Concentration of Carbon Dioxide in Various Libyan Cities

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Abstract: Air pollution is defined as the concentration of foreign materials or substances in the air which have negative effects on the health and life of people in any place on the earth. There are many air pollutants in the atmosphere different forms of materials such as liquids, solids or gaseous substances such those which are generated as a result of different human activities related mainly to industry, construction, transportation or other natural resources. According to world health organization (WHO) air pollution is the leading environmental cause of disease and premature death worldwide. In addition to that, fine particulate matters (aerosols), with a maximum diameter of 2.5 microns, are responsible for more than 6.4 million deaths each year, from different diseases such as coronary artery disease, stroke, lung cancer, chronic obstructive pulmonary disease, pneumonia and neonatal disorders.

It was possible to mitigate these emissions by using the market available capture technologies such as infra-red detectors to detect and measure the presence of Carbon dioxide in the free air in several selected places in Libya. Based on our measurements of CO_2 concentration, a significant increase in carbon dioxide emission was noticed in the cities of Ras Al-Anouf and Al-Zawiya compared to larger cities such as Tripoli or Benghazi. The high levels of carbon dioxide in the cities of Ras Al-Anouf and Al-Zawiya are related to the presence of petrochemical complexes and oil refining stations in both cities.

Keywords*: Air Pollution, Aerosols, Carbon Dioxide, Transportation, Ammonia, Nitrogen Oxides.*

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I. INTRODUCTION

Air pollution is defined as the concentration of foreign substances or materials in the air that have negative effects on the health and life of people anywhere on the Earth's surface. There are many types of air pollutants which include different substances such as liquids, solids or gases. These substances are produced by various natural and human activities mainly related to industry, construction, transportation or the use of other natural resources. According to the World Health Organization (WHO), air pollution is the major pollution problem worldwide. It is the leading environmental cause of many diseases and the leading cause of premature death in all countries of the world [1]. Air pollution is mainly caused by very fine particles (aerosols), also known as particles with a maximum diameter of 2.5 microns.

These fine particles are responsible for more than 6.4 million deaths each year, due to diseases caused by air pollution. The main source of carbon dioxide in Libya is the crude oil industry. Libya's crude oil industry has abundant local resources, with a capacity of about 1,200,000 barrels per day, according to the Libyan National Oil Corporation's Information Department. This is much more than the amount of oil consumed locally, which is estimated at about (227,000 barrels per day where the rest is exported).

Some of the crude oil facilities in Libya include Ras Lanuf export port located on the Gulf of Sirte, Zawiya refinery station, located in the north west of Libya where it can process about 120,000 barrels per day of crude oil. Also, Tobruk refinery port, Brega port, and Sarir refinery, both located in the eastern part of Libya [2]. Refineries are a major source of airborne emissions of carbon dioxide (CO_2), carbon monoxide

(CO), methane (CH4), and volatile organic compounds (VOCs), which include hazardous compounds such as butadiene, benzene, sulfur, reduced sulfur compounds, sulfur oxides, ammonia, nitrogen oxides, heavy metals, particulate matter, and odor.

Most of the pollutants are of natural origin such as carbon dioxide (CO_2), carbon monoxide (CO), methane (CH4) in addition to other fine natural dust particles. These harmful gases are mainly emitted from several sources, the most important of which are the oil, cement and electricity industries, followed by the transportation, residential and commercial sectors. According to Yasser et al. (2017), the total annual CO_2 equivalent in Libya is about 64.6 million tons of CO_2 equivalent. This represents about 9.7 tons/year/capita [3]. The largest share of emissions is for CO_2 (96.76%), followed by CO2 (2.13%). Libya ranks 53rd out of 225 countries in terms of CO2 emissions with a contribution of 0.22% and ranks 41st out of 225 countries in terms of CO_2 emissions per capita [3].

Carbon dioxide (CO2) is a chemical compound that is a very small component of the Earth's atmosphere, at 410.0%, but it is one of the gases that cause the greenhouse effect facing the planet. Carbon dioxide is also called coal gas and is known in some references as coal gas or liquid gas. It exists as a relatively inert gas at normal temperatures and is unstable at high temperatures. It is generally an inactive and non-flammable gas. Physically, carbon dioxide is one and a half times heavier than normal air. It is easily converted into a liquid and easily at a certain pressure.

Carbon dioxide is found in nature in the Earth's atmosphere, hydrosphere, lithosphere and biosphere. The atmosphere contains an estimated 800 gigatons of carbon dioxide, while the hydrosphere contains 38,000 gigatons, in the form of gas dissolved in water and in the form of bicarbonates and carbonates, while carbon dioxide in the lithosphere is chemically bound to carbonate rocks such as calcite and dolomite, which contain an estimated 60,000 teratorns of carbon dioxide. The element carbon, which is essential for life on Earth, is exchanged between these spheres in what is known as the carbon cycle.

Carbon monoxide (CO) and carbon dioxide (CO_2) are two completely different gases. Carbon monoxide is toxic, has an unpleasant odor, and is flammable, while carbon dioxide is colorless, odorless, non-toxic, non-flammable, and is used in fire extinguishers. While carbon dioxide can naturally occur in the Earth's atmosphere, carbon monoxide is not present in the Earth's atmosphere at all. Carbon monoxide (CO) is produced in various ways, such as the incomplete combustion of hydrocarbon-based fuels, and enters the bloodstream through the lungs and forms carboxyhemoglobin, affecting both healthy and sick people [4]. CO detectors typically use infrared sensors to detect gas levels in the atmosphere, while carbon monoxide detectors primarily use electrochemical sensors, gel sensors, and metal oxide semiconductor sensors.

The nuclear densities of the two gases differ significantly. For example, carbon dioxide from a gas cylinder leak is denser than atmospheric air, so CO detectors must be placed close to the ground. While the density of carbon monoxide gas is equal to the density of air, carbon monoxide detectors should be placed at a higher level.

II. METHODOLOGY

The installation and use of carbon dioxide detection systems helps mitigate risks by continuously monitoring carbon dioxide levels and alerting employees to potential hazards before they become more serious. Early detection of carbon dioxide not only protects workers and equipment, but also ensures regulatory compliance, reduces the likelihood of accidents, and supports a safe work environment. With the increasing focus on health and safety, especially in indoor spaces, carbon dioxide detectors have become an important part of safety protocols in many areas. In this study, infrared detectors were used to detect and measure the presence of outdoor carbon dioxide emissions in several selected cities in Libya.

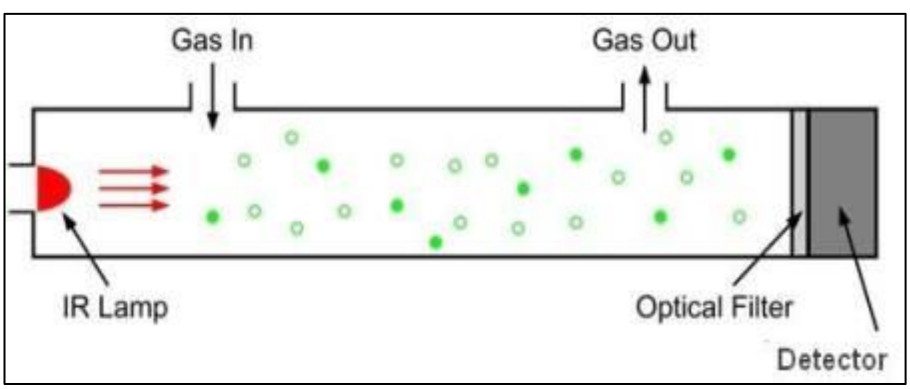

Fig.: (1) Displays a Simple Components of the Infrared Detector

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The infrared detector consists of an infrared source, a light tube, a wave filter, and an infrared detector [5]. Most modern carbon dioxide detectors use a non-dispersive infrared (NDIR) sensor that measures the infrared light in an air sample. This technique is useful because the amount of light passing through the air or into the sample is inversely proportional to the number of carbon dioxide molecules in the air. Carbon dioxide detectors use NDIR carbon dioxide sensors that detect the presence of carbon dioxide molecules in the air based on their ability to absorb infrared radiation. When infrared light passes through the air sample tube, the carbon dioxide molecules absorb a range of these rays while allowing other wavelengths of light to pass through. At the other end of the tube, the remaining light hits an optical filter that absorbs all wavelengths of light except the wavelength absorbed by carbon dioxide gas. The remaining carbon dioxide molecules are counted by the infrared detector, which sends an analog voltage to the sensor circuit. In this way, it can be said that the carbon dioxide sensor "counts" the number of carbon dioxide molecules in the air.

The principle measurement of gas detection is based on the presence of infrared radiation and since each gas has a characteristic infrared absorption frequency, the absorption is related to the concentration, which follows the Lambert-Beer law. Traditional infrared absorption analysis models used to measure the concentration of any gas are mostly dual-wavelength detection methods. Two channels are used to select the wavelengths for measurement through narrow-band filters.

To obtain valid information from the detector signal, the Goertzel algorithm is used to filter the original signal. The algorithm has the following main parameters: sampling rate Rt, target frequency f, sampling number in the detection section N, and full cycle number K_{cnum} of the target frequency in the detection section. The relationship between the parameters meets $K_{cnum}=Nf/Rt$.

III. RESULTS AND DISCUSSION

Libya's economy and its greenhouse gas emissions are largely influenced by oil production. Libya's greenhouse gas emissions are closely linked to GDP, which is a production indicator given its oil-based economy. The energy sector accounts for the largest share of Libya's greenhouse gas emissions. In 1990 and 2012, its emissions accounted for about 95% of the total. Most of these emissions are cyclical emissions from crude oil and natural gas production (64% in 2012). Libya's total greenhouse gas emissions in 2013 were 133.01 million tons CO_2, accounting for 0.28% of global greenhouse gas emissions [6]. The manufacturing, transport and power generation sectors together account for about 34% of global greenhouse gas emissions. The non-energy sector emitted 6.1 million tons of carbon dioxide equivalent, or 5% of Libya's total emissions, of which agriculture accounted for about 48% [6]. Libya signed and ratified the United Nations Framework Convention on Climate Change in1999 but has yet to submit a national communication assessing the country's vulnerability to climate change and proposing a policy framework to address the threat. The World facing an unprecedented climate crisis, and carbon emissions are the main cause of this crisis. In order to mitigate the effects of climate change, it is necessary to reduce carbon emissions from various sources. Scientific research has produced a variety of solutions, such as: Carbon capture technology is a good way to solve this problem. By capturing and storing carbon dioxide from industrial processes or the atmosphere, these technologies can prevent large amounts of greenhouse gas emissions from entering the atmosphere and causing global warming [7].

Refineries are major source of airborne emissions of carbon dioxide (CO_2), carbon monoxide (CO) and methane (CH_4) and volatile organic compounds (VOCs), which include hazardous compounds such as butadiene, benzene, sulfur, reduced sulfur compounds, sulfur oxides, ammonia, nitrogen oxides, heavy metals, particulate matter, and odor as shown on Fig 2.

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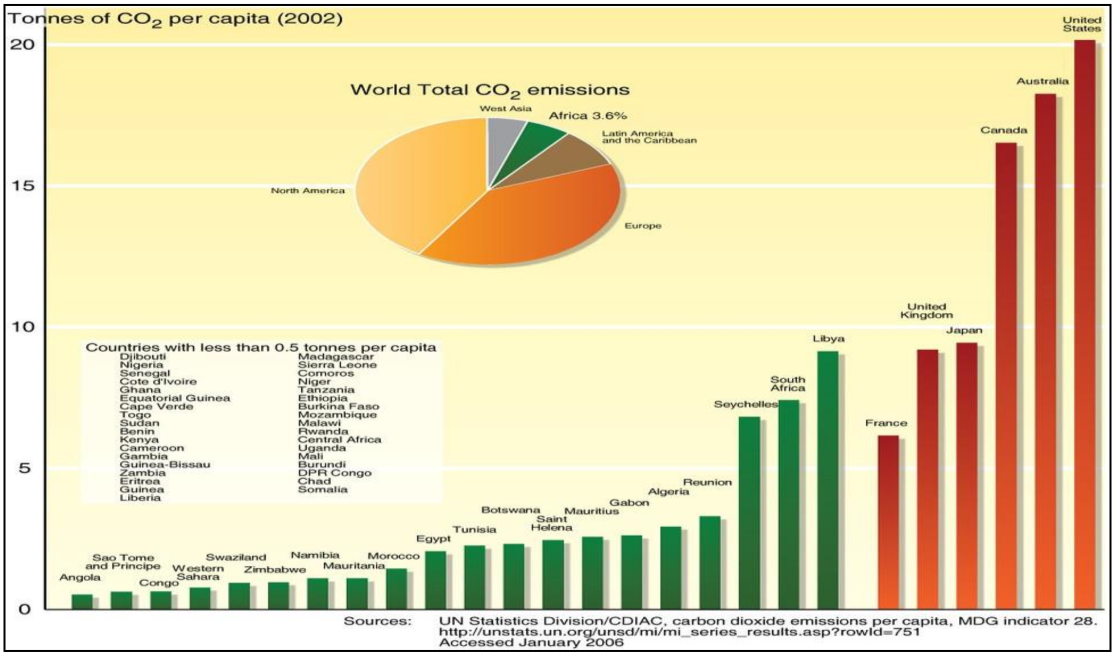

Fig. (2) Show the Amount of Carbon Dioxide Which Emissions from Different Countries Included Libya

In the petrochemical sector, a wide range of petrochemicals are made from natural gas and crude distillates like naphtha (from petroleum refining) as feedstock, and these petrochemicals are then utilized to make a variety of consumer goods. Olefins (such as ethylene, propylene, butylenes, and butadiene) and aromatics (such as benzene, toluene, and xyleme) are among the fundamental petrochemicals produced via cracking, reforming, and other methods. There are eight petrochemical industrial units in Libya [8] where methanol and fertilizers are the main products of Marsa El-Brega, which went online in 1978. It was made up of two methanol units that can generate 720,000 tons of methanol annually (tpy), two urea units with a combined capacity of 900,000 (tpy), and two ammonia units with a capacity of 700,000 tpy [9].

In Fig (3) we can see the big amount of carbon dioxide which is released from the oil and chemical and petro chemical industries from 1750 to 2022 in this case that means a lot of gaseous which can cause a lot of problems to the air pollution and to our health in the whole of the world.

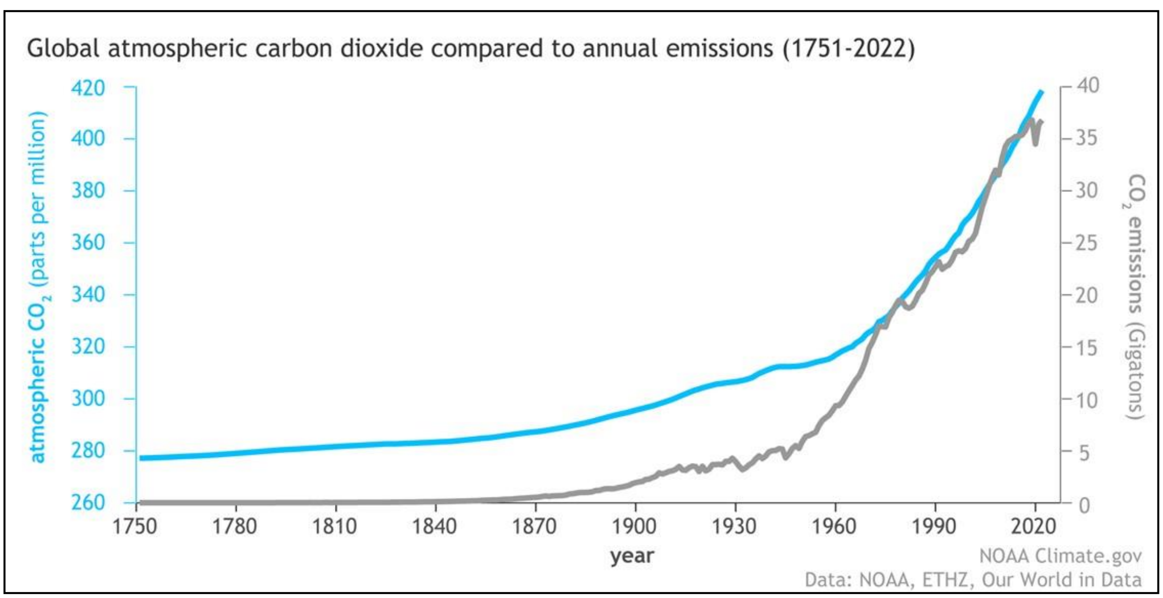

Fig 3 Global Atmospheric Carbon Dioxide Compared to Annual Emissions {1751-2022).

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As on the following graph, Fig (4), we can see the amounts of emission of gaseous to the atmosphere was little pit low comparing the last many years ago in that time the units was measuring the amount by part per million now in the 2011 the amount was measured by tons from the next graph, figure four we can see the huge amount of carbon dioxide which make air pollution which cause a lot of problems to our health other than increase the temperature for our earth.

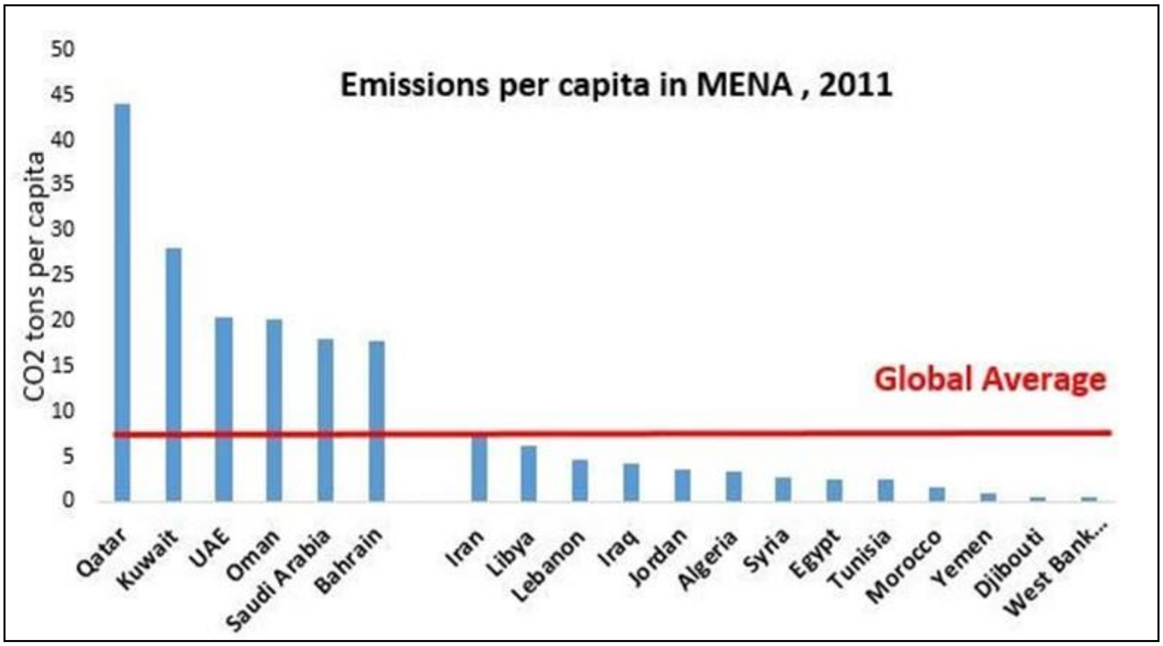

Fig (4): Emissions of Carbon Dioxide in Tons Per Capita in Mena ,(2011).

IV. CONCLUSION

The results of field studies in specific areas in Libya were used in addition to published or unpublished records of other operations to estimate the pollutants emitted from air emission sources in Libya; unfortunately, some industrial activities were left unassisted due to the lack of information required to conduct a scientific environmental assessment. According to this study, most factories lack the necessary measuring and control equipment to measure harmful gas emissions in all industrial establishments in Libya.

Libya ranks 41st out of 225 countries in terms of carbon dioxide emissions per capita and 53rd out of 225 countries in terms of carbon dioxide emissions, with a contribution of 0.22%. There are about 61.1 million tons of air emissions annually [3]. The proportion of carbon dioxide (CO_2) (96.76%) was the most abundant among the air pollutants in Libya. The total annual carbon dioxide equivalent emissions are about 64.6 million tons CO_2, or 9.7 tons per capita, which is a high percentage that makes Libya outperform all its neighbors such as Egypt, Tunisia and Algeria. This high percentage leads to high levels of pollution in the country which increases health risks and creates social and economic issues.

It will become clear through monitoring the status of air pollution in Libya that many of the elements required to address this issue are missing. For example, there is no comprehensive national plan to address a number of environmental issues, such as air pollution; the Ministry of Electricity or the Environment Authority do not impose any restrictions on exceeding the permissible levels of pollutants; and there are no responsible monitoring or testing facilities that monitor the rise in the percentage of pollution of all types throughout the country.

Through this study, we see that warnings about the dangers of air pollution are being made by ringing alarm bells throughout the country. We must start addressing this issue immediately by recruiting environmental authorities to develop comprehensive plans to investigate air pollution issues and propose possible treatments for this environmental problem.

Increase awareness, educational and cultural programs on rationalizing energy consumption and protecting the environment and the population from the health risks resulting from environmental pollution at all educational levels and in all social media. Civil society organizations and non-profit organizations can pool their resources to contribute to addressing this issue by forming specialized technical teams to help raise environmental awareness, encourage people to use environmentally friendly equipment and means of transportation, and reactivate public transportation or use other mass transportation. Establish and develop a set of indicators indicating the size and rates of air pollution and innovate

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practical scientific solutions that address most of the pollution damages associated with sustainable development projects.

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