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EXHAUST GASES EMITTED BY AUTOMOBILES AND THEIR IMPACT ON THE ENVIRONMENT

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Abstract:
This article investigates the adverse effects of automobile exhaust gases on the environment, human health, and plant life. These emissions typically contain harmful substances such as carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), and unburned hydrocarbons, which contribute significantly to air pollution and the acceleration of global warming. Prolonged exposure to these pollutants in humans can lead to chronic respiratory illnesses, cardiovascular disorders, and allergic reactions. In the plant world, toxic emissions hinder growth, reduce agricultural yields, and degrade overall ecosystem stability. The study highlights the urgent need to adopt environmentally friendly technologies and implement stringent emission controls in order to reduce vehicular pollution and safeguard public health and environmental quality.
Keywords: Exhaust gases; air pollution; global warming; vehicular emissions; chemical exposure; air quality; public health.

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Introduction

In the modern era, automobiles have become an indispensable part of human life; however, their negative impact on the environment has been increasingly significant. Internal combustion engines release various harmful substances into the atmosphere during operation, which pose serious threats to human health, plant life, and the overall ecological balance [1]. Among the primary pollutants emitted by vehicles are carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), unburned hydrocarbons, and particulate matter, all of which contribute to the degradation of air quality and intensify global climate change [2].

The increasing density of urban traffic and the aging vehicle fleet in many developing countries have further aggravated the situation, leading to elevated concentrations of pollutants in densely populated areas [3]. Scientific studies have shown that long-term exposure to automobile emissions is associated with chronic respiratory and cardiovascular diseases in humans, as well as reduced agricultural productivity due to inhibited plant growth [4].

This paper explores the chemical composition of automobile exhaust gases, analyses their direct and indirect effects on the environment and living organisms, and proposes effective strategies for minimising vehicular emissions through technological innovation and regulatory frameworks.

Materials and Methods

Over the past fifty years, the number of vehicles worldwide has increased more than twelvefold, surpassing one billion automobiles in use. Globally, the current ratio of people to cars is approximately 7:1. In developed countries such as Canada, Germany, Italy, France, and the United Kingdom, there are between 500 and 700 vehicles per 1,000 inhabitants, while in the United States this number reaches 800, and in Russia it stands at 400 [1].

Automobile engines release various chemical compounds into the atmosphere as a result of fuel combustion. One of the most pressing environmental challenges today is the reduction of harmful substances emitted by motor vehicles. Scientific studies have identified over 200 pollutants released into the air during engine operation, many of which are highly toxic [2].

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The most hazardous components of vehicle emissions include:

- Carbon oxides (CO and CO_2) – Carbon monoxide (CO) is a poisonous gas that interferes with the oxygen-carrying capacity of the blood. Carbon dioxide (CO_2), while non-toxic to humans, is a major greenhouse gas contributing to global warming.
- Nitrogen oxides (NO_x) – These react with atmospheric moisture to form acid rain and damage the respiratory tract.
- Sulphur dioxide (SO_2) – Combines with water vapour in the atmosphere to produce acid rain, contaminating soil and aquatic ecosystems.
- Unburned hydrocarbons (HC) – Contribute to the formation of ground-level ozone and photochemical smog.
- Particulate matter (PM) – Tiny airborne particles that penetrate deep into the lungs and can cause severe respiratory illnesses.

These emissions significantly pollute the atmosphere and disrupt ecological balance. The major problems associated with vehicular emissions include:

- Air pollution – Gaseous emissions from cars fill urban air with harmful substances, reducing the overall quality of life.
- Climate change – CO_2 and other heat-trapping gases elevate global temperatures, leading to increasingly severe environmental consequences.
- Soil and water contamination – Acid rain reduces soil fertility and pollutes water bodies with toxic chemicals.

In Uzbekistan, the widespread use of personal vehicles has contributed to significant environmental noise and air pollution. Over 60% of the population in major urban areas reportedly suffers from harmful levels of noise. Moreover, 40% of atmospheric emissions are attributed to motor vehicles. In 2021, Uzbekistan had approximately 3.14 million registered cars owned by individuals, with 75% (about 2.4 million) running on gas fuel, 796,000 on petrol, and around 71,000 on diesel. By 2023, this figure had risen to 4.6 million registered vehicles [3].

These developments have not gone unnoticed in terms of their environmental toll. Tashkent, the capital city, is increasingly ranked among cities with high levels of air pollution. The growing number of automobiles, combined with insufficient emission control and outdated fuel systems, continues to degrade air quality.

Automobile exhaust gases also pose serious risks to human health:

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- Respiratory illnesses – Toxic gases and particulate matter can cause asthma, bronchitis, and even lung cancer.
- Cardiovascular diseases – Polluted air damages the circulatory system, increasing the risk of heart-related conditions.
- Neurological effects – Gases such as carbon monoxide can reduce oxygen supply to the brain, leading to headaches, fatigue, and cognitive impairment.

Plant life is similarly affected:

- Impact on photosynthesis – Polluted air accumulates on leaf surfaces, reducing the plants' ability to perform photosynthesis.
- Acid rain damage – Harms root systems and stunts plant growth.
- Biodiversity loss – Persistent pollution may lead to the extinction of sensitive plant species, affecting entire ecosystems.

Results and Discussion

Numerous scientists and researchers have studied the environmental and health impacts of toxic gases emitted by automobiles. Among the most prominent figures in this field is Arie Haagen-Smit (1919–2006), an American chemist who was the first to establish a link between vehicle emissions and photochemical smog. His groundbreaking research identified automobiles as the primary contributors to air pollution in Los Angeles, thereby laying the foundation for environmental regulatory policies [4].

Another influential figure is James Lovelock, the author of the *Gaia Hypothesis*, who investigated atmospheric changes and the impact of human activity—particularly transportation—on the Earth's climate system. His work brought attention to the delicate interdependence between the biosphere and the atmosphere [5].

Paul Crutzen, a Nobel Laureate in Chemistry (1995), made substantial contributions to the study of atmospheric chemistry. He demonstrated the role of nitrogen oxides (NO_x) in the depletion of the ozone layer, a critical discovery that underscored the dangers posed by vehicular emissions to the global climate [6].

John B. Heywood, a professor at the Massachusetts Institute of Technology (MIT), conducted pioneering research on internal combustion engines and

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vehicle emission control technologies. His work has been instrumental in advancing cleaner engine designs and emission mitigation systems [7].

Given the escalating environmental challenges caused by motor vehicle emissions, several strategies must be implemented:

- Development and enforcement of vehicle emission standards – Establishing and continuously expanding ecological classification systems for vehicles is essential to regulate their environmental performance.
- Monitoring chemical composition of exhaust gases – Regular testing of emission content ensures compliance with environmental norms and facilitates early intervention when standards are exceeded.
- Urban traffic planning and road infrastructure modernisation – Upgrading urban road networks and introducing low-emission zones in residential areas can reduce localised pollution and noise levels.
- Promotion of eco-friendly transport – The use of electric and hybrid vehicles significantly decreases the emission of harmful gases into the atmosphere.
- Adoption of cleaner fuels – Switching to low-sulphur fuels contributes to improved air quality and reduced environmental toxicity.

The demand for alternative fuels to replace petrol is growing worldwide. To date, electricity, ethanol, natural gas, methanol, and other energy sources have been tested as viable alternatives. Consequently, many countries have begun transitioning their transport sectors toward sustainable fuel systems, underscoring the importance of reducing dependence on traditional fossil fuels [8].

These measures are not only environmentally beneficial but also necessary to mitigate the long-term health and ecological risks associated with vehicular pollution.

Conclusion

Reducing the environmental impact of toxic gases emitted by automobiles requires a multifaceted approach, combining technological solutions with behavioural and policy changes. Enhancing public ecological awareness and promoting responsible transport choices play a key role in mitigating air pollution. Regular monitoring of the technical and chemical composition of

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vehicle emissions, along with the limitation of private vehicle usage—especially in densely populated areas—are essential steps in this process.

Increasing the use of public transportation, such as buses, subways, and bicycles, can significantly reduce the number of private vehicles on the roads, thereby lowering overall emissions. In Uzbekistan, initiatives such as "Car-Free Fridays" are being promoted to raise environmental consciousness and reduce vehicular activity in urban areas.

Afforestation efforts also contribute meaningfully to air purification and carbon dioxide reduction. Planting trees not only helps absorb greenhouse gases but also enhances biodiversity and improves urban microclimates.

Finally, the enforcement of stricter environmental regulations and emission standards is imperative. Strengthening legislation and ensuring compliance through rigorous monitoring will be vital in curbing harmful emissions and achieving sustainable urban development.

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