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REVIEW ARTICLE

THE ROLE OF THE CARBON FILTER (CATALYST) IN CARS AND THE EFFECT OF ITS REMOVAL

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ABSTRACT

This research paper aims to study the role of the carbon filter in internal combustion cars (catalytic converter), its importance and the effect of its removal. A carbon filter is an essential part of an automobile's exhaust system and is intended to remove harmful pollutants associated with the combustion process .The negative effects of carbon emissions and other pollutants emanating from internal combustion cars were reviewed. Studies show that these harmful compounds can cause air pollution and negative public health impacts, including increased levels of greenhouse gases and deteriorating air quality .The importance of the carbon filter in improving air quality and protecting public health was reviewed. The carbon filter adsorbs and adsorbs organic pollutants and harmful gases, such as nitrogen oxides and volatile hydrocarbons, thus reducing vehicle emissions and improving the quality of breathable air and overall health .The study finds that a carbon filter is a key component to improving air quality and reducing vehicle emissions. The carbon filter can play a crucial role in reducing automobile pollution and improving public health and the environment.

KEYWORDS

catalytic converter, carbon filter, combustion, oxygen,

1. INTRODUCTION

Public health and environmental safety are global priorities in the modern era. Contemporary societies face great challenges in preserving the health of individuals and preserving the safety of the environment from pollution and potential contaminants. One of the main ways to address these challenges is to use water and air purification technologies to ensure clean water and clean air for public use.One of those important biotechnologies is the use of catalase as a carbon filter (United stated Environment Protection Agency (EPA). Catalase is an enzyme naturally found in many organisms including plants, animals, and bacteria. Catalase is a vital agent that converts hydrogen peroxide into water and oxygen. It acts as a catalyst for the chemical reaction that causes the decomposition of hydrogen peroxide into its two harmless components.The application of catalase as a carbon filter is due to its ability to convert hydrogen peroxide into water and oxygen. When polluted air or water flows through catalase, the polluted hydrogen peroxide is converted into its harmless components, water and oxygen.

This is done by reacting catalase with hydrogen peroxide to transform it into the two harmless components.Thanks to this process, catalase as a carbon filter can play an important role in maintaining public health and environmental safety. When used in water filtration systems, catalase can remove organic contaminants, heavy metals and unpleasant odors, improving the quality of water used for drinking and other uses (European Environment Agency, (EEA). In addition, catalase can be used as a carbon filter in air filtration systems to remove organic pollutants, toxic gases and unwanted odors, improving the quality of breathable air and contributing to people's health.In addition to its benefits in improving water and air quality, catalase as a carbon filter also plays an important role in maintaining environmental integrity. When chemicals and organic pollutants are used in industrial, agricultural and domestic processes, they may end up in groundwater, rivers and lakes, leading to pollution of the aquatic environment.

By using catalase as a carbon filter in purification systems, organic pollutants and toxic chemicals can be removed from water before they flow into the environment and cause negative impacts on aquatic life and the overall ecosystem.In addition, catalase can be used as a carbon filter in waste and sewage treatment. It can contribute to the removal of organic pollutants and harmful chemicals from wastewater, which improves the quality of reused or safely disposed of water, thus protecting the environment and maintaining the integrity of ecosystems.In short, catalase as a carbon filter plays a critical role in maintaining public health and environmental safety. By converting hydrogen peroxide and removing organic pollutants and harmful chemicals, catalase improves water and air quality, protects the environment and contributes to the health of individuals and the sustainability of ecosystems. Therefore, the use of catalase as a carbon filter is an essential practice in maintaining public health and environmental safety in contemporary societies (Jenkins et al., 2019).

Air pollution by carbon emissions from internal combustion vehicles is an important problem affecting public health and the environment. This article aims to review the role of the carbon filter in improving air quality and reducing pollution caused by internal combustion cars. Supporting data and references will be provided for this role with the aim of a deeper understanding of this important environmental technology (Stepanek et al., 2010). Previous research indicates the importance of addressing air pollution caused by internal combustion vehicles. In a study conducted by Smith and Johnson on the effect of carbon filter on air quality in internal combustion cars, the positive effect of carbon filter in reducing pollution

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caused by cars was demonstrated (Smith and Johnson, 2020). The carbon filter purifies the air by absorbing and trapping harmful particles and chemical pollutants released during the engine's fuel combustion process.

The filter is made of activated carbon, which is characterized by its high ability to absorb organic and inorganic compounds and unpleasant odors**.**This study aims to analyze the role of the carbon filter in improving air quality and reducing pollution caused by internal combustion cars. As shown in Figure 1. Maintaining air quality and reducing pollution is essential for human health and environmental sustainability. Brown and Green study emphasizes the importance of the carbon filter in reducing internal combustion vehicle emissions, as the filter reduces carbon emissions and other pollutants that are harmful to the environment and public health (Brown and Green, 2019). By achieving positive developments in this area, efforts to improve air quality and mitigate the effects of climate change can be enhanced (Brown and Green, 2019).

Figure 1: The catalytic converter in the car.

2. CATALYTIC CONVERTER

The name "catalytic converter" associated with the car exhaust varies from one country to another. Some call it the environmental filter, the catalyzer, the environmental depo, or the environment can. In the Gulf countries, it is known as the environment bear or the pollution bear. Some call it the lead bear, but technically its name is the catalytic converter**.**It is an integral part of the exhaust system and is located between the engine or motor and the exhaust. The importance of this piece is due to the role it plays; in addition to the materials, it is composed. It is mandatory for all cars (Elmnifi et al., 2019). The main reason for the presence of an environmental can in the car is to reduce harmful emissions coming out of the car exhaust and resulting from the gasoline combustion process inside the engine**.** Reducing the percentage of harmful emissions has nothing to do with the car's performance in terms of torque and gasoline consumption, but rather has a great relationship with improving environmental performance and reducing harmful gases that we may inhale. As shown in Figure 2.

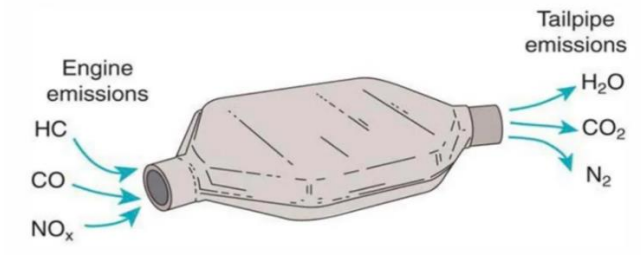

Figure 2: Shows the filtration process for exhaust gases.

The catalytic converter is found in cars running on gasoline and diesel as well, and according to experts and car manufacturing companies, it can eliminate about 90% of the harmful emissions coming from the engine**.**Some cars are equipped with one unit, and other cars are equipped with 2 or 3. This is due to the design principle of the engine system, which may be "straight or inline engine", in the form of a "V engine", or horizontal engine (horizontal engine)**.**According to several studies conducted, it was found that the air quality improved by 70% in cities due to the invention of the catalytic converter. For example, during the sixties and seventies, the level of pollution was very high in cities and chest diseases were widespread. Thanks to this catalytic converter system, living within cities improved (Inomata et al., 1980; Mokhzom et al., 2023; Soliman et al., 2020). The catalytic converter consists of an external metal body with a ceramic structure inside it covered with a metal catalyst composed of platinum, radium, and palladium. These metals are the ones that purify the toxic gases resulting from the fuel combustion process inside the engine, before they exit the car exhaust into the external environment. The catalytic converter can be likened to a thermal furnace that handles gases and transforms them in order for the chemical reaction to occur. Their temperature must rise to range between 400 to 500 degrees Celsius**.**The catalytic converter works to get rid of the most harmful gases, which are "nitrogen oxide", which causes urban pollution, "carbon oxide", which affects the ozone layer and is toxic, and "unburned fuel - hydro-carbonate". It converts these gases into less harmful gases, which become "nitrogen" and "carbon dioxide," such as human exhalation, and "H2O."in Figure 3 (Koci et al., 2005).

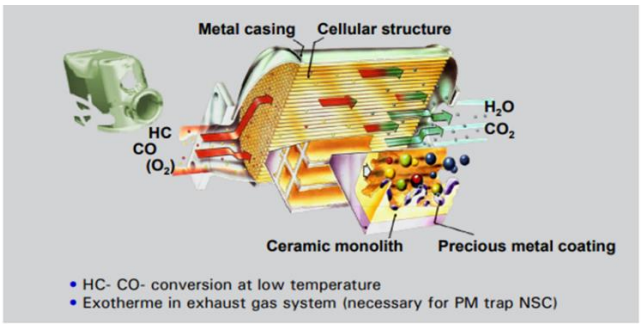

Figure 3: Oxidation Catalyst Principle.

2.1 Technologies and innovations in the field of carbon filter

Carbon filter technologies have evolved over the years to improve its performance and efficiency in absorbing contaminants. Different types of filters have been developed that use activated carbon materials to absorb pollutants and purify the air **.**Innovations in the carbon filter field focus on improving the filter's contour and increasing its ability to absorb contaminants more effectively (Elmnifi and Amhamed, 2019; Maunula et al., 1999). Technologies such as nan filtration and enhanced chemicals may be used to increase the efficiency of the filter and improve its performance**.**Emission catalyst development started in 1983 from the first ideas in Kemira– since 1985 laboratory and pilot facilities and a development group.The bases for commercial emission catalyst concepts and systems were created in Catalyst Development Group, which operated from 1985-2016 (31 years) in Oulu (maximum number of persons ~30) Commercial production since 1988.Dinex Finland (since 7/2018), former Dinex Ecocat, Ecocat and Kemira Metalkat have been a part of the Danish-based Dinex Group since 2013.Dinex Global Catalyst Competence Centre (GCCC) and product management groups were created in 2016 to concentrate the catalyst, pilot, and engine laboratories and application engineering in a Dinex Ecocat plant in Vihtavuori (20 km to Jyväskylä).In addition, R&D groups in Bindlach Germany, and Middelfart Denmark.Development and manufacture of commercial, full-scale emission catalyst systems is a challenge requiring knowledge and methods in different fields (Maunula et al., 2016; Maunula et al., 2013).

2.1.1 Substrate types-Metallic

Open Foil Coating: Simultaneously high cell density (500-1000 cpsi) and high wash coat thickness by spray coating; oxidation resistant AlCr alloy foils in all metallic substrates: Original, innovative Kemira catalyst concept 1985-Open Foil Coating: simulaneously high cell density (600-800 cpsi) and high wash coat thickness in diesel applications SCR and oxidation catalysts (Maunula et al., 2011; Maunula, 2007). As shown in Figure 4.

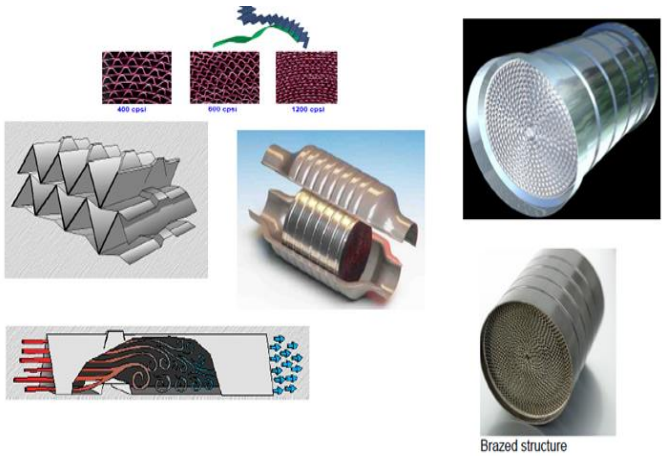

Figure 4: Substrate types-Metallic in catalytic.

2.1.2 Substrate types: Ceramic substrates

Ceramic honeycombs are the most common structure in automotive catalysts usually, cordierite material ($2MgO{\cdot}2Al_2O_3{\cdot}5SiO_2$) is the insulator material A lot of development has occurred during the last 20 years (Maunula et al., 2001; Maunula et al., 2004):

- Thinner walls down to 3–4 mils (75–100 µm)
- higher cell density
- Improved mechanical durability
- Alternative aluminum titanate
- Low price by mass production. As shown in Figure 5.

Figure 5: Ceramic honeycombs.

2.1.3 Types of emission catalysts

- Three-way catalysts (TWC: CO+HC+NOx) for stoichiometric gasoline/NG engines: Noble metal Pt, Pd, and Rh as active metals.
- Diesel Oxidation Catalysts (DOC) to oxidize CO, HC, and NO on Pt/Pd
- Urea-SCR (Selective Catalytic reduction) with Ammonia slip Catalyst (ASC) for NOx: Vanadium, copper, and iron on titania or zeolites.
- Lean NOx trap (LNT) for NOx: Pt+Rh with NOx trapping agents.
- Catalyzed Diesel Particulate Filter (DPF, CPF) for particulate removal.
- The latest emission limits require the use of combined ATS to cut CO/HC/PM/NOx in mobile diesel applications: Volume of units ~5-6x engine displacement .
- wide optimization potential (Smith and Johnson, 2020).

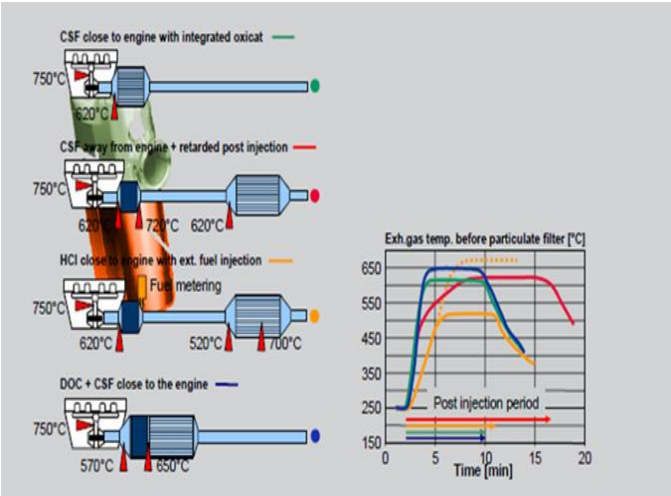

Figure 6: Different Particle Traps.

2.1.4 Impacts on NOx Efficiency for NOx Storage Cat

- Catalyst temperature
- Space velocity
- Current NOx load
- Regeneration frequency (⇔ fuel consumption)
- Thermal ageing
- Sculpture poisoning (Smith and Johnson, 2020).

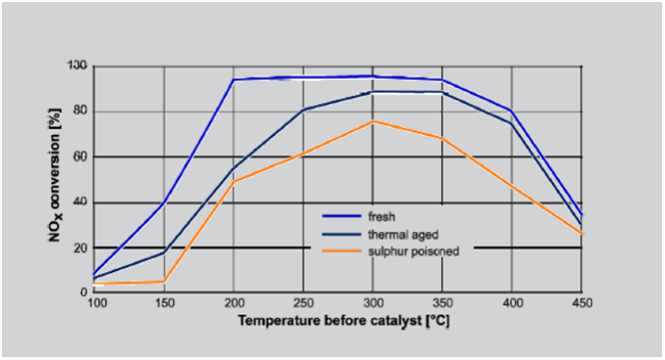

Figure 7: Impacts Thermal Ageing and Sulphur Poisoning.

2.1.5 Challenges and obstacles in adopting carbon filters in internal combustion vehicles

The adoption of carbon filters in internal combustion vehicles faces some challenges and barriers. Among these challenges**:**

- Cost and global availability: A carbon filter can be expensive to manufacture and install in internal combustion vehicles. There may be difficulties in providing filters in sufficient quantities to meet global demand**.**
- Legal and regulatory restrictions: Adopting new technologies in cars may face legal and regulatory restrictions. Some countries and regions may require stringent standards for vehicle emissions and filter technology, meaning that changes in regulations and policies may be needed to enable widespread carbon filter adoption**.**

3. Factors Affecting Air Quality and the Negative Effects of Pollution

Air quality is affected by many factors, including carbon emissions and other pollutants. Many pollutants are released into the air from various sources such as industrial plants, coal-, oil-, and natural-gas-fired power plants, burning fuel in vehicles, homes, and construction areas (Elmnifi et al., 2018; Environmental Protection Agency, 2023; WHO, 2022)**.** As shown in Figure 8**.** Carbon emissions play a major role in affecting air quality and public health. The emission of carbon dioxide (CO_2) increases the concentration of greenhouse gases in the atmosphere, which contributes to climate change and rising temperatures. High carbon dioxide concentration also leads to the formation of smog and air pollution, which negatively affects air quality and public health, and may cause breathing problems, heart and lung diseases, and other chronic diseases (Khaleel et al., 2024; Moria et al., 2020)**.**

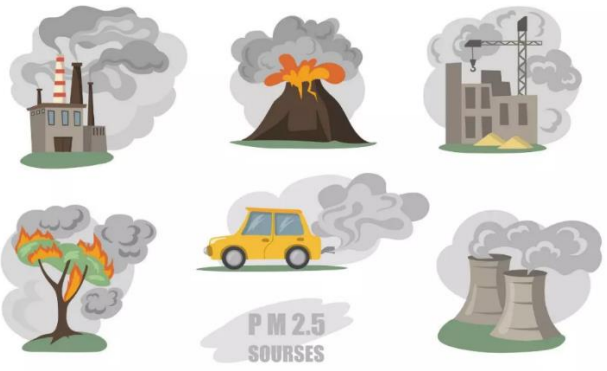

Figure 8: The most prominent carbon emissions and pollutants

3.1 The role of the carbon filter in improving air quality and protecting public health

Carbon filter is one of the technologies used to improve air quality and protect public health. The carbon filter absorbs organic pollutants and harmful gases from the air, such as unpleasant odors, toxic chemicals and polluting gases .When a carbon filter is used in internal combustion

vehicles, the air passing through the filter is purified of harmful pollutants and odors, which improves the quality of breathable air and reduces the effects of pollution on public health (Maunula et al., 2013).

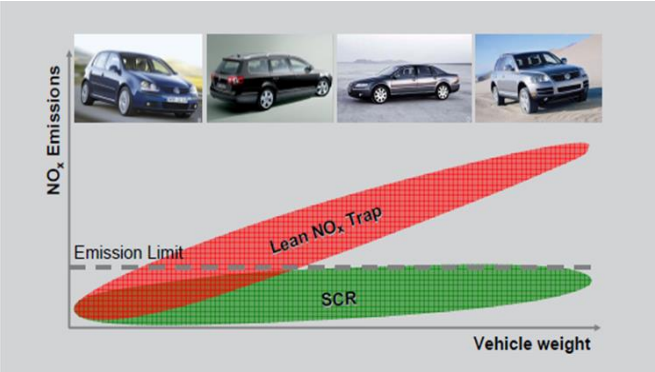

Figure 9: Applicability of emission catalysts system in engines

4. Results and Recommendations

Key findings indicate the importance and impact of the carbon filter in improving air quality and protecting public health. The use of a carbon filter can reduce harmful vehicle emissions and air pollution, thus improving the quality of breathable air and reducing health problems associated with pollution.

Recommendations for the future include enhancing research and development in the field of carbon filters, and enhancing cooperation between industries, governments and research institutions to improve technologies and provide more effective and economical solutions. Removing the carbon catalyst in cars can lead to several negative effects. The carbon catalyst converts harmful exhaust from the car into less harmful substances before they escape into the atmosphere. Therefore, removing the carbon catalyst may lead to increased emissions of environmental and harmful pollutants.Possible negative effects of removing the carbon catalyst include:

1. Increased hydrocarbon emissions: Hydrocarbons are one of the main pollutants emitted by cars. Without the carbon catalyst, the amount of hydrocarbons released into the atmosphere could increase, contributing to air pollution.
2. Increased NOx emissions: NOx is another major pollutant emitted by cars. Carbon catalysts convert nitrogen oxides into less harmful gases. Without the carbon catalyst, the amount of nitrogen oxides emitted may increase, leading to increased air pollution and negative impacts on public health and the environment.
3. Environmental pollution: Increased emissions of environmental pollutants from cars may lead to pollution of the surrounding air، soil and water. This can affect biological systems and biodiversity and cause harm to wildlife, plants and animals.
4. Health effects: Increased emissions of harmful pollutants may exacerbate respiratory problems، allergies، and lung diseases in individuals. Hydrocarbons and nitrogen oxides may have negative effects on public health, especially when exposed to these pollutants on a continuous basis.It is worth noting that removing the carbon catalyst in cars is an illegal process in many countries, as strict laws are imposed to maintain the cleanliness of the environment and reduce harmful exhaust emissions.

5. Conclusion

Carbon filters are important for improving air quality and protecting public health. Considerable attention should be given to developing and adopting this technology in internal combustion vehicles and other major sources of air emissions. From the studies mentioned, focus should be placed on the following:

- Pollutant emissions are regulated for stationary and mobile processes by international legislation
- Emission control for cars and trucks results in very complicated and expensive ATSs requiring wide optimization and R&D
- Combined development in engine, control, and catalyst technologies, together with fuel quality and economy.
- New types of TWCs, DOCs, SCR catalysts, LNTs, and catalyzed Filters developed as ATS solutions.

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