Pollution Due To Carbon Monoxide Co, Sulfur Dioxide So_2, Nitrogen Oxide No_2 Gases Released Into Makurdi Metropolitan Environment As A Result Of Different Out / Indoor Door Activities In Benue State Nigeria.

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ABSTRACT

Gas monitors for carbon monoxide CO, sulfur dioxide SO_2, nitrogen oxide NO_2) and stop watches were used to assess the quantity of these gases released when various machines and engines were at work in Makurdi Metropolis. Data was taken after every fifteen minutes in the daytime (8hours) on exhausts of take off vehicles at major and minor roads, markets, on electric generating and milling machines, in restaurants and domestic kitchens from five areas of the town , High-level roundabout labeled as zone A , Wurukum roundabout - zone B, Wadata market - zone C, Nyiman layout - zone D and Gyado villa - zone E. Average results from all the zones show the highest amount of Carbon monoxide CO in the atmosphere as 33.5 ppm in zone B , Sulfur dioxide SO_2 as 1.2 ppm in A and Nitrogen dioxide NO_2 as 0.28 ppm.in zone E. Going by the Environmental Protection Agency EPA National Ambient Air Quality Standards NAAQS amended in 1990, Environmental Health Watch 2011 , National Guidelines on Environmental Health Practice in Nigeria and Environmental Health Officers Registration Council of Nigeria 2007 . The six principal pollutants called "criteria" pollutants which include carbon monoxide , sulphur dioxide and nitrogen dioxide , their limits to exposure is high.

Key words Gases , Zones , Exhausts, Methodology , Inhaled

INTRODUCTION

The Clean Air Act, amended in 1990, caused the Environmental Protection Agency EPA to set National Ambient Air Quality Standards NAAQS (40 CFR part 50) for pollutants considered harmful to public health and the environment and it identified two types of national ambient air quality standards. Primary standards for public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. According to records of Nathanson J (2010) on environmental works clean air, an essential component of a healthful environment, is a mixture of many different gases. EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants, they are graded in the following table .

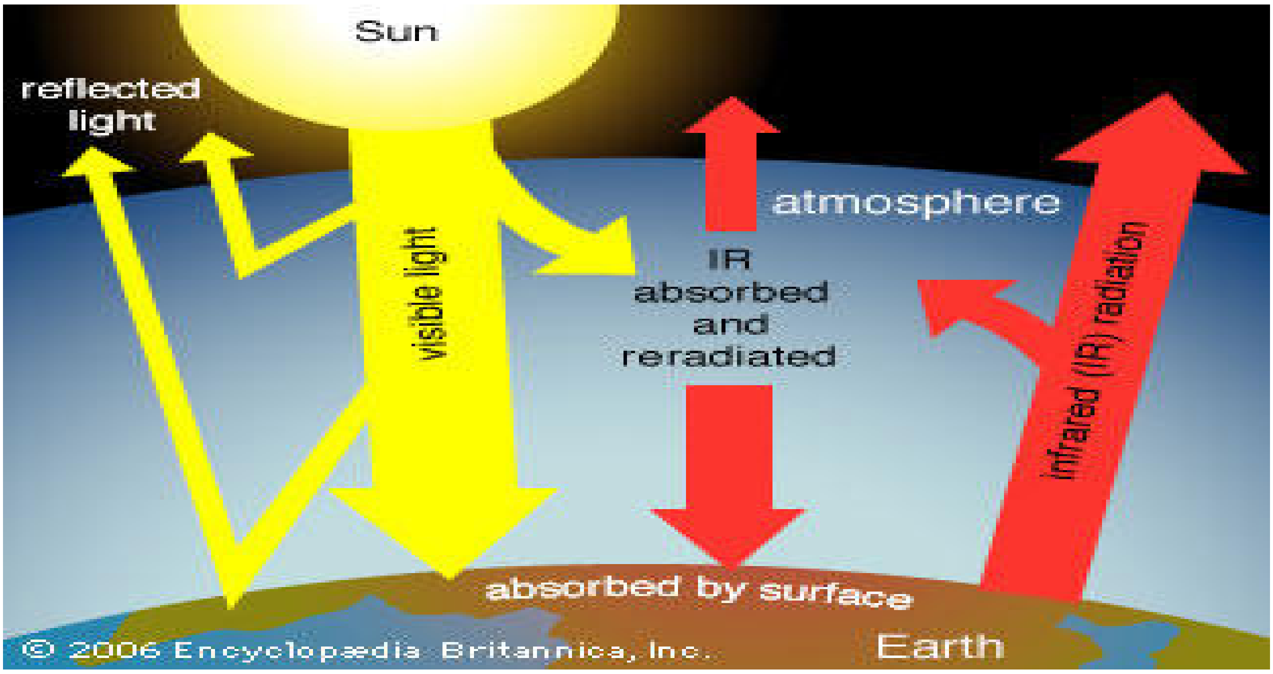
Table 1 Criteria pollutants and their exposure limits

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm
			1-hour	35 ppm
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb
		primary and secondary	Annual	53 ppb
Ozone [73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	12 $\mu g/m^3$
		secondary	Annual	15 $\mu g/m^3$
		primary and secondary	24-hour	35 $\mu g/m^3$
	PM_{10}	primary and secondary	24-hour	150 $\mu g/m^3$
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb
		secondary	3-hour	0.5 ppm

Two gases predominate: nitrogen, which makes up 78 percent of the volume of clean dry air, and oxygen, which makes up 21 percent. Argon, an inert element, accounts for almost 1 percent of clean dry air, and the remainder includes very small or trace concentrations of carbon dioxide, methane, hydrogen, helium, ozone, and other gases. In the Earth's atmosphere, water vapour is also a significant component but the most variable one, ranging from 0.01 to 4 percent by volume; its concentration in air varies daily and seasonally, as well as geographically. The anthropogenic causes of air pollution (burnings , vehicle and industrial emissions of gases) are numerous and the publications of Nsi (2007) shows air pollution as the presence of one or more contaminable substances in the atmosphere resulting from gaseous, liquid or solid waste components or by-products that are detrimental to the quality of human life, health or welfare, the natural functioning of ecosystems and can attack or destroy infrastructures . According to Raymond Dasman [2010] it is the immediate effect of air pollution on urban atmospheres that is most noticeable and causes the strongest public reaction . There is environmental pollution that occur as a result of natural causes such as volcanic eruption, while some are anthropogenic such as increased use of automobiles, machineries in agricultural and industrial , consumption of fossil fuels has increased atmospheric carbon dioxide levels steadily since 1900, and the rate of increase is accelerating , its output may exceed both the capacity of plant life to remove it from the atmosphere and the rate at which it goes into solution in the oceans. It creates a “greenhouse effect.” in the atmosphere by allowing light rays from the sun to pass through, but not allow the escape of the heat rays therefore, causing an increase in the temperature of the lower atmosphere. This causes melting of the polar ice caps, raising of the sea level, and flooding of the coastal areas of the world . Global warming according to Hegerl, Gabriele C.; et al. (2007). is the increase in the average temperature of Earth's near-surface air and oceans since the mid-20th century and its projected continuation. Global surface temperature increased 0.74 ± 0.18 °C between the start and the end of the 20th century. The Intergovernmental Panel on Climate Change (IPCC) concludes that most of the observed temperature increase since the middle of the 20th century was very likely caused by increasing concentrations of greenhouse gases resulting from human activity such as fossil fuel burning and deforestation. These basic conclusions have been endorsed by more than 40 scientific societies and academies of science, including all of the national academies of science of the major industrialized countries.

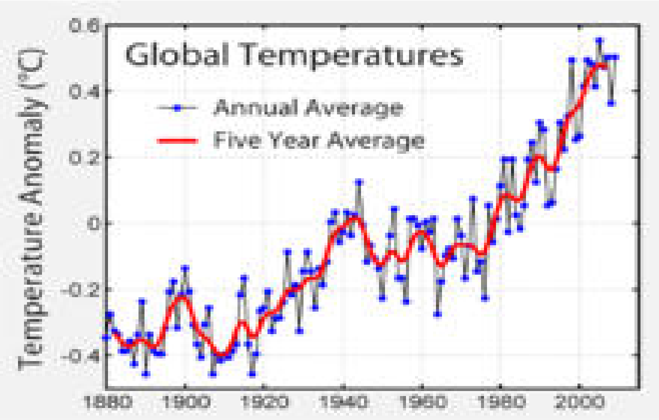
1 . The greenhouse effect on Earth

Some incoming sunlight is reflected by the Earth's atmosphere and surface, but most is absorbed by the surface, which is warmed. Infrared (IR) radiation is then emitted from the surface. Some IR radiation escapes to space, but some is absorbed by the atmosphere's greenhouse gases (especially water vapour, carbon dioxide, and methane) and reradiated in all directions, some to space and some back toward the surface, where it further warms the surface and the lower atmosphere



Only the few greenhouse gases which make up less than 1 percent of the atmosphere, offer Earth any insulation. Greenhouse gases occur naturally or are manufactured the most abundant naturally occurring greenhouse gas is water vapor, followed by carbon dioxide, methane, and nitrous oxide. Human-made chemicals that act as greenhouse gases include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

Since the 1700s, human activities have substantially increased the levels of greenhouse gases in the atmosphere. Scientists are concerned that expected increases in the concentrations of greenhouse gases will powerfully enhance the atmosphere’s capacity to retain infrared radiation, leading to an artificial warming of Earth’s surface. .In 2000, carbon dioxide emissions were rising less than 1 percent annually and greenhouse gases in the atmosphere "reached a record high in 2005," the United Nations reported in November, warning that "global average concentrations of carbon dioxide and nitrous oxide" will be even higher in 2006. Today they are rising more than 2.5 percent annually, and the Energy Department’s latest report projects America’s carbon dioxide emissions will increase by one third from 2005 to 2030. Meanwhile, U.S. dependence on OPEC nations for oil imports "has risen to its highest level in 15 years." In September 2006, 70 percent of oil consumed in the United States came from foreign sources, up from 58 percent in 2000



Global mean surface temperature difference relative to the 1961–1990 average (2009 Ends Warmest Decade on Record. NASA Earth Observatory Image of the Day, January 22, 2010)

.2. 0 Gas Pollution

According to. Likens, G. E., F. H. Bormann and N. M. Johnson. (1972) distilled water, once carbon dioxide is removed, has a neutral pH of 7. Liquids with a pH less than 7 are acidic, and those with a pH greater than 7 are alkaline. "Clean" or unpolluted rain has an acidic pH, butusually no lower than 5.7, because carbon dioxide and water in the air react together to form carbonic acid, a weak acid. However, unpolluted rain can also contain other chemicals which affect its pH. A common example is nitric acid produced by electric discharge in the atmosphere such as lightning . Carbonic acid is formed by the reaction

$$H_2O\ (l) + CO_2\ (g) = H_2CO_3\ (aq)$$ ------------------------------------i

Carbonic acid then can ionize in water forming low concentrations of hydronium and carbonate ions:

$$H_2O\ (l) + H_2CO_3\ (aq) = HCO_3^-\ (aq) + H_3O^+\ (aq)$$ --------------------------ii

Jerry A. Nathanson (2010) .in his Environmental Works reports carbon monoxide as an odourless, invisible gas formed as a result of incomplete combustion with gasoline-powered highway vehicles as the primary source, residential heating systems and certain industrial processes. Power plants emit relatively little carbon monoxide because they are carefully designed and operated to maximize combustion efficiency.

$$2CO(s) + O = 2CO\ (g)$$ -------------------------------iii

Exposure to carbon monoxide can be acutely harmful since it readily displaces oxygen in the bloodstream, leading to asphyxiation at high enough concentrations and exposure times. Carbon monoxide is a gas that comes from the incomplete burning of fossil fuels in automobile engines, power stations and industrial machines. It is also released at high concentrations during metallurgical processes such that many countries now have laws that regulate the amount of carbon monoxide that should be emitted from its machines. Philip (2007) it forms a complex called carboxyheamoglobin which prevents the blood form circulating the needed oxygen in the body which makes people feel dizzy, tired and also gives headache. A research by Mwar (2003) shows that, an average of 5.7ppm of this gas is being emitted per hour into the atmosphere in Gboko town. The same analysis by Okwu (2000) shows that an average of 4.7ppm of carbon monoxide is emitted into the atmosphere in Otukpo town. These results are below the Federal Environmental Protection Agency's FEPA limit of 35ppm per hour.

2.1 Sulfur dioxide

Sulfur dioxide **a** colourless gas with a sharp, choking odour is formed during the combustion of coal or oil that contains sulfur as an impurity. Most sulfur dioxide emissions come from power-generating plants; very little comes from mobile sources. This pungent gas can cause eye and throat irritation and harm lung tissue when inhaled. It also reacts with oxygen and water vapour in the air, forming a mist of sulfuric acid that reaches the ground as a component of acid rain. Acid rain is believed to have harmed or destroyed fish and plant life, caused, corrosion of metals, deterioration of the exposed surfaces of buildings and public monuments. Amongst the major historic pollutants in the quality and quantity of gas expelled into our environment by different engines are high levels of sulphur dioxide arising from the combustion of sulphur containing fossil fuels such as coal for domestic and industrial purposes. Sulphur dioxide is a colorless, corrosive reactive gas with the chemical formula SO_2. It is odourless at small concentrations but quite pungent (rotten egg smell) at high concentrations. . Power plants which burn coal are the biggest emitters of sulphur dioxide. Sulphur dioxide undergoes several complex steps of chemical reactions before they react in air forming environmental problems like acid rain.

The steps are broken down into two phases which are the gas phase and aqueous phase. There are many potential reactions that can contribute to the oxidation of sulphur dioxide in the atmosphere with varying degrees of success. One is photooxidation of sulphur dioxide by ultraviolet light. This process uses light form of the electromagnetic spectrum causing the loss of two oxygen atoms; however this reaction was found to be an insignificant contributor to the formation of sulphuric acid.

$$SO_2\,(g) + O_2\,(g) \quad = \quad SO_3\,(g). \quad \text{-------------------------iv}$$

Photooxidation is slow due to absence of a catalyst proving why it's not a significant contributor. Afterwards, it becomes sulphuric acid when it joins with hydrogen atoms in the air.

$$SO_3\,(g) + H_2O\,(l) \quad = \quad H_2SO_4\,(aq) \quad \text{---------------------v}$$

This reaction occurs quickly, therefore the formation of sulphur dioxide in the atmosphere is assumed to form sulphuric acid. In the atmosphere sulphur dioxide absorbs solar radiation in the range 300-400nm producing excited states of SO_2 which undergoes oxidation to SO_3 and in the presence of water vapour converted to H_2SO_4.

$$SO2 + hv \quad = \quad SO^{\cdot}_2 \text{ (excited state)------------------------------iv}$$

$$SO^{\cdot}_2 + O_2 \quad = \quad SO^{\cdot}_4 \text{---v}$$

$$SO^{\cdot}_4 + O_2 \quad = \quad SO_3 + O_3 \text{---vi-}$$

$$SO_2 + H_2O \quad = \quad H_2SO_4 \text{--vii}$$

Oxidation of SO_2 can also take place by interaction with the free radical $HO^{\cdot}$ Present in photochemical s

$$SO_2 + HO^{\cdot} \quad = \quad HOSO^{\cdot}_2 \text{--viii}$$

$$HOSO^{\cdot}_2 + O_2 \quad = \quad HOSO_2O^{\cdot}_2 \text{--ix}$$

$$HOSO^{\cdot}_2O^{\cdot}_2 \quad = \quad HOSO_2O^{\cdot} + NO^{\cdot}_2 \text{--x}$$

A second process is when sulphur dioxide reacts with moisture found in the atmosphere; sulphate dioxide quickly oxidizes forming a sulphite ion. Another common reaction from sulphur dioxide to sulphuric acid is by ozone oxidation; this occurs at a preferable rate and is sometimes the main contributor to the oxidation of sulphuric acid. This hydroxy radical is produced by the photo decomposition of the ozone and is highly reactive of any type of chemical compound. It hardly requires a catalyst and is 108-109 times more abundant in the atmosphere than molecular oxygen. Other insignificant reactions include oxidation by-product of alkene-zone reactions, oxidation by reaction of NxOy species, oxidation by reactive oxygen transients, and oxidation by peroxy radicals. Sulphur dioxide is considered an indicator of air quality and quantity of gas expelled into environment by different engines due to its negative health and environmental effects at even low concentration. The concentration of sulphur dioxide in the atmosphere can influence the habitat suitability for plant communities as well as animal life. Sulphur dioxide emissions are a precursor to acid rain and atmospheric particulates. Some symptoms of sulphur dioxide emissions in human health are impairment of respiratory function, aggravation of existing respiratory diseases, decreased ability of lungs to clear foreign particle, visible impairment from haze formation, plant and water damage from acid rain, aesthetic damage to monuments, structures and sculptures to from accelerated decay; A community with a sustainable air quality should have concentration of sulphur dioxide not exceeding 0.03ppm over an annual range . There are however methods in reducing SO_2 emissions such as flue-gas desulphurization; a technology that enables SO_2 be chemically bound in power plants burning sulphur containing coal or oil. I.e. calcium oxide (lime) reacts with sulphur dioxide to form calcium sulphite.

$$CaO \text{ (lime)} + SO_2 = CaSO_3 \text{------------------------------xi}$$

2.2 Nitrogen dioxide

According to Bassey (1998) Nitrogen dioxide is a pungent, irritating gas known to cause pulmonary edema, an accumulation of excessive fluid in the lungs. Nitrogen dioxide also reacts in the atmosphere to form nitric acid, contributing to the problem of acid rain. In addition, nitrogen dioxide plays a role in the formation of photochemical smog, a reddish brown haze that often is seen in many urban areas and that is created by sunlight-promoted reactions in the lower atmosphere. NO_2 is an important air pollutant because it contributes to the formation of photochemical smog which can have significant impacts on human health. The major source of NO_2 in Nigeria is the burning of fossil fuels, coal, oil and gas most of the NO_2 in cities come from motor vehicle exhaust about 80%. Other sources of NO_2 are petrol and metal refining electricity generation form coal-fired power stations other manufacturing industries and food processing unfiled gas heaters and cookers are the major sources of NO_2 in Australian homes.

Nitrogen oxides are formed when combustion temperatures are high enough to cause molecular nitrogen in the air to react with oxygen. Stationary sources such as coal-burning power plants are major contributors of this pollutant, although gasoline engines and other mobile sources are also significant . The phenomenon occurs when sulfur dioxide and nitrogen oxides from the burning of fossil fuels combine with water vapour in the atmosphere. The resulting precipitation is damaging to water, forest, and soil resources. It is blamed for the disappearance of fish from many lakes . Reports also indicate that it can corrode buildings and be hazardous to human health. Because the contaminants are carried long distances, the sources of acid rain are difficult to pinpoint and hence difficult to control. The international scope of the problem has led to the signing of international agreements on the limitation of sulfur and nitrogen oxide emissions. All nonmetals form covalent oxides with oxygen, which react with water to form acids or with bases to form salts. Most nonmetal oxides are acidic and form oxyacids, which in turn yield hydronium ions (H_3O^+) in aqueous solution. There are two general statements that describe the behaviour of acidic oxides. First, oxides such as sulfur trioxide (SO_3) and dinitrogen pentoxide (N_2O_5), in which the nonmetal exhibits one of its common oxidation numbers, are known as acid anhydrides. These oxides react with water to form oxyacids, with no change in the oxidation number of the nonmetal; for example,

$$N_2O_5 + H_2O \rightarrow 2HNO_3\text{.-----------------------xii}$$

Second, those oxides in which the metal does not exhibit one of its common oxidation numbers, such as nitrogen dioxide (NO_2) and chlorine dioxide (ClO_2), also react with water. In these reactions, however, the nonmetal is both oxidized and reduced (i.e., its oxidation number is increased and decreased, respectively). A reaction in which the same element is both oxidized and reduced is called a disproportionation reaction. In the following disproportionation reaction, N^{4+} is reduced to N^{2+} (in NO) and oxidized to N^{5+} (in HNO_3).

$$3NO_2 + H_2O \rightarrow 2HNO_3 + NO\text{-----xiii}$$

Nitrogen (N) forms oxides in which nitrogen exhibits each of its positive oxidation numbers from +1 to +5. Nitrous oxide (dinitrogen oxide), N_2O, is formed when ammonium nitrate, NH_4NO_3, is heated. This oxide, which is a colourless gas with a mild, pleasant odour and a sweet taste, is used as an anesthetic for minor operations, especially in dentistry. It is called laughing gas because of its intoxicating effect. It is also widely used as a propellant in aerosol cans of whipped cream. Nitric oxide, NO, can be created in several ways. The lightning that occurs during thunderstorms brings about the direct union of nitrogen and oxygen in the air to produce small amounts of nitric oxide, as does heating the two elements together. Commercially, nitric oxide is produced by burning ammonia (NH_3), whereas in the laboratory it can be produced by the reduction of dilute nitric acid (HNO_3) with, for example, copper (Cu).

$$3Cu + 8HNO_3 \rightarrow 2NO + 3Cu(NO_3)_2 + 4H_2O\text{------------------------------xiv}$$

Gaseous nitric oxide is the most thermally stable oxide of nitrogen and is also the simplest known thermally stable paramagnetic molecule—i.e., a molecule with an unpaired electron. It is one of the environmental pollutants generated by internal-combustion engines, resulting from the reaction of nitrogen and oxygen in the air during the combustion process. At room temperature nitric oxide is a colourless gas consisting of diatomic molecules. However, because of the unpaired electron, two molecules can combine to form a dimer by coupling their unpaired electrons.

$$2NO \rightleftharpoons N_2O_2 \text{------------} \text{-xv}$$

Thus, liquid nitric oxide is partially dimerized, and the solid consists solely of dimers.

When a mixture of equal parts of nitric oxide and nitrogen dioxide, NO_2, is cooled to −21 °C (−6 °F), the gases form dinitrogen trioxide, a blue liquid consisting of N_2O_3 molecules. This molecule exists only in the liquid and solid states. When heated, it forms a mixture of NO and NO_2. Nitrogen dioxide is prepared commercially by oxidizing NO with air, but it can be prepared in the laboratory by heating the nitrate of a heavy metal, as in the following equation,

$$2Pb(NO_3)_2 + heat \rightarrow 2PbO + 4NO_2 + O_2, \text{------------} xvi$$

or by adding copper metal to concentrated nitric acid. Like nitric oxide, the nitrogen dioxide molecule is paramagnetic. Its unpaired electron is responsible for its colour and its dimerization. At low pressures or at high temperatures, NO_2 has a deep brown colour, but at low temperatures the colour almost completely disappears as NO_2 dimerizes to form dinitrogen tetroxide, N_2O_4. At room temperature an equilibrium between the two molecules exists.

$$2NO_2 \rightleftharpoons N_2O_4 \text{------------} \text{-xvii}$$

Dinitrogen pentoxide, N_2O_5, is a white solid formed by the dehydration of nitric acid by phosphorus(V) oxide.

$$P_4O_{10} + 4HNO_3 \rightarrow 4HPO_3 + 2N_2O_5 \text{------------} xviii$$

Above room temperature N_2O_5 is unstable and decomposes to N_2O_4 and O_2. Two oxides of nitrogen are acid anhydrides; that is, they react with water to form nitrogen-containing oxyacids. Dinitrogen trioxide is the anhydride of nitrous acid, HNO_2, and dinitrogen pentoxide is the anhydride of nitric acid, HNO_3.

$$N_2O_3 + H_2O \rightarrow 2HNO_2 \text{------------} xix$$
$$N_2O_5 + H_2O \rightarrow 2HNO_3 \text{------------} xx$$

Nitrogen dioxide reacts with water in one of two ways. In cold water NO_2 disproportionates to form a mixture of HNO_2 and HNO_3, whereas at higher temperatures HNO_3 and NO are formed. In their chemical activity, the nitrogen oxides undergo extensive oxidation-reduction reactions. Nitrous oxide resembles oxygen in its behaviour when heated with combustible materials. It is a strong oxidizing agent that decomposes upon heating to form nitrogen and oxygen. Because one-third of the gas liberated is oxygen, nitrous oxide supports combustion better than air. All the nitrogen oxides are, in fact, good oxidizing agents. Dinitrogen pentoxide reacts violently with metals, nonmetals, and organic materials, as in the following reactions with potassium (K) and iodine gas (I_2).

$$N_2O_5 + K \rightarrow KNO_3 + NO_2 \text{------------} xxi$$

$$N_2O_5 + I_2 \rightarrow I_2O_5 + N_2 \text{------------} xxii$$

2.3 Carbon monoxide (CO)

The source of the carbon found in living matter is carbon dioxide (CO_2) in the air or dissolved in water. Algae and terrestrial green plants (producers) are the chief agents of carbon dioxide fixation through the process of photosynthesis, through which carbon dioxide and water are converted into simple carbohydrates. These compounds are used by the producers to carry on metabolism, the excess being stored as fats and polysaccharides. The stored products are then eaten by consumer animals, from protozoans to man, which convert them into other forms. All animals return CO_2 directly to the atmosphere as a by-product of their respiration. The carbon present in animal wastes and in the bodies of all organisms is released as CO_2 by decay, or decomposer, organisms (chiefly bacteria and fungi) in a series of microbial transformations. Part of the organic carbon—the remains of organisms—has accumulated in the Earth's crust as fossil fuels (e.g., coal, gas, and petroleum), limestone, and coral. The carbon of fossil fuels, removed from the cycle in prehistoric time, is now being released in vast amounts as CO_2 through industrial and agricultural processes, much of it quickly passing into the oceans and there being "fixed" as carbonates. If oxygen is scarce (as in sewage, marshes, and swamps) some carbon is released as methane gas.

Carbon monoxide emitted from the exhaust of a car

.An incomplete reaction is especially probable when it takes place quickly, as in an automobile engine; for this reason, automobile-exhaust gases contain harmful quantities of carbon monoxide, sometimes several percent, although antipollution devices are intended to keep the level below 1 percent. As little as 1/1000 of 1 percent of carbon monoxide in air may produce symptoms of poisoning, and as little as of 1 percent may prove fatal in less than 30 min. It is a major component of air pollution in urban areas. In addition to being present in automobile exhaust, carbon monoxide also occurs in cigarette smoke. Because it is odorless, carbon monoxide is an insidious poison. It produces only mild symptoms of headache, nausea, or fatigue, followed by unconsciousness. An automobile engine running in a closed garage can make the air noxious within a few minutes; a leaking furnace flue may fill a house with unsuspected poison. Fuel gas, which may contain as much as 50 percent carbon monoxide, often has small quantities of unpleasant-smelling sulfur compounds purposely added to make leaks noticeable.

Hemoglobin, the oxygen-carrying substance in blood, has a much greater affinity for carbon monoxide than it has for oxygen; together they form a stable compound, carboxyhemoglobin, that decreases the amount of uncombined hemoglobin available for oxygen transport. Carboxyhemoglobin has a characteristic cherry-red colour—in spite of asphyxiation, cyanosis (turning blue) does not occur; the skin is pink or pale and the lips bright red. Indications of carbon monoxide poisoning include headache, weakness, dizziness, nausea, fainting, and, in severe cases, coma, weak pulse, and respiratory failure. Treatment must be prompt and includes respiratory assistance and the administration of oxygen, often with 5 percent carbon dioxide and sometimes under high pressure. Recovery from mild intoxication may be complete, but prolonged exposure or breathing of high concentrations of the gas result in permanent tissue damage, especially to the heart and central nervous system. Chronic carbon-monoxide poisoning, as among garage and railroad workers, may mimic other common illnesses including colds and rheumatism Raymond Dasman (2010)

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3.0 MATERIALS AND METHODS

The apparatus used were the gas monitor for carbon monoxide (CO), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2), and a stop watch. A gas monitor is a device which detects the presence of various gases within an area; it is battery operated and transmits warnings , alarms and flashing lights . Functions through sensors , selecting a particular gas out of several gases depending on their molecular structure and concentration.

Figure 1.2 A multiple gas monitor/detector

Gas monitors for carbon monoxide CO, sulfur dioxide SO_2, nitrogen oxide NO_2) and stop watches were used to assess the quantity of these gases released when various machines and engines were at work in Makurdi Metropolis. Data was taken after every fifteen minutes in the daytime (8hours) on exhausts of take off vehicles at major and minor roads, markets, on electric generating and milling machines, in restaurants and domestic kitchens from five areas of the town , High-level roundabout labeled as zone A , Wurukum roundabout - zone B, Wadata market - zone C, Nyiman layout - zone D and Gyado villa - zone E. Average results from all the zones. Average readings were taken for each zone and the values were then used to estimate the average amount of CO, SO_2, and NO_2 present in the atmosphere .

4.0 Results

Zone A, average quantities of these gases taken in 3 places after every 15 minutes (Short Term Exposure Limit STEL) for 8 hours the first week . (ppm)

CO_2	SO_2	NO_2	CO_2	SO_2	NO_2	CO_2	SO_2	NO_2
14.34	1.2	0.04	15	0	0	20	0.08	0.04

Zone B, average quantities of these gases taken in 3 places after every 15 minutes (Short Term Exposure Limit STEL) for 8 hours the second week . (ppm)

CO ppm	SO2 ppm	NO2 Ppm	CO ppm	SO2 Ppm	NO2 ppm	CO ppm	SO2 Ppm	NO2 ppm

33.5	00.0	00.0	14.0	0.08	0.04	33.32	00.0	00.0

Zone C, average quantities of these gases taken in 3 places after every 15 minutes (Short Term Exposure Limit STEL) for 8 hours the third week . (ppm)

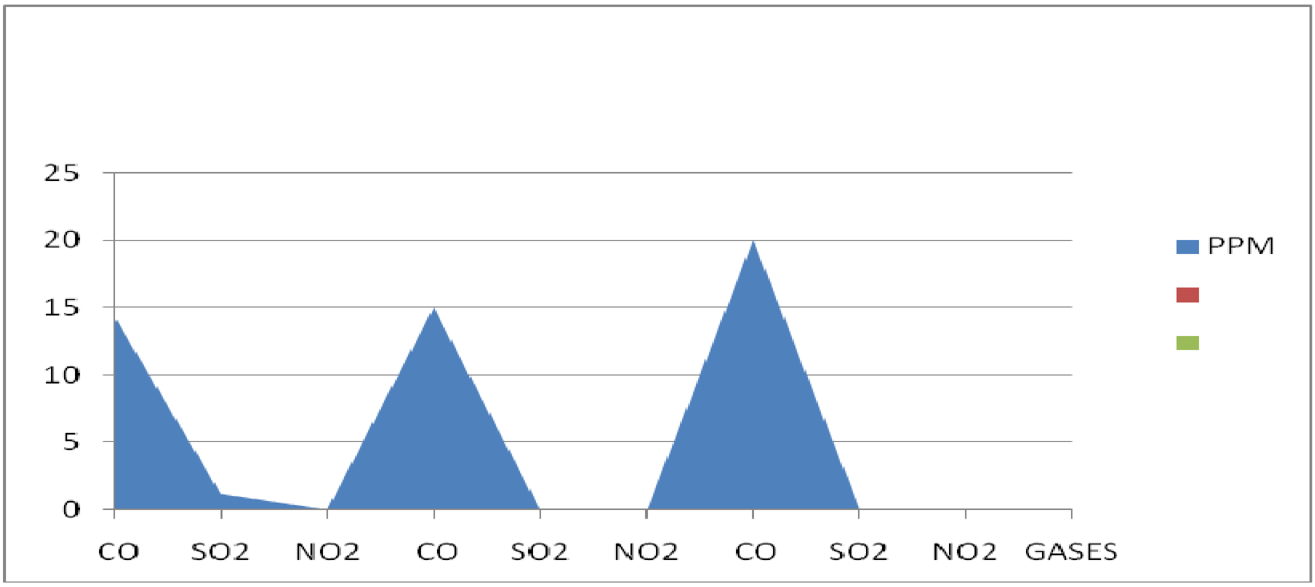
8.0	0.16	0.16	13.0	0.20	0.00	15.54	0.20	0.20

Zone D, average quantities of these gases taken in 3 places after every 15 minutes (Short Term Exposure Limit STEL) for 8 hours the fourth week . (ppm)

9.32	0.00	0.04	17.0	00.0	2.0	9.64	00.0	0.24

Zone E, average quantities of these gases taken in 3 places after every 15 minutes (Short Term Exposure Limit STEL) for 8 hours the fifth week . (ppm)

17.64	00.0	0.04	10.64	00.0	0.28	19.32	0.00	0.00



Zone A results representing the pattern of the gases expelled in all the zones

5 OBSERVATIONS

. Environmental Protection Agency EPA National Ambient Air Quality Standards NAAQS amended in 1990 refers to Short-term exposure limit (STEL) as the acceptable exposure limit to a toxic or an irritant substance over a short period of time (time-weighted average TWA), usually 15 minutes. This term is used in occupational health, industrial hygiene and toxicology. Data collected in this work is displayed above and average results from all the zones show the highest amount of Carbon monoxide CO in the atmosphere as_33.5 ppm in zone B , Sulfur dioxide SO_2 in the atmosphere shows 1.2 ppm as highest average in zone A and Nitrogen dioxide NO_2 as 0.28 ppm. in zone E.

6 CONCLUSION

The data as well as the chart above show the levels of gas emissions in the atmosphere of Makurdi especially carbon monoxide . Criteria pollutants and their exposure limits presented at the introduction paragraph also show cause for concern . It can therefore be concluded that there is air pollution in the atmosphere of Makurdi metropolis

7 RECCOMENDATIONS

Reducing pollutant emissions by collecting and trapping in air-cleaning devices as they are generated and before they can escape into the atmosphere controls ambient air pollution from stationary sources, including power plants and industrial facilities .Below is a Cyclone collector, for removing relatively coarse particulates from the air. Small cyclone devices are often installed to control pollution from mobile sources.

Once collected, particulates adhere to each other, forming agglomerates that can readily be removed from the equipment and disposed of, usually in a landfill.

Another device called wet scrubber traps suspended particles by direct contact with a spray of water or other liquid , washes the particulates out of the dirty airstream as they collide with and are entrained by the countless tiny droplets in the spray.

Electrostatic precipitation is a commonly used method for removing fine particulates from airstreams. In an electrostatic precipitator particles suspended in the airstream are given an electric charge as they enter the unit and are then removed by the influence of an electric field.

Gas adsorption, as contrasted with absorption, is a surface phenomenon. The gas molecules are sorbed—attracted to and held—on the surface of a solid. Gas adsorption methods are used for odour control at various types of chemical-manufacturing and food-processing facilities, in the recovery of a number of volatile solvents (e.g., benzene), and in the control of VOCs at industrial facilities.

Activated carbon (heated charcoal) is one of the most common adsorbent materials; it is very porous and has an extremely high ratio of surface area to volume. Activated carbon is particularly useful as an adsorbent for cleaning airstreams that contain VOCs and for solvent recovery and odour control. A properly designed carbon adsorption unit can remove gas with an efficiency exceeding 95 percent.

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