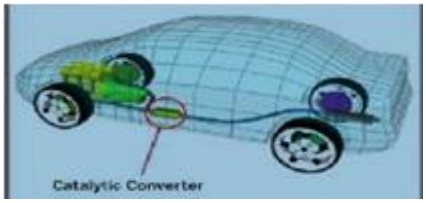

Fig 1. The location of the catalytic in the car

In the case of combustion in the machine, the first oil comes to the carburetor, work is done on the piston based on the laws of thermodynamics, this work is transferred to other processes of the car, and finally the tires make a circular motion, so the vapor of the burning materials in the process enters the first part of the catalytic, which reacts with platinum and rhodium materials, and in the second part of the catalytic, platinum and palladium react with oxidation, which results in the exhaust (external). With the help of the exhauster, non-toxic gases are released into the environment, as a result of which these gases are less dangerous for the environment and the human body (Chen et al., 2020). The catalytic converts 98% of toxic gases into less dangerous gases. It is covered with layers that have an internal honeycomb structure and the following catalytic process converts harmful gases into harmless gases (Heck et al., 2019).

Reduction Catalyst

In the first stage, the catalytic has a changeable feature, which prevents the diffusion of nitrogen monoxide with the help of platinum and rhodium, with a mechanism where a molecule of nitrogen oxide comes into contact with the catalytic, then the catalytic separates the nitrogen atom from the molecule. liberates oxygen in the form of O_2. Nitrogen atoms connect with other nitrogen atoms due to the catalytic and nitrogen is formed (Ji et al., 2020). The internal structure of the catalyst is shown in Figure 2.

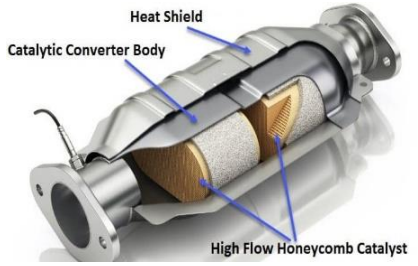

Fig 2. The structure and internal materials of the catalytic

Oxidation Catalyst

The oxidation stage is the second converting part in the catalytic, which converts unburned hydrocarbons and carbon monoxide into carbon dioxide by purifying the catalytic part with platinum and palladium. When the catalytic is well warmed up, it works well. On this basis, it is necessary that when the car is started, it should not move for some time, so that the catalytic of the car is well warmed up and starts working well. The catalytic is located inside the car silencer and converts harmful gases into non-harmful gases, nitrogen oxides into nitrogen and oxygen, carbon monoxide into carbon dioxide in the oxidation process, and hydrocarbons into water and carbon dioxide in the oxidation process. converts to oxide (Sassykova et al., 2019).

$$C_xH_{4x} + 2xO_2 \rightarrow xCO_2 + 2xH_2O$$

Briefly, carbon monoxide converts CO to carbon dioxide CO_2, hydrocarbons HC to carbon dioxide CO_2 and water vapor H_2O, and nitric/nitrogen monoxide NO_2 to nitrogen N_2 and oxygen O_2, As per Figure 3.

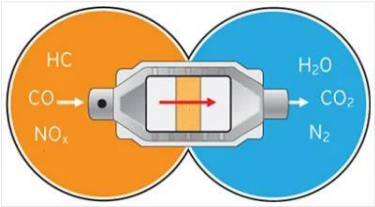

Fig 3. Purification of harmful gas to the oxidation catalyst

Catalytic converters are found in cars, generators, buses, trailers, trains... almost any other device that uses combustion. In cars and other machines, the catalytic is a consumable part. The condition of the catalytic depends on the distance traveled from 80000km to 100000km. After this distance, it is necessary become to change the catalytic (Ji et al., 2020). Without a catalytic in cars and other electrical equipment, carbon monoxide, nitrogen monoxide and hydrocarbons are produced, which are colorless and odorless. The soil forms a dirty smog on the globe, nitrogen oxides also cause smog and acid rain. In the environment, these produced gases have a very negative effect on themselves, such gases also play a role in increasing the temperature of the atmosphere and causing climate change. Breathing too much carbon monoxide and nitrogen monoxide poisons a person and causes headache, dizziness, shortness of breath, nervousness, nausea and discomfort and may cause death. Carbon monoxide gas is more harmful for heart patients, elderly people, children and pregnant women than others. Also, the increase of carbon and nitrogen monoxide in the environment endangers the life of animals and plants (Sultonovich et al., 2020).

METHODOLOGY

This study was conducted in Jalalabad city, the central province in the east of Afghanistan to explore on the presence of catalytic in car silencer in order to prevent environmental pollution and take good care of the car, as well as to inform people about the value of catalytic. A mixed method research design was used for the study i.e. both quantitative and qualitative research designs were used. A total of 102 relevant participants participated in the study including 30 university professors, 21 drivers, 17 mechanics, 14 car sellers, 10 students and 10 persons from the public. The average age of the participants is more than 30 years. In order to collect quantitative data, a two-part questionnaire was designed by the researchers in Google Form. The questionnaire comprised of 15 questions in two parts. The first part consisted of questions on general information whereas the second part consisted of questions that collected data on the emissions from the car, the hazards of smoke, the role of catalytic in preventing environmental pollution, technical problems for the car in the absence of catalytic and the price of catalytic. The questionnaire was distributed for three weeks. Furthermore, in order to collect the qualitative data, face-to-face semi-structured interviews were conducted with 5 car mechanics and 5 car drivers in Jalalabad city regarding the value of catalytic in cars and prevention of environmental pollution. The participant for the interviews were selected based on their work experience in the field and familiarization with the car parts. The quantitative data of the study were statistically analysed in Excel and presented in the form of percentages. The qualitative data was thematically analyzed and presented.

RESULTS

The summary results of the quantitative data show that 77% have a car, 33% do not have a car, 78% are familiar with driving and 22% are not familiar with driving, 66% know the catalytic and 34% do not know it, 57% are aware of the value of the catalytic in the car silencer and 43% are not aware of the value of the catalytic. 66.7% are aware of the exhaust gas from the car silencer and 33.3% are not aware, 64.7% of people are aware of the car damage if there is no catalytic in the car silencer and 35.3% have no information, also 56.9% of people are aware of the role of catalytic in environmental pollution have information about the price of catalytic and 43.1% people do not have information.

Similarly, a number of themes emerged in the analysis of the qualitative data. The first theme that emerged from the analysis of the data elaborates that the catalytic helps the car to not pollute the environment. The catalytic is a device in every car that cleans the dangerous gases before they emit from the silencer of the car. According to another participant A catalytic is a valuable part of the car and without catalytic the car will emit toxic gases which will cause various diseases. According to another participant If the car does not have a catalytic, it produces carbon monoxide and other dangerous gases and it helps in reducing the noisy effect of the

silencer. According to another participant I have heard about catalytic in cars and it is an essential part of the car that reduces the bad effects of the dangerous gases emitting form the car.

The second theme that appeared from the analysis of the data emphasizes that the catalytic is an essential part for the health of the car itself. According to one of the participants If the car does not have a catalytic, the car breaks down quickly and cannot go at high speed. According to another participant If the car has catalytic, the car will be in good condition for a longer period and it will not need a mechanic. A car that has the catalytic will use less fuel.

The third theme that appeared form the analysis of the data highlights that the price of the catalytic. Based on the views of the participants, the price of the catalytic ranges from 10,000 to 50,000 Afghanis. One participant expressed that the catalytic of different models of the cars have different prices, the catalytic of 2010 model cars costs up to 800 dollars. Another participant said, as catalytic is a valuable part in the car, it is usually removed from the cars and replaced with a fake Chinese or Pakistani catalytic and the original catalytic is sent back to Dubai and other countries. Moreover, several participants were unaware of the price of the catalytic.

The fourth theme that emerged from the analysis of the qualitative data explains the detection of catalytic in the car. If the body is gently hit with something, the sound can tell about the presence or absence of the catalytic in the silencer. Another participant said that "the catalytic can be detected if a small hole is made in the silencer.

DISCUSSION

The study investigated the role of catalytic vehicles in the reduction of environmental pollution in Nangrahar city of Afghanistan. Based on the findings of the study, catalytic play a vital role in the reduction of environmental pollution in Nangarhar city of Afghanistan. The study revealed that catalytic helps the cars to not pollute the environment. The catalytic breaks down dangerous gases into environment friendly gases before they leave the silencer of the car and so has a great role in the reduction of environmental pollution. Similarly, the catalytic is an essential part of the car that has a vital role in the health of the car i.e., the car having the catalytic will be in good condition for a longer period of time, will go with high speed and will use less fuel. The findings of the study are in line with what found by Cybulski et al. (2005) who elaborate that there is a device called a catalytic (made of various high-value materials such as platinum, rhodium, palladium, gold nanoparticles, etc.) in the silencer of vehicles and other combustion machines and when fuel is burned, harmful gases such as carbon monoxide, nitrogen monoxide and hydrocarbons are produced and when they reach to the catalytic, it converts 98% of the toxic gases into less dangerous gases with the help of a chemical reaction, oxidation and reduction process. This is further supported by Hwang et al. (2019) who state that the catalytic converts the harmful gases into non-hazardous gases. They add that if the car or combustion engine does not have a catalytic device, in addition to environmental pollution, the poisonous gases emitted from the silencer harm humans as well as plants health. The dangerous gases usually cause dizziness, shortness of breath, nervousness and depression in humans. In addition, the catalytic device keeps the car engine healthy, protects the engine from consuming too much oil, the car takes good speed, keeps the sound of the engine good, and also the catalytic keeps the price of the car stable (Gao et al., 2019). The study further found that the catalytic price range from 10000 to 50000 Afghanis which indicates that it is an important part of the cart.

CONCLUSION

Based on the findings of the study it is concluded that catalytic has a great role in the reduction of environmental pollution in Nangarhar city of Afghanistan and does have a great role in the climate change. In automobiles and other combustion engines, the catalytic converter is an expensive and valuable tool that converts carbon monoxide produced by fuel into carbon dioxide, nitrogen monoxide into nitrogen oxide, and hydrocarbons based on a chemical reaction with water vapor. So, the catalytic protects the environment from pollution and harmful gases and ultimately play a great role in the climate change. Furthermore, based on the findings of the study, the use of catalytic is recommended in every car and other fuel consuming machines to avoid environmental pollution, damage to the human body and maintain the car health. The standard maintenance of the catalytic depends on the distance covered by the car, the standard catalytic condition in the car is from 80000km to 100000km, if the car goes too low and hits the ground or the silencer is hit hard, catalytic breakage is more likely, so it is suggested to be careful about it. In addition, it is to inform all the readers that the original

catalytic has a high price and that is why it is usually replaced with a cheap fake Pakistani or Chinese made catalytic.

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