

Aspects regarding the pollutants and pollution from road vehicles in the context of the sustainable development of automotive transport

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Abstract. The scientific paper presents a concrete research carried out by the authors in order to implement concepts of a technical nature, so that those interested in this field can get acquainted with a certain way of exposing problems regarding pollutants and pollution from road vehicles in the context of the sustainable development of automotive transport.

Below we present a technical and managerial study with engineering nuances, through which readers can look at and understand the concept of sustainable development of this sector in a global context. The work shows aspects regarding the chemical, noise pollution and mechanical vibrations produced by motor vehicles during their operation, the evolution in percentage of the European Pollution Norms, the date of their entry into force and the harmful effects that the pollution has on habitats and human health.

Keywords: *motor vehicle, automotive-related pollutants, chemical pollution, noise pollution, mechanical vibrations*

Introduction

Road transport is one of the basic pillars of the transport system in the EU, being the main driver of the mobility of goods and passengers with a vital role in the economy and society, which ensures people's quality of life through efficiency and accessibility.

In the EU, automotive transport is the most preferred option for the population, which defines it as the main polluter of the environment, contributing greatly to climate change.

"The notion of the environment should not be confused with that of nature, which predates it and has a different content. The concept of the environment has the character of a system; it is a complex but unitary system, consisting of a very large number of elements and links, having a certain capacity for self-regulation and in which the most active factor is represented by human communities" [4].

Taking into account the characteristics and composition of the elements of the road transport system, it occupies vast spaces on the earth's surface, interacts directly with the environment because the entire transport activity is carried out in nature, contributes greatly to urban and extra-urban sprawl, fragments habitats, eliminates pollutants that contaminate the air and waste that damages and waterproofs the surface of the earth's crust.

According to statistics, one third of the total amount of final energy is consumed by all existing transmission systems. More than 70% of the energy consumed from oil of this quantity, goes to the road transport system. The other part, 30%, is the result of environmental pollution by air and maritime transport systems. In this case, the road transport system is to blame for EU greenhouse gas emissions, which have brought about major climate change.

"Transport is responsible for around a quarter of the EU's greenhouse gas emissions. All modes of transport must therefore contribute to the decarbonization of the mobility system. This requires a systemic approach. Firstly, there is a need for low and zero-emission vehicles with efficient alternative powertrains for all modes of transport" [11].

Compared to other sectors of the economy (energy, industry, construction, etc.), which have taken measures to reduce emissions and pollution since 1990, the transport sector has developed rapidly and chaotically, which has caused polluting emissions from transport activities, increasing and causing significant damage to nature. For this reason, the transport sector has become a major hindrance to the implementation of European objectives in the field of environmental protection. Although in this regard, authorities around the world come up with proposals and draft laws and regulations related to environmental protection (fuel quality standards, pollutant emissions standards of the engines that equip motor vehicles, the use of cleaner vehicle manufacturing technologies, etc.), still the quantities of chemicals and waste of any kind that end up in nature are still high.

Given the road transport system, road traffic is the main source of noise pollution affecting human health, biodiversity and the human habitats in the territorial land areas.

1 Pollutants from motor vehicles

All vehicles within the road transport system, which use carbon-based fossil fuels, during the combustion process in internal combustion engines, in order to obtain the energy used in the transport process, eliminate gases in the form of pollutants in the atmosphere, polluting the atmosphere.

The gases resulting from combustion interact and combine with the gases that are part of the atmospheric air, forming harmful, dangerous substances.

Human society today knows a continuous development as a result of the progress of science and technology, but it is now aware that this evolution is made with enormous sacrifices of the environment, which is frequently contaminated with pollutants, harmful substances and waste.

"Lately, a term associated with the environment is pollution, which manifests itself as a continuous aggression against its integrity. Pollution is, in fact, the price that people pay for the benefits brought about by modern technology. What is now called pollution is the end of a process that began with the formation of human communities and which, at some point, began to degrade the environment" [4].

The direct-acting pollutants eliminated in the atmosphere by the internal combustion engines of motor vehicles which have a harmful effect on living organisms are the following:

1. Pollutants with a direct effect on morbidity and mortality (e.g. nitric oxide, sulphur dioxide, hydrogen sulfide, carbon monoxide and heavy metals, etc.);
2. Pollutants with indirect effect on morbidity and mortality (e.g. destruction of the ozone layer, greenhouse effect, acid rain, etc.).

60% of the overall environmental pollution by pollutants is created by the exhaust gases resulting from the internal combustion engines of motor vehicles.

It has been shown that in the first two minutes of operation after starting an internal combustion engine, 80% of the amount of pollutants is carbon monoxide eliminated into the atmosphere.

Chemical pollution (pollution with exhaust gases) is produced by toxic gases eliminated as a result of combustion processes in the internal combustion engines of motor vehicles.

The main pollutants, toxic gases emitted by motor vehicle engines in the transport process are: hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NO), sulfur dioxide (SO₂), nitrogen and nitrogen compounds.

Carbon monoxide from motor vehicles has the property of accumulating in large quantities in winter and spring, when there is the atmospheric calm, and the combustion of fossil fuels in internal

combustion engines reaches a maximum point. This usually occurs in large metropolises, where road traffic is very intense. The phenomenon occurs due to the chemical stability that the gas has at low ambient temperatures.

Hydrocarbons are chemical compounds that have in their composition molecules formed by carbon and hydrogen atoms.

Nitrogen and nitrogen compounds are a harmful substance resulting mainly from the combustion process of diesel fuel in internal combustion engines. It combines with water from the atmosphere and generates acid rains that have destructive effects on buildings and vegetation. They are polluting chemical compounds that make a constant contribution to environmental pollution, and nitrogen dioxide (NO₂), a combination of nitrogen with oxygen, is considered one of the most dangerous polluting substances. Nitrogen dioxide is formed at high temperatures, and its source is the carbon-based fuel burned in the internal combustion engines of motor vehicles.

Other harmful substances resulting from the automotive transport process are also: volatile organic compounds (VOCs) – benzene, soot, asbestos, dust particles, lead compounds, benzo- α -pyrene, aldehydes and heavy metals.

The exhaust emissions of motor vehicles have the following particularities:

- ✓ They are always eliminated very close to the (ground) road, which creates high concentrations at low heights. This effect is quite dangerous, due to the fact that low-density gases have high diffusion capacity in the environment;
- ✓ Emissions of harmful gases are carried out over large areas, especially in very crowded cities. Here the concentrations of harmful gases have maximum effect when the road traffic is high, and the possibilities of airing the streets are reduced or diminished by the art elements or the nearby constructions.
- ✓ The volume, concentration and nature of the pollutants are directly proportional to the type of fuel burned, the type of motor vehicle and its technical condition, the operating condition and wear of the engines.

1.1 Pollution caused by motor vehicles propelled by the internal combustion engine

It is well known that a motor vehicle pollutes throughout its life, from its genesis, in the manufacturing process until scrapping (destruction / dismantling). The motor vehicle pollutes the most during the total duration of its life, as a result of maintenance processes and during its movement on the earth's surface, when it eliminates into the atmosphere harmful gases resulting from the combustion of fossil fuels in the engine in order to obtain the energy necessary for movement, it produces mechanical vibrations and noises that affect hearing.

Given the data researched so far and those presented by the EEA (European Economic Area), we can show that lately the average pollutant emissions for new motor vehicles registered in the EU Member States (27 countries), to which Iceland, Great Britain and Norway are also added, were 122.4 grams CO₂/km. Although these emissions were below the target set by the EU, that of 130 g/km, however, polluting emissions instead of falling have increased alarmingly.

In order to take action accordingly, at the level of 2020, the EC (European Commission) has set tough measures in terms of CO₂ emissions from motor vehicles. They will not have to exceed the value of 95 grams CO₂/km, compared to the level of 2019. Therefore, all European motor vehicle manufacturers are obliged to refer exactly to this value, if they do not want to bear penalties.

In this regard, European manufacturers are currently manufacturing vehicles whose engines strictly meet pollution standards Euro 6 c, Euro 6d-TEMP and Euro 6 d. The standards achieved are in line with EU requirements regarding pollutants emitted by the vehicles they produce and sell to users.

In order to significantly reduce carbon emissions from motor vehicles, the European Commission argues that manufacturers will have to improve the fuel efficiency of their fleet and accelerate the production of low and zero-emission vehicles.

In order to meet the requirements, the motor vehicles were equipped with catalytic converters, which convert pollutants resulting from the combustion processes of fuels in engines with internal

combustion into less polluting substances, which did not affect the environment. From the Euro 5 pollution norm upwards, all motor vehicles, especially those equipped with diesel engines, have been equipped with particulate filters (DPF), which retain particles larger than 10-12 microns, existing in the exhaust gases of the engines.

The catalytic converters or the catalysts, as they are also called among motorcyclists, are a result of the technological evolution that were introduced into the automotive industry in the second half of the '70s, and since then their performance has continuously improved. From a functional point of view, some redox reactions are produced in catalytic converters, reactions obtained with the help of noble metals such as Rhodium (Rh), Palladium (Pd) or Platinum (Pt). The latter metal, being precious, is used less often in the construction of catalytic converters. The most used metals in their construction, however, remain Rhodium and Palladium. The catalytic converters in a motor vehicle are mounted on the exhaust gas trajectory, and the role of these noble metals is to enter into chemical reaction with the components of harmful gases (hydrocarbons, carbon monoxide and nitrogen oxides), eliminated by internal combustion engines, turning them into neutral substances.

The chemical reactions that take place in a catalytic converter, transform the three harmful chemicals into safer and more environmentally friendly substances, as follows:

- a) Hydrocarbons (HC) and oxygen (O₂) are converted into carbon dioxide (CO₂) and water vapor (H₂O);
- b) Carbon monoxide (CO) and oxygen (O₂) are converted into carbon dioxide (CO₂);
- c) Oxides of nitrogen (NO) and hydrogen (H₂) are converted into nitrogen (N₂) and water vapor (H₂O).

For example, the three-way catalytic converter converts all pollutants eliminated by a heat engine in which gasoline is burned and combines two **oxidation reactions** for the conversion of hydrocarbons and carbon monoxide, plus a **reducer reaction** for the transformation of pollutants. Redox reactions occur only in the presence of oxygen and are accelerated by the noble metals existing in the composition of the catalytic converter.

Mechanical vibrations are the vibrations transmitted to the ground (roadways) or to the environment, by the suspensions and running systems of the vehicles in motion, but also by the sound of their engines. Vibrations transmitted to the ground or to the environment are directly proportional to the weight and gauge of the vehicle or machine that produces them.

Mechanical vibrations are harmful to the environment, habitats and biodiversity, but also to the motor vehicle in its entirety. Regardless of the category of the roadways, when moving vehicles on them, more or less oscillations and shocks occur, which are transmitted in the structure of the bodies of motor vehicles and from there, to the goods transported or to the occupants occupying the seats of the means of transport. They also irreversibly affect parts, aggregates or vehicle parts, weakening their fatigue resistance and affecting reliability and maintainability.

"The oscillations of the motor vehicle have harmful effects on its occupants, leading to fatigue and discomfort" [8].

The comfort of the road vehicle is determined by the level of mechanical vibrations that are transmitted to the goods or persons transported. Specialists in the field make thorough research in this regard, in order to know all the harmful effects transmitted by mechanical vibrations to the roads, to the organs or bodies of motor vehicles, but also to goods or passengers, in order to be able to determine and establish the optimal criteria of the means of road transport in terms of comfort and ergonomics.

1.2 Pollution caused by the hybrid and electric vehicle

The hybrid-powered vehicle has in its composition two types of engines, through which propulsion is ensured. A thermal engine (as a rule, gasoline) and one or more electric engines. Depending on the type of electric engine, it can provide traction independent of the thermal one, in order to increase efficiency and reduce pollutant emissions. The thermal engine can be powered by gasoline (less often

diesel), but also by alternative fuels such as methane gas, methanol or LPG (liquefied petroleum gas). At this time, all thermal engines mounted on new hybrid vehicles have the Euro 6 pollution standard.

The advantage of electric engines lies in the fact that, when descending a slope or at decelerations, the thermal engine stops or operates at idle, and the electric engines operate in regenerative mode (electric generator mode), and the kinetic energy thus obtained is sent and stored in the electric accumulators.

"Propulsion systems which have in their composition, in addition to a conventional system with an internal combustion engine, at least one other system which provides traction torque to the wheels of the vehicle and which recovers part of the kinetic energy obtained from deceleration, shall be referred to as regenerative hybrid propulsion systems." [1].

Due to the electric engine(s) mounted on this motor vehicle that runs in series or in parallel with the thermal engine (individually with autonomy in electric mode or as support of the thermal engine at traction), the exhaust gas emissions are reduced, being equal to or below the quantity of 130 and 95g/km respectively, regulated by the EU.

"The combination of the internal combustion engine and the electric engine is based on the perfect interaction between the modern control system and the optimized hybrid components. The management systems integrated in hybrid vehicles ensure that the switch between electric, hybrid and internal combustion powertrains is achieved without affecting passenger comfort. In this regard, the electronic control system has permanent access to data from the sensors of the internal combustion engine, the electric control unit, the state of charge of the batteries, etc. The management system analyzes, regulates and commands in real time the interaction between the two propulsion systems." [5].

We consider that the hybrid motor vehicle is the passing element, the axle, the interface between the classic and the electric vehicle. It is, if we could say, a temporarily viable alternative, found by mankind to the classic thermally motorized vehicle.

The electric-powered vehicle has the highest efficiency in terms of pollution because its polluting chemical emissions are zero, i.e. it does not pollute with exhaust gases. This is due to the fact that this type of vehicle uses for propulsion an electric engine(s) powered by electricity from a rechargeable electric battery.

The only source of chemical pollution in the case of this type of vehicles is the internal combustion engine (in the case of hybrid motor vehicle), the noises, mechanical vibrations produced during its movement on the earth's surface and the PM 2.5 fine particles resulting from the friction of the brake pads with the disc during braking (when they do not brake regeneratively).

Other sources of pollution in the case of hybrid vehicles also occur when there are accidental leaks or as a result of the failure of some systems or installations (brake fluid, antifreeze fluid, refrigerator agent from the air conditioning installations, fuel from the tank, engine oil, steering or transmission mechanism).

Also, another source of pollution that this type of motor vehicle produces is the pollution resulting from the manufacturing process. During the life cycle it pollutes audibly in traffic, produces mechanical vibrations in operation or when its used electrical batteries are replaced.

Noise pollution is the pollution produced by motor vehicles in operation and is created by the frictional forces between parts, structural elements or organs in motion by rotation or translation. Noise pollution is also caused by motor vehicles that are in dynamics when the air is rubbing with the external elements of the bodies or when the tires are contacted with the ground (the road).

The physical or objective characteristics of noise are [7]:

- *the intensity or strength of the sound* is the most important character that depends on the features of the source, the distance and the possibilities of transmission or multiplication. It is measured in decibels or phonies. The decibel is a physical quantity and represents the logarithmic unit calculated from the absolute audibility threshold of 0 dB for a sound of 1000 Hz. The phone is the physiological unit of perception by the human ear of the weakest sound arousal.

- *duration* - the time that the sound arousal (noise) acts on the auditory analyzer.

- *frequency* - represents the number of acoustic vibrations in a second and is measured in the number of periods per second or Hz.

Road traffic noise is defined as the sound produced by the mechanical vibrations emanating from the environment that are transmitted to the hearing aid of living beings, possessors of auditory organs.

For example, the human ear perceives sound waves with frequencies in the range of 16–20.000 vibrations per second, and their intensity perceives it in the range of 0 to 120 dB.

People, to communicate with each other, talk producing vibrations of the environment with sound variations in the range of 30-60 dB. The range of 20-30 dB does not pose a danger to the human ear, the maximum limit borne by man being 80 dB. A sound level of about 130 dB creates acoustic pain for the human ear, and those of 150 dB can no longer be supported.

"Around 20% of the EU population suffers from noise levels, which health experts find unacceptable" [7].

"113 million people are affected in the long term by day-evening-night road noise levels of at least 55 decibels [dB(A)]. In most European countries, over 50% of urban residents are exposed to road noise levels of 55 dB or higher..... According to the WHO, at this level there is a high probability that health effects will occur" [2][12].

"The 2003 EU Noise Directive, which entered into force in all Member States in 2006, sets a daily exposure limit value (8 hours) to noise of 87 dB" [5].

As regards the European Union's policies on noise pollution, the *"Green Paper"* [9] refers to *"Future policies on noise"*[9]. With regard to these policies, the European Commission has referred to environmental noise as *"the main environmental problem on the European continent"* [9].

Figure 1 shows the negative effects of noise on human health.

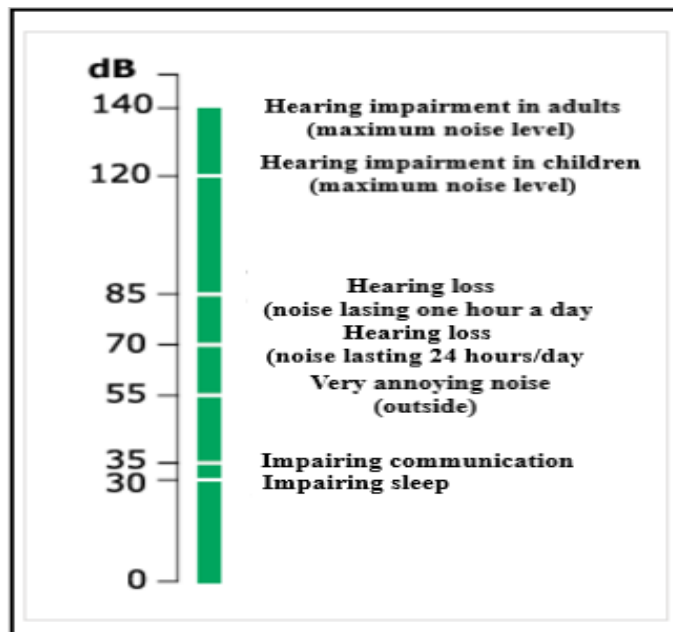


Figure 1. Negative effects of noise on human health [3].

2. Current European standards on the quality of gas emissions from motor vehicles

"The last two decades have included the 18 warmest years that have ever been recorded. The trend is obvious. Immediate and decisive action towards the fight against climate change is essential" [11].

In order to reduce pollution, the European Parliament and the Commission are constantly concerned that the transport sector, in particular, automotive transport eliminates less harmful gases in

the environment, which kill people and animals, damage the lives of human biotopes and habitats, create and deepen global warming.

In this regard, they come up with strict legislative proposals, to which all European countries must submit, regardless of whether they are part of the Schengen area or not. All legislative proposals in this direction become laws on the basis of which applicable rules and standards are established, which must be respected by all vehicle manufacturers on the territory of the European continent.

Exhaust emission standards are not an environmental label in the strictest sense, but require compliance with the limit values set for air pollutants emitted by new vehicles.

The threshold values, in accordance with the European emission exhaust standard for internal combustion engines, apply to the following air pollutants: carbon monoxide (CO), nitrogen oxides (NO_x), all hydrocarbons (HC) and particulate matter (PM). The threshold values vary according to the type of engine and type of vehicle and are constantly reviewed by the European Parliament's Commission.

The limit values for the emission pollutant concentrations in the flue gas of EU internal combustion engines, which are subject to pollution standards, and the date of their entry into force, are set out in Table 1:

Table 1. Limit values for the European pollution standards and the date of their entry into force

Pollution norm Limit values (g/km)	Euro 1	Euro 2, ID	Euro 2, IID	Euro 3	Euro 4	Euro 5	Euro 6
CO	2,72	1,0 (63,24%)	1,0 (63,24%)	0,64 (36%)	0,50 (21,88)	0,50 (0%)	0,50 (0%)
NO_x	-	-	-	0,5	0,25 (50%)	0,18 (28%)	0,08 (55,56%)
HC+NO_x	0,97	0,70 (27,84%)	0,90 (7,22%)	0,56 (37,78%)	0,30 (46,43%)	0,23 (23,33%)	0,17 (26,09%)
P.M.	0,14	0,08 (42,86%)	0,10 (28,57%)	0,05 (50%)	0,025 (80%)	0,005 (80%)	0,005 (0%)
Date of entry into force of the norm (day/month/year)	01.07.1992	01.01.1996	01.01.1996	01.01.2000	01.01.2005	01.01.2009	01.09.2014

Note: The values in parenthesis show us the percentage of the reduction of the newly implemented polluting emissions norm compared to that of the pollution standard presented above;

Motor vehicles whose engines operate by indirect injection (IID-Euro 2) were required as minimum exhaust gas limits, those of direct injection engines (ID-Euro 2). The requirement entered into force on September 30, 1999.

After all this, the pollution standard EURO 5 has applied to all types of vehicles as from January 1, 2011.

3. Effects of pollution on humans and human habitats

Along with the industrial development, factories and plants were considered the main polluters of the environment, but given the technological progress in the field of transport, today they are the main source of pollution of human habitats, with almost 30% of the volume of CO₂ emissions in the EU. 72% of the total come from road transport.

Specialists claim that, worldwide, 21% of the total CO₂ emissions are due to the transport sector, the road sector accounting for three quarters of the pollutant gas emissions, of which 15% are CO₂ emissions from the combustion of fossil fuels in vehicle engines. Most of the polluting gases are produced by passenger transport vehicles (45.1%), respectively from freight vehicles (29.4%).

"The average global mortality from environmental pollution is estimated at 8.8 million people per year. The global average mortality rate is about 120 people per year per 100.000 inhabitants, which is far exceeded in East Asia (196 people per year per 100.000 inhabitants) and Europe (133 people per year per 100.000 inhabitants). Without fossil fuel emissions, the global average life expectancy would increase by 1.1 (0.9-1.2) years and 1.7 (1.4-2.0) years by eliminating all emissions" [6].

In this regard, in order to reduce environmental pollution, the EU has set a target of reducing CO₂ emissions from transport by 60% by 2050, comparing with the level of pollution in 1990.

"Lately, a term associated with the environment is pollution, which manifests itself as a continuous aggression against its integrity. Pollution is, in fact, the price that people pay for the benefits brought about by modern technology. What is now called pollution is the end of a process that began with the formation of human communities and which, at some point, began to degrade the environment" [4].

Thus, in November 2018, the European Commission presented the European Union's long-term strategy to reach an environmentally neutral economy by 2050. That action comprises eight possible ways.

In this regard, the European Parliament voted on a resolution of recommendations on March 14, 2019, and MEPs called on those responsible to raise the target of reducing polluting emissions for 2030 and repeated for the second time its position to allocate funds of at least 35% of research expenditure, such as *Horizon Europe* [19] for example, in projects to support climate objectives.

By itself, pollution constitutes the contamination of the environment with materials that affect the normal functioning of nature, bringing significant changes to ecosystems and seriously affecting human health.

In former times the population, which had a low density on the earth's surface, did not pose significant problems to environmental pollution, but once the density of the global population increased exponentially, the effects of this demographic development began to be seen through the residues thrown into nature and the generation of large quantities of pollutants resulting from social and industrial activities. This harm to the environment with time, affected air quality, water and soil, destroyed people's health, creating the premise of serious illnesses or premature deaths. However, we, as inhabitants of this planet, have not been sufficiently aware and have treated the measures to combat it superficially.

"A mix of decarbonized, decentralized and digitized energy, more efficient and sustainable batteries, highly efficient electric powertrains, connectivity and autonomous driving, offer opportunities to decarbonize road transport with important global benefits, including clean air, noise reduction, accident-free traffic, all of which taken together generate major health benefits for citizens and the European economy" [11].

The main problem of pollution is air quality, which has decreased considerably in areas of congested cities. The World Health Organization has estimated that more than seven million people die annually due to the harmful effects of air pollution. A problem in this regard is the very air breathed by people in the crowded metropolises of the world and in the dwellings where they live.

Chemical air pollution has harmful effects on the human body, causing sleep disturbances, and more seriously, it develops cancerous tumors. More and more doctors claim that particulate matter and high temperatures irreparably affect the heart, respiratory function and the central nervous system. All this increases the risk of developing cardiovascular diseases and can cause strokes. The effects of

pollution can also produce various allergies that later degenerate into asthma. Frequent exposure to various types of pollutants, solvents or perfumes, generates in some people multiple chemical sensitivity, known as environmental disease, having manifestations similar to allergic reactions.

The main chemical compounds resulting from the road transport process, which pollute the environment are: dust particles, carbon monoxide, hydrocarbons, nitrogen oxides, soot, sulfur dioxide, lead compounds, benzo- α -pyrene, aldehydes and heavy metals. The exposure of the human body to the vast majority of these harmful chemical compounds, can irreversibly damage human health or cause death. For example, carbon monoxide reduces the body's ability to transfer oxygen to the blood and is dangerous for people with heart disease, a high concentration of this chemical compound in the blood causes the death of living cells. Lead attacks the nervous system, kidneys and liver, creates anemia, hypertension and osteoporosis, and exposure to high amounts generates loss of consciousness, convulsions and mental retardation. Benzene has an effect on the central nervous system and is carcinogenic.

Another disruptive factor of the environment is noise, noise (sound) pollution. Noise or sound pollution is transmitted into the atmosphere via sound waves. Produced at a high intensity, they become disturbing and irreversibly damage the human inner ear.

In the case of the road transport system, the sound waves come from the frictional parts and organs of motor vehicles and machinery, but also from the contact of the running system with the ground. Infrasound produces nervous disorders, decreasing the ability for physical and intellectual work. Within the road transport system, the highest level of noise is found in major urban intersections. As a result of the increase in the motorization degree of the population, the intensity of road traffic in the last period has increased and, as a result, the level of urban and interurban noise is high.

Therefore, in order to reduce the level of chemical, noise pollution and mechanical vibrations from motor vehicles, mankind must find as soon as possible alternatives to the way of travel by means of road transport. It can only be solved by using ecological, environmentally friendly vehicles, the frequent use of public transport, avoiding unnecessary journeys and moving towards other transport systems.

A sustainable and durable future of the road transport system cannot be ensured unless urgent measures are taken to limit and even eliminate all polluting environmental sources. This depends on each of us, on the education of each of us and on our behavior and manifestations towards the environment. We believe that if we behave in a principled manner with nature, in the future it will show its gratitude to us and the generations to come.

4. Conclusions:

Air pollution is the phenomenon by which the chemical composition of air is intervened in the form of a change in the proportion of its constituents or by the emergence of new constituents that enrich forms harmful to biotopes, biodiversity, affect human health, flora and fauna.

Current hybrid motor vehicles produce maximum noises in motion at a level of 60-69 Db, and in stationary the noise level in dB does not exceed 65-70 Db. So, the main source of chemical and noise pollution of the environment is the road vehicles propelled by thermal engines that fall under the non-Euro – Euro 5 pollution norms.

Environmental pollution related to transport processes is characterized by noises produced by the loud uncoordinated sounds produced by heavy traffic or by exhaust gases eliminated by vehicles operating or moving near human settlements.

In everyday life, the effects of the noises produced by the road transport system are perceived by people and sometimes become unbearable in large urban agglomerations, where road traffic is heavy. Modern vehicles are increasingly quieter, but the denser the traffic, the sound and noise they produce accumulate and are further amplified by the vertical walls of buildings or art monuments in the immediate vicinity of streets or intersections.

The ethical principle of 'Polluter pays' applies to all transport organizations that do not comply with environmental legislation in transport. According to research conducted at this time, the transport sector pollutes more globally than industry, over 70%.

After the signing of the Treaty of Rome, as from January 1958, the fundamental principles of the Common Transport Policy (PCT) were established, by which the so-called four freedoms were applied among the signatory states.

At EU level, but also in Romania, automotive transport is the most preferred option of the population, which makes it the main polluter of the environment, contributing greatly to climate change.

Within the road transport system, road traffic is the main source of noise pollution, affecting human health, biodiversity and the human habitats in the territorial land areas.

The limit values according to the emission exhaust standards for the engines of internal combustion vehicles have periodically decreased along with the entry into force of the Euro 1 norm on July 1, 1992, therefore, at the entry into force of the Pollution Standard Euro 6 on September 1, 2014, the threshold values are reduced, so that the level of pollutants from vehicles causes less damage to nature and human health. This was due to EU policies on road transport pollution, and the decreases by nuisance category for road vehicles were as follows:

- ✓ for carbon monoxide (CO) - Euro 1 (2.72 g/km) to Euro 6 (0.50 g/km), the result is a decrease of 18.38%;
- ✓ for nitric oxide (NO_x) - Euro 3 (0.5 g/km) to Euro 6 (0.08 g/km), the result is a decrease of 16%;
- ✓ for all hydrocarbons (HC+NO_x) - Euro 1 (0.97 g/km) to Euro 6 (0.17 g/km), the result is a decrease of 17.52%;
- ✓ for particulate matter (PM) - Euro 1 (0.14 g/km) to Euro 6 (0.005 g/km), the result is a decrease of 3.57%.

In order to significantly reduce carbon emissions from motor vehicles, the European Commission argues that manufacturers will have to improve the fuel efficiency of their fleet and accelerate the production of low and zero-emission vehicles.

Given the data researched so far and those presented by the EEA (European Economic Area), we can show that the average pollutant emissions for new vehicles registered in the EU Member States (27 countries), to which Iceland, Great Britain and Norway are also added, were 122.4 grams CO₂/ km in 2019, with an increase of 1.6 g compared to 2018. Although these emissions were below the EU's 2018 target of 130 g/km, however, pollutant emissions instead of falling have increased alarmingly.

In order to take action accordingly, at the level of 2020, the EC (European Commission) has set even tougher measures in terms of CO₂ emissions from motor vehicles. They will not exceed 95 grams of CO₂/km compared to 2019. Therefore, all European vehicle manufacturers are obliged to refer exactly to this figure if they do not want to bear penalties.

Making a critical analysis of this sector, given the research and studies carried out, we found that these figures have climbed as a result of the population's appetite for the purchase of new, medium and large SUV-class vehicles. This type of vehicle has a high fuel consumption as a result of powerful engines with high displacement, poor aerodynamics (massive bodies with non-performing aerodynamic coefficient), but also due to the technical operating conditions given by the 4x4 traction, which involves low speeds to ensure high traction powers, at high engine speeds, with a high fuel consumption and implicitly, several nuisances eliminated in the atmosphere. Statistics show that Europeans purchased in 2020 with 38% more such vehicles compared to 2019, although the SARS CoV-2 pandemic has affected the economies of EU countries, but also the European production of motor vehicles, keeping people at home. This is also due to the massive purchase of vans by Europeans in 2019 and 2020, simultaneously with motor vehicle sales, which have declined.

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