

Air Pollution And Environmental Hazards From Vehicle Exhaust: A Case Study Of The City Of BOUIRA (North-Central Algeria)

تلوث الهواء والمخاطر البيئية الناتجة عن عوادم المركبات:

دراسة حالة مدينة البويرة (شمال وسط الجزائر)

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Date Of Receipt: 08/02/2026

Date Of Acceptance: 30/03/2026

Date Of Publication: 31/03/2026

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ملخص:

يُعتبر تلوث الهواء منذ فترة طويلة مشكلةً مرتبطة بالدول الفقيرة، لكنه في الوقت الراهن لا يستثني الدول النامية ولا المتقدمة، وأضحى يشكل تحدياً صحياً عالمياً. يهدف هذا العمل إلى دراسة التلوث الجوي الناتج عن غازات العادم في مدينة البويرة شمال الجزائر، وذلك من خلال تحديد وقياس مختلف الملوثات أو الجسيمات المنبعثة من السيارات، وتقدير مستوى التلوث لكل مكون على حدة، بما مكن من تحقيق الهدف المسطر.

اعتمدت الدراسة على بيانات مستخرجة من البطاقات التقنية للفحص داخل محطة المراقبة التقنية بمدينة البويرة، حيث أُجرى العمل الميداني خلال الفترة الممتدة من فبراير إلى يونيو 2022، مما أتاح الوصول إلى تقديرات موثوقة. أظهرت النتائج أن البيئة تشهد تركيزاً مرتفعاً من أول أكسيد الكربون، إضافة إلى نسب مرتفعة من الهيدروكربونات، وهو ما يعكس خطورة الانبعاثات الغازية على الصحة العامة والبيئة المحلية.

الكلمات المفتاحية:

التلوث الجوي؛ غازات العادم؛ الصحة؛ أول أكسيد الكربون؛ الهيدروكربونات.

Abstract:

Air pollution has long been considered a problem specific to developing nations however, it now affects both developing and developed nations alike, becoming a global public health issue. This study aims to examine air pollution caused by vehicle exhaust gases in the city of Bouira, located in northern Algeria, by identifying and measuring the various pollutants and particles emitted from vehicles, and by assessing the pollution level of each component individually. The research relied on data obtained from technical inspection cards at the vehicle inspection station in Bouira, where the fieldwork was conducted between February and June 2022. This approach provided reliable estimates of pollutant emissions. The results indicate elevated atmospheric concentrations of carbon monoxide, with particularly elevated levels of hydrocarbons, underscoring the severity of gaseous emissions for public health and the local environment.

<i>Review EL'BAHITH - ENS - Bouzareah - Algiers</i>					
<i>ISSN : 9577-1112</i>	<i>EISSN : 2602-5388</i>	<i>Volume: (18)</i>	<i>Number : (01)</i>	<i>year: 2026</i>	<i>Pages: 172-191</i>

Keywords: *Atmospheric pollution; carbon monoxide; exhaust gases; health; hydrocarbons*

1. INTRODUCTION:

Exposures to environmental pollution remain a major source of health risk throughout the world (Bhanu et al., 2014), though risks are generally higher in developing countries (Vladimir, et al., 2018), where poverty, lack of investment in modern technology and weak environmental legislation combine to cause high pollution levels (Sang-K. and Zang, 2014). Associations between environmental pollution and health outcome are, however, complex and often poorly characterized (Elise E. M. M. et al., 2002). Air pollution was long considered an “environmental burden” specific to low-income countries, but nowadays it spares neither underdeveloped nor developed countries and is becoming a global health problem (Ioannis et al., 2020).

Air pollution is one of the most critical public health challenges of our era (Rico.A, 2020), on account not only of its impact on climate change but also its impact on public and individual health due to increasing morbidity and mortality (Mahmoud A., 2011). There are many pollutants that are major factors in disease in humans (Kevin, 2012). Among them, Particulate Matter (PM), particles of variable but very small diameter, penetrate the respiratory system via inhalation, causing respiratory and cardiovascular diseases, reproductive and central nervous system dysfunctions, and cancer (Suleimana, 2019). Despite the fact that ozone in the stratosphere plays a protective role against ultraviolet irradiation, it is harmful when in high concentration at ground level, also affecting the respiratory and cardiovascular system (Rojaramani, 2019).

Transport plays a fundamental role in the lives of societies and individuals (Alminas, 2009): how people interact, work, play, organize production, develop cities, and get access to services, amenities and goods is inextricably linked with the development of mobility and the choices people make about it (Avishai (Avi), 2020). In societies that rely heavily and increasingly on private motorized transport, vehicles are expected to become safer, more luxurious and powerful, and to be driven more frequently (Daniel J., 2015). These expectations, however, often do not take account of the ensuing consequences: increased fuel consumption, greater emissions of air pollutants and greater exposure of people to hazardous pollution that causes serious health problems (Pier M, 2017). The increased intensity of and reliance on transport also increase the risk of road-traffic injuries, exposure to noise and sedentary lifestyles (Vasyl, 2020), these risks are a disproportional threat to the most vulnerable groups in the population, such as children and the elderly, and they raise important questions about social inequalities (Anna, 2008).

Motor vehicles are a significant source of urban air pollution (Siti H., 2020). Adverse effects on health due to proximity to roads were observed after adjusting for socioeconomic status and after adjusting for noise (Duque L., 2016). Elevated health risks associated with living in close proximity to roads is unlikely to be explained by PM_{2.5} mass since this is only slightly elevated near roads (David, 2017). In contrast, levels of such pollutants as ultrafine particles, carbon monoxide, NO₂, black carbon, polycyclic aromatic hydrocarbons, and some metals are more elevated near roads (Araviiskaia, 2019). Individually or in combination, these are likely to be responsible for the observed adverse effects on health (Katerina, 2019). Current available evidence does not allow discernment of the pollutants or pollutant combinations that are related to different health outcomes, although association with tailpipe primary PM is identified increasingly (Simonas, 2019).

The objective of this work is to study the atmospheric pollution generated by the exhaust gases in the city of Bouira in the North of Algeria. The quantification and qualification of the various pollutants or particles emitted by cars on the one hand, and the determination of the level of pollution of each particle on the other hand, enabled us to achieve the set objective. The work carried out was therefore based on data obtained from a survey of the technical control station within the city of Bouira; the field took place between February and June 2022 in order to reach the estimates. Reliable digital the results obtained show that the environment is highly concentrated in carbon monoxide and especially in hydrocarbons,

2.Materials and Methods

2-1- Studyarea

The city of Bouira, is the capital of the commune of Bouira which is located in the second crown of the North-Center of the country, 120 km south-east of the capital Algiers, it is located at the convergence of three national roads: - RN 05 which connects Algiers and Constantine via Bouira, - RN 33 which connects Bouira and Tizi-Ouzou via Haizer (Naziha, 2020).

In terms of land use planning, the city of Bouira is part of the unity planning defined by the PAW and which includes the municipalities of: Bouira, Ain Turk, Ait Laaziz, El-Hachimia and Oued-El-Berdi (Figure 1). The climate of Bouira in general is of the continental type characterized by cold winters and hot and dry summers, because the chain of Djurdjura will slow down the influence of the Mediterranean (Zeggane, 2021).

For the city of Bouira, road movements are made from the "bus station" whose counts that have been made there indicate that the capacities are largely exceeded. Indeed, with an average of 1000 daily movements to various destinations and 2 movements per minute at the morning rush hour, this terminal is no longer able to

meet customer needs. Finally, it should be noted that in 2006, 789 accidents were counted on the RN5, of which 62% were identified on the only section of the Bouira-Algiers relationship which belongs to the city of Bouira. Despite such a negative road traffic situation on the Bouira-Algiers relationship, the participation of the rail mode remains almost non-existent, even constantly decline, due to the lack of regional line operation and the poor performance of trains in transit.

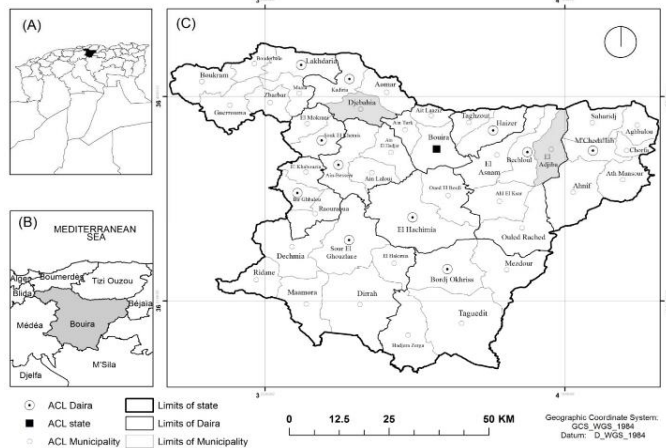


Figure1. Location of study area

The technical inspection station for vehicles is located in the city of Bouira, where urban clusters intersect with agricultural land, as illustrated in the satellite image. The station lies adjacent to National Road No. 5, a major axis linking northern and eastern Algeria. This strategic positioning highlights the station's role as an intermediary facility between the city and road users, enhancing its capacity to accommodate vehicles arriving from various surrounding region

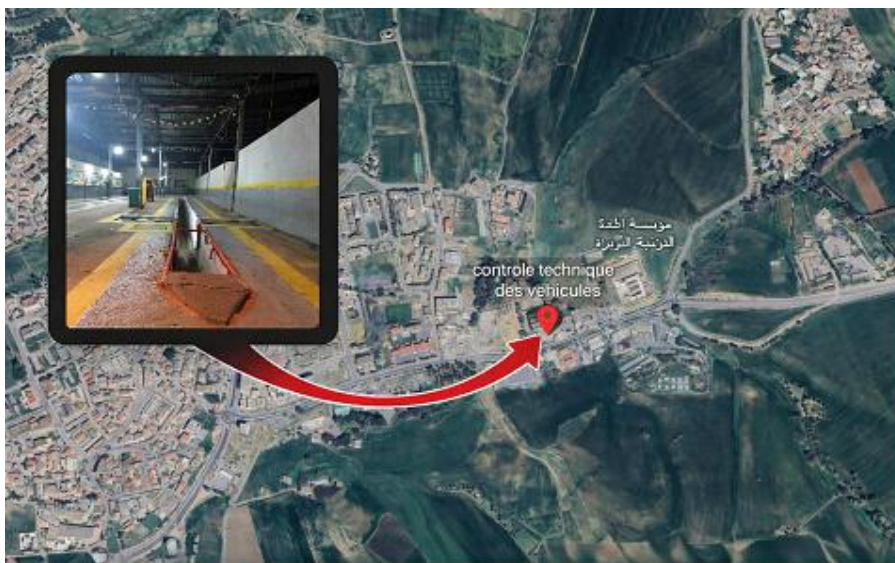


Figure 2: Geographical Location of the Bouira Vehicle Technical Inspection Station.

District	Energy Source				Total
	Gazoline	%	Diesel	%	
Ain Defla	24397	70,19	10360	29,81	34757
Alger	651929	71,33	262014	28,67	913943
Bejaia	62899	55,59	50247	44,41	113146
Blida	147655	76,42	45561	23,58	193216
Bouira*	42735	73,03	15779	26,97	58514
Boumerdes	60895	63,27	35345	36,73	96241
Chlef	45291	58,68	31894	41,32	77185
Médéa	38929	64,67	21265	35,33	60193
Tipaza	58115	73,16	21319	26,84	79435
Tizi Ouzou	60357	50,68	58738	49,32	119095

Table1.

Distribution of the car national fleet in the North Central cities and energy source until 31/12/2021
Source: National Statistical Office, Algeria, 2021.

*Bouira: Study area

Table 01 shows that the Bouira city's fleet reached 58514 vehicles at the end of 2021, ranking second to last in the North-Centre region's total fleet, with gasoline vehicles contributing 73.03% and 26.97% to vehicles using fuel oil.

2.2. Natural fresh air

Clean air is a basic requirement of life (Muhammad, 2019). Indoor air quality (IAQ) (see glossary) describes the cleanliness or content of the air inside buildings, particularly as it relates to the health of occupants (Isabelle, 2018). Gases or particles released into the indoor air that may affect health arise from multiple sources, as wide-ranging and common as gas cookers, new carpets and furniture, cleaning products, and the materials used in construction of the dwelling (Jim, 2008). To these are added excess moisture in the air, the presence of biological agents, and polluted air from external sources (Fraser R, 2015). The effects on health of polluted indoor air may be experienced in the short-term or after repeated exposure, although determining a specific link between exposure and symptoms is far from simple, given variations in the physical environment, individual sensitivity and underlying medical conditions. Nevertheless, the evidence indicates that the health impact can be severe (Isobel, 2019).

Air is a mixture of several gases, where the two most dominant components in dry air are 21 vol% oxygen and 78 vol% nitrogen, Oxygen has a molar mass of 15.9994 g/mol and nitrogen has a molar mass of 14.0067 g/mol, Since both of these elements are diatomic in air - O₂ and N₂, the molar mass of oxygen gas is 32 g/mol and the molar mass of nitrogen gas is 28 g/mol (Peter, 1996).

The average molar mass is equal to the sum of the mole fractions of each gas multiplied by the molar mass of that particular gas:

M mixture = (Xi*Mi +,,,,, + Xn*Mn) (1) Where

Xi = mole fractions of each gas

Mi = the molar mass of each gas

The molar mass of dry air is 28.9647 g/mol, Composition and content of each gas in air is given in the table below (Iribarne, 2012).

Gas		Mole fraction	
Name	Formula	in ppm	in %
Nitrogen	N ₂	780,840	78,084
Oxygen	O ₂	209,460	20,946
Argon	Ar	9,340	0,9340
Carbon dioxide	CO ₂	417	0,0417
Neon	Ne	18,18	0,001818
Helium	He	5,24	0,000524
Methane	CH ₄	1,87	0,000187
Krypton	Kr	1,14	0,000114

Table 2. Major constituents of dry air, by mole fraction
Source : Pedro de F.V, 2020.

2.3. Statistical analyzes

Reports indicate that 84% of transportation emission-related deaths took place in the G20 countries (Awais and Muhammad, 2022). Only four of the largest vehicles markets in the world, i.e., China, India, the European Union (EU) and the United States, were responsible for 70% of these deaths (Susan C et al., 2019). Such deaths have been declining in the EU and the USA. However, they are increasing in China and India. The death toll from transport-related pollution is also increasing in most other parts of the world (Ruwantissa, 2016).

Rapidly growing urban populations and industrialization have led to an ever-growing demand for energy and has altered land use patterns (Manish and Ram, 2019). The energy and transportation demands for urban populations are met by fossil-fueled vehicles creating pockets of high pollution in and around the urban areas (Benjamin K, 2009). Declines in air quality have become an important concern

in the cities around the world, and the situation has worsened in the past few decades (Rafia et al., 2003). Air pollution in developed countries has decreased in the recent years due to stricter emissions control requirements, the introduction of cleaner fuels and technological innovations in renewable resources (Crippa et al., 2015). However, in developing countries, the situation has generally worsened due to inefficient energy utilization in systems such as biomass cookstoves, coal-fired building heating systems, and poorly maintained vehicles (Tiwari, 2018).

Algeria has adopted the same program as the other Mediterranean countries to reduce the lead content in gasoline (0.15 g L1) (Kerbachi et al., 2013). According to refineries' officials, the gasoline aromatic content varies between 35% and 40%, where benzene represents 2.5-3.0% of the total aromatics (Rabah et al., 2006). The substitution of lead by benzene and other aromatic compounds (European Council [EC] Directive 85/210) in gasoline has been the object of several studies, which clearly proved the increase of aromatic emissions in the atmosphere. In order to limit benzene emissions in the atmosphere, the EC Directive has fixed the maximum benzene content in petrol at 1% (Yacine et al., 2012).

2.4. Types and Sources of Air Pollutants

The interactions between humans and their physical surroundings have been extensively studied, as multiple human activities influence the environment. The environment is a coupling of the biotic (living organisms and microorganisms) and the abiotic (hydrosphere, lithosphere, and atmosphere) (Jennifer M, 2021). Pollution is defined as the introduction into the environment of substances harmful to humans and other living organisms, Pollutants are harmful solids, liquids, or gases produced in higher than usual concentrations that reduce the quality of our environment (Andrew, 2007).

Air pollution has various health effects, the health of susceptible and sensitive individuals can be impacted even on low air pollution days, Short-term exposure to air pollutants is closely related to COPD (Chronic Obstructive Pulmonary Disease), cough, shortness of breath, wheezing, asthma, respiratory disease, and high rates of hospitalization (a measurement of morbidity (Erza G, and Muhammad,2021)

All chemical, biological and physical agents that modify the natural characteristics of the atmosphere are referred to as "air pollutants". Air pollutants arise both from natural processes (volcanic activities, oceans, forests, etc.) and human activities (fossil fuel combustion, transportation, power plant emissions or emissions from other industrial processes). Air pollutants can be classified as either primary or secondary. Primary pollutants are substances directly produced by a process, such as ash from a volcanic eruption or carbon monoxide gas from a motor vehicle exhaust. Primary pollutants can be transformed in the lower atmosphere by

solar radiation and heat into secondary pollutants, such as ozone (O3) and other photochemical pollutants.

Air pollution and specifically urban air pollution remain worrying concerns. Indeed, exposure to air pollutants can lead to an increase not only in morbidity but also in mortality. Even if important progress was made in order to reduce emissions of industrial sources, with a substantial decrease in SO2 concentrations, road traffic has become the first source of emissions in urban areas, with a subsequent increase in photo-oxidant air pollution. So the means of transportation and communication are the largest contributor to atmospheric air pollution and therefore the general climate pollution, Table 03 shows that transport contributes to air pollution in the following proportions: 92% CO, 4% SO2, 65% HC and 42% NO-NOx.

Source	CO (%)	SO ₂ (%)	HC (%)	NO-NO _x (%)
Transportation	92	4	65	42
Industries	4	32	26	21
Power plants	-	48	-	32
Space heating	3	12	3	5
Combustion	1	4	6	0

Table 3. Global percentages of the impact of air pollution
Sources (Riley and Felix, 2018)

2.5. Vehicle exhausts gases and pollutants

Pollutants from vehicle engines are mainly CO (carbon monoxide), NOx (oxides of nitrogen), fine particles and HC (hydrocarbons) (Shivaji, 2013). These four pollutants are known as ‘local pollutants’ in that when emitted, they remain in the vicinity in which the vehicle has driven (Marion and Philippe, 2022). They are also subject to controls by European legislation that places limitations on vehicle emission levels (Barouch et al., 2018). Consequently, motor manufacturers and oil companies have been required to take steps to improve engine design and fuel quality to satisfy these controls, and have consequently succeeded in reducing the levels of these local pollutants (Gautam T, 2014).

Emissions from fuel oil combustion depend on the grade and composition of the fuel, the type and size of the boiler, the firing and loading practices used, and the level of equipment maintenance (Pirjola et al., 2004). Because the combustion characteristics of distillate and residual oils are different, their combustion can produce significantly different emissions (Qi et al., 2010). In general, the baseline emissions of criteria and non-criteria pollutants are those from uncontrolled

Review EL'BAHITH - ENS - Bouzareah - Algiers					
ISSN : 9577-1112	EISSN : 2602-5388	Volume: (18)	Number : (01)	year: 2026	Pages: 172-191

combustion sources, uncontrolled sources are those without add- on air pollution control (APC) equipment or other combustion modifications designed for emission control (Mahboob et al., 2007) . Baseline emissions for sulfur dioxide (SO₂) and particulate matter (PM) can also be obtained from measurements taken upstream of APC equipment (Dayana M et al., 2019).

2.5.1. Carbon dioxide (CO₂): Carbon dioxide (CO₂), as one of the greenhouse gases (GHGs) emissions emitted by human activities, is the main cause for climate change (Alexey et al., 2020). As of 2018, global CO₂ emissions had increased to 37.1 Gt, of most of which still comes from the combustion of fossil fuels from a wide range of industrial processes and transportation. (Zhien et al., 2020).

2.5.2. Carbon monoxide (CO): This invisible gas is the result of incomplete combustion of fuel and is very toxic to humans (Mani et al., 2009). Most modern engines only produce tiny amounts of CO thanks to efficient combustion processes, but older engines are bigger offenders (Timothy, 2016). Symptoms of CO poisoning may include headache, dizziness, weakness, nausea, vomiting, and finally loss of consciousness. The symptoms are very similar to those of other illnesses, such as food poisoning or viral infections (Patrick C et al., 2018).

2.5.3. Nitrogen oxides (NO_x): Nitrogen oxides are produced in any combustion process (Lopatin O, 2020). They are highly reactive and can contribute to smog when they come into contact with other airborne chemicals. Some manufacturers famously cheated NO_x tests (Rahila R and Siddiqui, 2014). Nitrogen oxides are important ambient air pollutants which may increase the risk of respiratory infections (Pier M and Massimo, 2017).

2.5.4. Sulfur dioxide (SO₂): This is a colourless gas that smells like burnt matches and occurs naturally in crude oil used to refine petrol and diesel (Paul R and Jesse, 2002). It forms acids when burned, leading to engine corrosion and smog. SO₂ is very harmful for plant life, animal, and human health (Sarath K et al., 2019). People with lung disease, children, older people, and those who are more exposed to SO₂ are at higher risk of the skin and lung diseases (Calvo et al., 2013).

2.5.5. Hydrocarbons (HC): HCs escape from exhausts as unburnt fuel due to incomplete combustion (Neal et al., 2014). They also evaporate from the fuel tank and nozzle when you fill up at the petrol station (Subhashish et al., 2019).

2.5.6. Benzene (C₆H₆): This occurs naturally in petrol and diesel in very small quantities and is also emitted from vehicle exhausts as unburnt fuel (Shivaji, 2013). Benzene is a carcinogenic substance and high levels of inhalation can severely harm human health (Mihriban Y et al., 2015).

2.5.7 Particulates: Particles consist of elemental carbon core and a large number of adsorbed substances, such as heavy metals and various organic compounds (Xiao-q et al., 2006). These are volatile or semi-volatile organic compounds, such as polycyclic aromatic hydrocarbons (PAHs), nitroarenes, etc., material of biologic origin, animal and plant debris and fungal spores, ions (sulfate, nitrate) and reactive gases (ozone, peroxides, aldehydes) and inorganic components (SiO_2 , Fe_2O_3 and Al_2O_3) (CÉLIA A, 2008). Diesel engines emit airborne particles of black soot and metal, known as particulate matter (Ivan G and Maria de F, 2015). Modern cars are fitted with diesel particulate filters (DPFs) to stop these harmful particles being pumped out into the atmosphere (Jiacheng Yet al., 2018).

2.5.8. Lead: Historically, the major source of lead emissions to the air was combustion of leaded gasoline in motor vehicles (such as cars and trucks) (Timothy J et al., 2022). Following the elimination of leaded gasoline in the United States by the mid-1990s, the remaining sources of lead air emissions have been industrial sources, including lead smelting and battery recycling operations, and piston-engine small aircraft that use leaded aviation gasoline (Howard W and Sammy,2012). Lead accumulates in bones, blood, and soft tissues of the body. Exposure to lead can affect development of the central nervous system in young children, resulting in neurodevelopmental effects such as lowered IQ and behavioral problems (Angelika E, and Jeffrey, 2020).

In Table 4, the standard level of some conventional air pollutants is presented in which the values were defined as air quality standards that provide public welfare protection. As it can be easily understood, fossil fuel consumption shares the largest part of air contamination. Air pollutants can also be classified into anthropogenic and natural according to their source of emission. From anthropogenic aspect, air contamination occurs from industrial and agricultural activities, transportation, and energy acquisition. While from natural contaminant has different sources of emission such as volcanic activities, forest fire, sea water, and so on.

Air pollutants®	Major source of emission	Averaging time	Standard level	Health impact target organs
Particle pollutants				
PM _{2,5}	Motor engines, industrial activities, smokes	24 h	35 µg/m ³	Respiratory and cardiovascular diseases, CNS and reproductive dysfunctions, cancer
PM ₁₀		24 h	150 µg/m ³	
Ground-level ozone	Vehicular exhaust, industrial activities	1 h	0,12 mg/m ³	Respiratory and cardiovascular dysfunctions, eye irritation
Carbon monoxide	Motor engines, burning coal, oil and wood, industrial activities, smokes	1 h	35 mg/m ³	CNS and cardiovascular damages
Sulfur dioxide	Fuel combustion, burning coal	1 h	75 µg/m ³	Respiratory and CNS involvement, eye irritation
Nitrogen dioxide	Fuel-burning, vehicular exhaust	1 h	100 µg/m ³	Damage to liver, lung, spleen, and blood
Lead	Lead smelting, industrial activities, leaded petrol	3 months average	0,15 µg/m ³	CNS and hematologic dysfunctions, eye irritation
Polycyclic aromatic hydrocarbons *	Fuel combustion, wood fires, motor engines	1 year	1 ng/m ³	Respiratory and CNS involvement, cancer

Table 4. Standard level of criteria air pollutants and their sources with health impact based on the United States Environmental Protection Agency

*Air quality standards according to the European Union; ® PM_{2,5} is stand for PM of 2,5 µm or less, PM₁₀ is stand for PM of 10 µm or more, PM = Particulate matter, CNS = Central nervous (Adel et al., 2016)

The type of fuel used (gasoline, diesel) controls the average amount of emissions from motor vehicles (cars), which results in many pollutants such as: carbon gases, sulfur, nitrogen, etc. Limited oxygen (air) with gasoline in the engine room, where each one gram of gasoline is mixed with 14.6 grams of oxygen, and a malfunction of an imbalance in this ratio will affect the engine performance and exhaust emissions negatively*), and Table 5, shows Standard quantities of pollutants from petrol and diesel cars (g) of pollutants per (kg) of fuel [gm/L.

Pollutant Quality	Gasoline cars	Diesel Cars
carbon monoxide CO	301,6	9,28
carbon dioxide CO ₂	180	191
Nitrogen Oxides NO _x	2,2	15,08
Sulfur dioxide SO ₂	0,14	3,48
HC , hydrocarbons	52,2	1,16
Pb , lead compounds	0,11	
Soot	0,22	1,16

Source: By editors based on information from (Abdullah et al., 2013)

Scientific research carried out by many specialized scientific institutions confirms that the total number of chemical compounds that are included in the composition of waste gases issued by the means of transportation and communications used for internal combustion engines reaches 200 compounds, carbon monoxide (CO), the most dangerous and most toxic, followed by nitrogen oxides (NO_x) and sulfur SO₂ HC hydrocarbons and other pollutants mentioned in the above table, and scientific studies in America and European countries have indicated that cars of various types contribute 60-80% of the carbon oxides in the atmosphere. These studies also confirm that carbon dioxide CO₂ It constitutes 21% of the total gases emitted from the combustion process in hydrocarbons.

Table 5 shows that carbon monoxide and carbon dioxide are the most emitted from car exhaust as a result of complete and incomplete combustion of hydrocarbon fuels in internal combustion engines and then unburned hydrocarbons come in third place with regard to gasoline cars, while lead is produced by gasoline engines. Without diesel engines, and oxides of sulfur and nitrogen are produced by diesel engines in greater proportions than in gasoline engines, and that these data are considered standard quantities measured in countries that impose strict considerations on protecting the environment from pollution from sources polluting the environment with them, the most important of which are means of transportation. The pollutants of different gases from vehicle exhausts change depending on the type of engine, vehicle speed, engine operating efficiency, vehicle maintenance, traffic density, the type of fuel used and the impurities it contains, which makes the

accurate estimation of pollution quantities and rates in Algerian cities such as Bouira need to take these criteria in Considerations , it is preferable to add a percentage or an increase coefficient to the calculated quantities based on the standard data.

3. RESULTS AND DISCUSSION

In this aspect, the descriptive approach with logical analysis of the digital data obtained from the departments and offices of the institutions related to the subject of the study, the Directorate of Environment and the Automobile Control Corporation in Bouira city, in order to reach the possible results in the form of digital values and realistic conclusions that reflect the actual reality of what The city is exposed to air pollution due to the main pollutants resulting from burning both types of fuel (gasoline and diesel) in the internal combustion engines of the city's transportation and communications, in order to contribute to the development of appropriate solutions to reduce the aggravation of this problem with the increase in the number of residents and the vehicles they use to reach the best standards and standards Internationally permitted for air components in civilized cities, which requires synergy, intensification and harnessing all possible efforts by the relevant authorities and institutions, as well as citizens who use cars of all kinds, and to provide the appropriate material support to follow up, monitor and limit this type of pollution, which is extremely dangerous and harmful to human life and property.).Table 6, shows the monthly consumption amounts for both types of fuel, gasoline and diesel, which are actually withdrawn over the months of the year (2021) at gas stations in Bouira*.

Months	Gasoline 95	Diesel	Total Quantity
1	6100	2500	8600
2	6000	2800	8800
3	6500	3250	9750
4	6000	2800	8800
5	5800	3200	9000
6	6000	3300	9300
7	6300	2900	9200
8	7500	3858	11358
9	5500	3000	8500
10	6350	3192	9542
11	6200	3400	9600
12	5099	3500	8599
Annual total	73349	37700	111049

Table 6. Amounts of fuel consumption of both types (petrol and diesel) during 2021

It is clear from Table 6, that the highest monthly consumption rate was during the month of August with an amount of 7500 m³ of gasoline and an amount of 3858 m³ of diesel. Figure 3 shows the curves of fuel consumption of both types of fuel Gasoline and diesel during the year 2021 AD, as well as the total quantities of consumption per cubic meter of both types of fuel during the year in the city of Bouira. The amount of gasoline (gasoline) and diesel fuel used in transportation and communications within the city of Bouira during the year 2021 is equivalent to 37700 m³ of diesel and 73349 m³ of gasoline with a total quantity of 111049 m³ for both types of fuel. The distribution and consumption of these quantities distributed to the fuel stations in Bouira city is through the numbers of cars listed in table 7 and figure 2, whose total numbers were estimated at about, 159602 vehicles with internal combustion engine gasoline and diesel for the year 2021. This is after adding 5% of the total registered vehicles for the year as an estimated percentage representing the number of cars registered in other cities and being used in the city. The numbers of cars with an internal combustion engine Both types of gasoline and diesel registered with the Automobile Control Corporation in Bouira city, the total numbers, and the percentage of each for the years 2015-2021, with the addition of 5% to those registered in other cities that are being used inside the city for 2021.

The number of cars registered with the automobile Control Corporation in Bouira city during the years 2015-2021. It is noted that the vehicles (cars) operating on gasoline in the city of Bouira and registered for the year 2021 constitute about 84% and the number of about (134028) cars. 2021, after adding 5% of cars registered in other Algerian cities and being used within the city of Bouira, a yearly total estimated at 159602 vehicles.

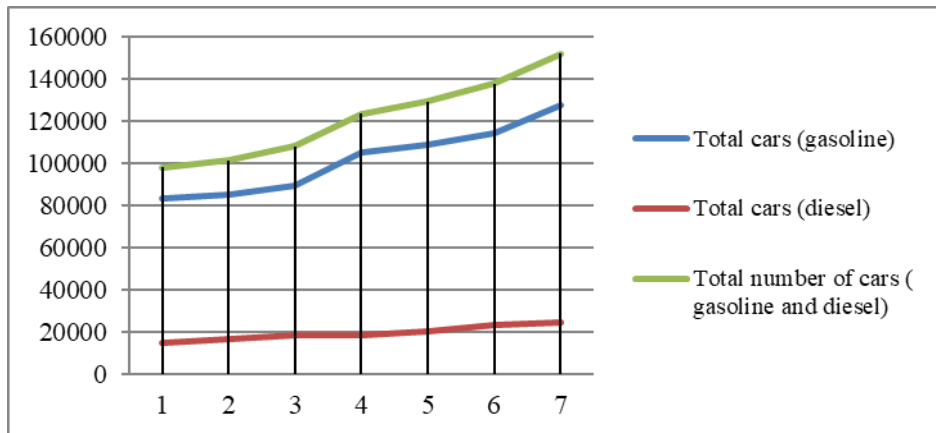
	Private (gasoline)	passenger cars (gasoline)	transport cars (gasoline)	transp ort cars (diesel)	traction locomotiv es (diesel)	Total cars (gasoline)	Total cars (diesel)	Total number of cars (gasoline and diesel)
2003	4275	*-	1509	1509	*-	*-	*-	*-
2004	6025	*-	3013	3012	*-	*-	*-	*-
2005	9075	*-	4538	4537	*-	*-	*-	*-
2006	5000	*-	5038	5037	*-	*-	*-	*-
2007	15025	*-	5725	5725	*-	*-	*-	*-
2008	19926	*-	6688	6687	945	*-	7632	*-
2009	26301	*-	7313	7312	977	*-	8289	*-
2010	32425	*-	9113	9112	1500	*-	10612	*-

2011	40201	*-	9663	9662	1648	*-	11310	*-
2012	48502	*-	10463	10462	2015	*-	12447	*-
2013	61500	*-	10863	10862	2593	*-	13455	*-
2014	67925	*-	11263	11262	2756	*-	14018	*-
2015	70000	1360	11725	11725	3272	83085	14997	98082
2016	71250	1376	12388	12387	4029	85014	16416	101430
2017	75000	1408	13075	13075	5424	89483	18499	107982
2018	90525	1418	13075	13075	5508	105018	18583	123601
2019	93750	1430	13738	13737	6473	108918	20210	129128
2020	97925	1434	15088	15087	8173	114447	23260	137707
2021	110550	1435	15660	15660	8696	127645	24356	152001
A percentage (5%) for the year 2021 AD						#6383	#1218	#7601
Total number for the year2021 AD						134028	25574	159602
percentage %						83,98%	16,02%	

Table 7. Number of motorized vehicles in Bouira city for the years 2003-2021

*- Lack of documented car registration data

#- Cars registered in other cities were represented and roamed in Bouira, equivalent to 5% of the total number of cars registered in the city.



Figur.2. Number of cars registered in the licensing office of Bouira city for the years (2015-2021)

4. EXPERIMENTAL

The amount of pollutants that were emitted from the means of transportation and transportation in city of Bouira during the year 2021 (in kilograms / year) was estimated as the last model year in which the relevant data are available during the months of the whole year, based on the quantities of gasoline that are withdrawn and consumed Diesel and the number of cars used as means of transportation and transportation in the city during the year, which were clarified as they appear in the table 8 and represented graphically as Figure 3.

substance	Gasoline residues (kg)	%	Diesel residues (kg)	%	Total Quantity (kg)	%
CO	23640614,4	56,22	385194,24	4,20	24025808,64	46,90
CO ₂	14109120	33,55	7928028	86,36	22037148	43,02
NO	172444,8	0,41	625940,64	6,82	798385,44	1,56
SO ₂	10973,76	0,03	144447,84	1,57	155421,6	0,30
HC	4091644,8	9,73	48149,28	0,52	4139794,08	8,08
Pb	8622,2	0,02	0	0,00	8622,2	0,02
Soot	17244,48	0,04	48149,28	0,52	65393,76	0,13
Total	42050664,44		9179909,28		51230573,72	

Figure 3. Estimated percentages of pollutants resulting from gasoline and diesel vehicle exhaust during 2021

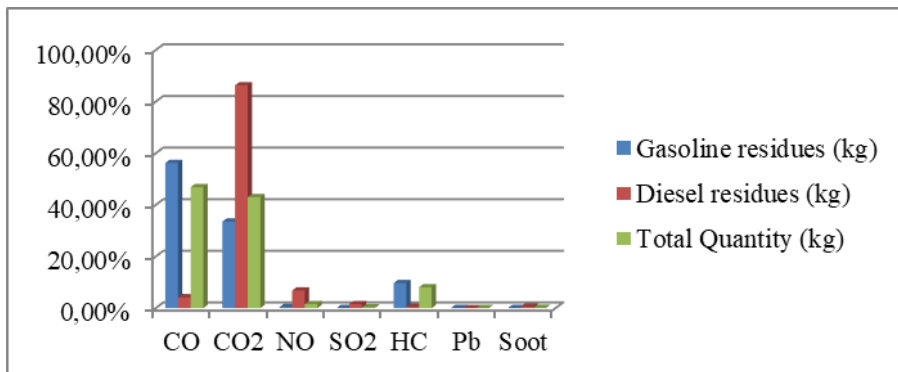


Figure 3.

Estimated percentages of pollutants resulting from gasoline and diesel vehicle exhaust during 2021

The amount of pollutants that were released from the means of transportation to the space of Bouira city during the year 2021 (in kilograms / year) was estimated as the last model year in which relevant data are available during the months of the whole year, based on what is withdrawn and consumed in terms of quantities of gasoline and diesel fuel and the number of cars used as means of transportation in the city during the year, which have been clarified as they appear in the attached tables and graphs.

- The volume of pollutants was calculated by the researchers based on the data provided on the quantities of fuel distributed by the Automobile Control Corporation in Bouira city.

The volume of pollutants emitted by one car during the year has been estimated according to the type of fuel used, depending on the quantities of fuel consumed during the year 2021 as shown in Table 9.

- This volume of pollutants was calculated by the researchers based on the data provided on the quantities of fuel distributed by the Vehicle and Truck Technologies Control Corporation in Bouira city, as well as the number of cars registered with the Bouira Licensing Office.

substance	single car emissions Gasoline type (kg/year)		single car emissions Diesel type (kg/year)	%
		%		
CO	196,78	56,23	15,77	4,20
CO2	117,4	33,55	324,6	86,37
NO	1,43	0,41	25,62	6,82
SO2	0,09	0,03	5,9	1,57
HC	34,048	9,73	1,97	0,52
Pb	0,072	0,07	0	0,00
Soot	0,143	0,04	1,97	0,52
Total	349,963		375,83	

Table 9. Estimated amounts of pollutants emitted by a single vehicle

5. CONCLUSION

Table 8 and Figure 3 clearly shows the quantities of pollutants for different gases from vehicle exhaust that were thrown into the city's atmosphere from the use of gasoline and diesel fuel, and it is noted that the huge amount of carbon monoxide CO that is emitted by the exhaust of gasoline engines compared to other pollutants, and that all Vehicles in the city release an annual amount of 24025808,64 metric tons of carbon monoxide (Tab. 8). The means of transportation and transportation also offer the quality of gasoline, estimated at 127645cars and used in the city of Bouira for the year 2021, the amount of which is about 42050664, 44 metric tons, and the amount of 9,131,760 metric tons of pollutants was estimated as a result of using 24,423 diesel cars in 2021, with a total amount of pollutants that reached 51230.574 tons metric.

Table 9 shows the percentage of the contribution of both gasoline and diesel fuels to each type of pollutant introduced to the air, and it is noted how gasoline exhaust is the main source of both pollutants with carbon monoxide and carbon dioxide, at 56% and 33.5%, respectively. And lead compounds (Pb) with an amount of up to 8.622 metric tons annually, at a rate of 0.02%, and this amount is not simple if we take into account the dangerous effect of lead, while it is noted that diesel exhaust is the main source of both carbon dioxide by 86.8% and soot pollutants (Soot.) by 0.52%, sulfur dioxide by SO₂ by 1.5% and nitrogen oxides by NO_x by 6.8%, while these quantities and percentages were marginal for gasoline engines. It can also be noted that the percentage of pollutants from carbon monoxide gas reached 4.19% of the total pollutants of diesel cars. As for hydrocarbon pollutants, their percentage was estimated at about 9.7% of the pollutants of gasoline cars, and sulfur dioxide gas represented a marginal percentage of gasoline pollutants estimated at about 0.025%, while the lead compound did not record any percentage of diesel pollutants. It is also noted that all these calculations are taken on the assumption that vehicle exhausts are caused by engines with high operational efficiency, that is, on the basis that most cars in the city of Bouira are modern or are being maintained according to the principles followed for regular maintenance constantly, and if we know that 60% of the cars The ones that operate inside the city are more than 10 years old (the life span of the car in most of the first and second world countries), and that some of the vehicles whose engines are not subject to the periodic maintenance necessary to adjust them according to the principles and standards followed for the efficiency of the engines,

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In addition to this, there are additional quantities and percentages of pollution from some other vehicles coming and passing from outside the city of Bouira daily, as well as there are quantities produced by other vehicles traveling in the city streets, especially for some other state institutions such as public authorities, so the environmental situation will worsen in terms of air pollution. It would be logical to consider that the estimated results presented in this research will be more accurate and objective if an estimated increase of up to 25% or more (at least) is added to the calculated quantities and percentages in the research. Table 8 shows the form of pollution emanating from the exhaust of a car that needs urgent maintenance of the engine to avoid polluting emissions to the environment.

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