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DETERMINATION OF LEVEL OF GASEOUS POLLUTANTS IN INDUSTRIAL ESTATES IN KANO, KANO STATE

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ABSTRACT
We conveniently carried out this study to determine the air pollution levels in industrial Estates in Kano State using Bayero University Kano (BUK) new site as the control area. Air pollution present not just an aesthetic problem. It also causes potential health problems. Thousands of deaths have been directly related to poor air quality in the cities. Crowcon Gas Detector was typically used to accurately measure the concentrations of Hydrogen Sulfide nitrogen dioxide, methane, sulfur dioxide, and carbon monoxide at Bompai, Sharada, Gundunwawa, and the control area. From the analysis of the results got, we found out that the pollution levels in the industrial estates; Bompai, Sharada, and Gunduwawa are higher than the levels of pollution at the BUK new site, the control area. Therefore, it is recommended that a clean air act should be enacted and agencies involved in the environment's protection empowered to implement it. The clean air act should establish a series of detailed control requirements that the federal government implements and the state administers.

Keywords: *Determination, Gaseous, Pollutants, Industrial Estates, Kano.*

Introduction

Background to the study

Over the years, there have been, continuously, a lot of concerns about the adverse effects of the activities of our industries on our environment. Although, the earliest pollutants in the atmosphere are of natural origin; smoke, fumes, ash, and gases from volcanoes, forest fire, sand, and dust from windstorms in arid regions, fog in humid low-lying areas, and natural terpene haze from pine trees in mountainous regions, long before human-induced, or anthropogenic problems came into existence (Howard *et al*, 1985). The industrialization has provided humanity with materials and social benefits. It has also brought in its wake up many unwanted substances and social problems. One of these problems is the degradation of the environment. These environmental problems are becoming threats to the very existence of living beings. The environment upon which our life is most dependent has fallen victim to pollution brought by the man himself through unplanned and unscientific urbanization, industrialization, and mineral exploitation (Ayodele *et al.*, 2000). The pollutants generated through human activities and their effects on the environments may lead to the extinction of man and other organisms if not monitored and checked (Chauhan, 2010). The sources of human-induced pollutants are numerous and varied and have been categorized into four groups-mobile transportations, stationary combustion, industrial process, and solid- waste disposal (Institute for Air Pollution Training, 1975). The regulated air pollutants are made up of two groups, namely; the criteria and hazardous air pollutants. The criteria pollutants include particulate matter, nitrogen oxides, sulfur oxides, carbon monoxide, ozone, and lead. The hazardous air pollutants include asbestos, beryllium, mercury, vinyl chloride, arsenic, radionuclides, benzene, and coke oven emissions (Chauhan, 2010Depending on their origin, pollutants are considered either primary or secondary contaminants. Primary pollutants, like oxides (SO2), nitrogen oxides (NO2), and hydrocarbons (HC) and those emitted directly to the atmosphere in the form in which they were emitted. Secondary pollutants such as ozone (O3) and peroxyacetylnitrate (PAN) are those formed in the atmosphere by photochemical hydrolysis or oxidation reaction (Howard *et al*, 1985).

Statement of the problem

Depending on their origin, pollutants are considered either primary or secondary contaminants. Primary pollutants, like sulfur oxides (SO2), nitrogen oxides (NO2), and hydrocarbons (HC) and those emitted directly to the atmosphere in the form in which they were emitted. Secondary pollutants such as ozone (O3) and peroxyacetylnitrate (PAN) are those formed in the atmosphere by photochemical hydrolysis or oxidation reaction (Howard et al, 1985)..

Aims and objectives of the study

The purpose of this study is;

i. to determine the levels of gaseous pollutants in some selected industrial estates in Kano metropolis, using an automatic gas sensor
ii. to compare the result with BUK new site as the control area
iii. to verify whether the concentration of gaseous pollutants in the industrial areas of the state is higher than what is obtainable in areas where there are no industries.

Significance of study

The findings of this study, about the concentration and hence distribution of pollutants in the industrial estates and the rural areas, may be useful for the improvement of environmental quality, for example, in the planning of reduction of industrial pollution emission, direction for further development of industries, reduction of pollution in urban areas for safety and creation of the pollution-free zone.

Scope and Limitation of the Study

This study deals with the gaseous pollution levels in industrial estates in Kano State. Peculiarly the areas considered are Bompai, Sharada, Gundunwawa, and BUK new site. We limit the research to challenging time and financial constraints.

Experimental Method

The Gasman Detector was designed to detect and measure gas concentration in one's present environment. It possesses an in-built capacity to automatically detect and measure the concentration of gases and/or a specific gas in the environment.

Sample Collection and Description of Sample Locations.

Samples of hydrogen sulfide, sulfur oxide, nitrogen dioxide, methane, and carbon monoxide gases were measured at three different locations in all of the selected industrial districts in Kano using five different gas sensors each for gas of interest. We also measured the temperature at each of the locations employing a thermometer. The selected industrial quarters typically include Bompai, Sharada, and Gunduwawa with BUK new site being used as the control area.

Sample Treatment

The automatic gas sensors treated the sample internally and indicate the concentration of each gas in the atmosphere in all of the areas in parts per million. The direct result is further converted to milligram per meter cube and presented accordingly.

Instrumentation

The Crowcon Gasman Detector Instruments were used in this research work. Specifically, Gasman ‘’FL’’ and ‘’TO” were used and are designed to monitor the presence of flammable gases, and specific toxic gases respectively.

Calibration

To adjust the span of the “TO” and “FL” versions, gas of a known concentration and a reliable delivery system to the sensor were required. The calibration gas test kits comprising a gas mixture of the required gas (e.g. H2S) and nitrogen of concentration 25 ppm -5 ppm in a disposable cylinder, regulator, tube and calibration adaptor. The calibration adaptor was fitted into the top of the sensor housing and the gas cylinder valve was opened. The gas flow rate is set to 0.15/min and the reading on the sensor was allowed to stabilize and the cylinder valve was closed and the adaptor was disconnected. The control valve was completely closed and carefully screwed onto the Can outlet thread. The valve knob was carefully turned to achieve a required gas flow shown on the flow indicator. The gas range was 0 to 50ppm for hydrogen sulfide, 0 to 10ppm for sulfur dioxide and nitrogen dioxide, 0 to 100ppm for methane.

Operation

With the unit carefully placed in the air, we turned the switch to the gas position. The green LED (Light-Emitting Diode) and the sounder operated once every three seconds to confirm the standard operation. We ensured the displaced reading to be zero. The Gasman sensor properly uses a catalytic bead which ultimately and automatically measured the gas concentrations.

Results and Discussions.

Results

Table 1.1: Concentration of gaseous pollutants in air and prevailing temperatures (℃) at Bompai

Pollutant	Site1	Site 2	Site 3	Mean Value (ppm)	Mean Value (mg/m3)
H2S	**1.00**	**3.00**	**2.00**	**2.00**	**3.000**
NO2	**0.10**	**0.40**	**0.20**	**0.23**	**0.466**
CH4	**1.00**	**1.00**	**1.00**	**1.00**	**0.706**
SO2	**0.10**	**0.10**	**0.10**	**0.10**	**0.282**
CO	**5.00**	**6.00**	**6.00**	**5.67**	**6.990**
Temp.	**36.40**	**37.40**	**37.90**	**-**	**-**

Table 1.2: Concentration of gaseous pollutants in air and prevailing temperatures (℃) at Sharada

Pollutant	Site1	Site 2	Site 3	Mean Value (ppm)	Mean Value (mg/m3)
H2S	**1.00**	**2.00**	**1.00**	**1.33**	**2.00**
NO2	**0.40**	**0.40**	**0.20**	**0.33**	**0.67**
CH4	**2.00**	**1.00**	**3.00**	**2.00**	**1.41**
SO2	**0.10**	**0.40**	**0.10**	**0.20**	**0.564**
CO	**4.00**	**2.00**	**1.00**	**2.33**	**2.33**
Temp.	**35.4**	**33.6**	**34.6**	**-**	**-**

Table 1.3: Concentration of gaseous pollutants in air and prevailing temperatures (℃) at Gunduwawa

Pollutant	Site1	Site 2	Site 3	Mean Value (ppm)	Mean Value (mg/m3)
H2S	**1.00**	**2.00**	**1.00**	**1.33**	**2.00**
NO2	**0.20**	**0.20**	**0.20**	**0.20**	**0.41**
CH4	**1.00**	**1.00**	**1.00**	**1.00**	**0.71**
SO2	**0.00**	**0.10**	**0.10**	**0.10**	**0.28**
CO	**3.00**	**4.00**	**5.0**	**4.00**	**4.93**
Temp.	**36.6**	**35.7**	**36.1**	**-**	**-**

Table 1.4: Concentration of gaseous pollutants in air and prevailing temperatures (℃) at BUK new site

Pollutant	Site1	Site 2	Site 3	Mean Value (ppm)	Mean Value (mg/m3)
H_2S	**1.00**	**1.00**	**1.00**	**1.00**	**1.50**
NO_2	**0.10**	**0.10**	**0.10**	**0.10**	**0.20**
CH_4	**0.10**	**0.20**	**0.30**	**0.20**	**0.14**
SO_2	**0.00**	**0.10**	**0.00**	**0.03**	**0.09**
CO	**2.00**	**2.00**	**1.00**	**1.67**	**2.06**
Temp.	**30.5**	**31.5**	**32.5**	**-**	**-**

Table 1.5: Summary of average/ Mean Concentration of gaseous pollutants in mg/m3 in air in research areas

Gas	Bompai	Sharada	Gunduwawa	BUK New Site
H_2S	**3.00**	**2.00**	**2.00**	**1.50**
NO_2	**0.47**	**0.67**	**0.41**	**0.20**
CH_4	**0.71**	**1.41**	**0.71**	**0.14**
SO_2	**0.28**	**0.56**	**0.28**	**0.09**
CO	**6.99**	**2.84**	**04.93**	**2.06**

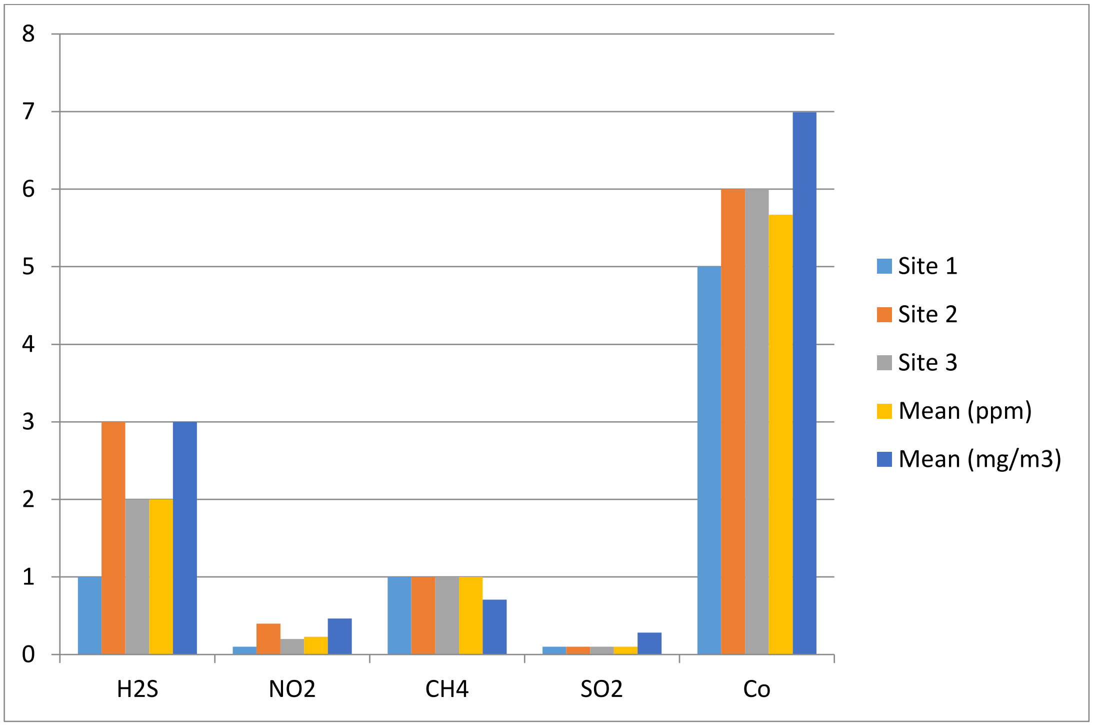

Figure 1: Concentration of gaseous pollutants in air at Bompai

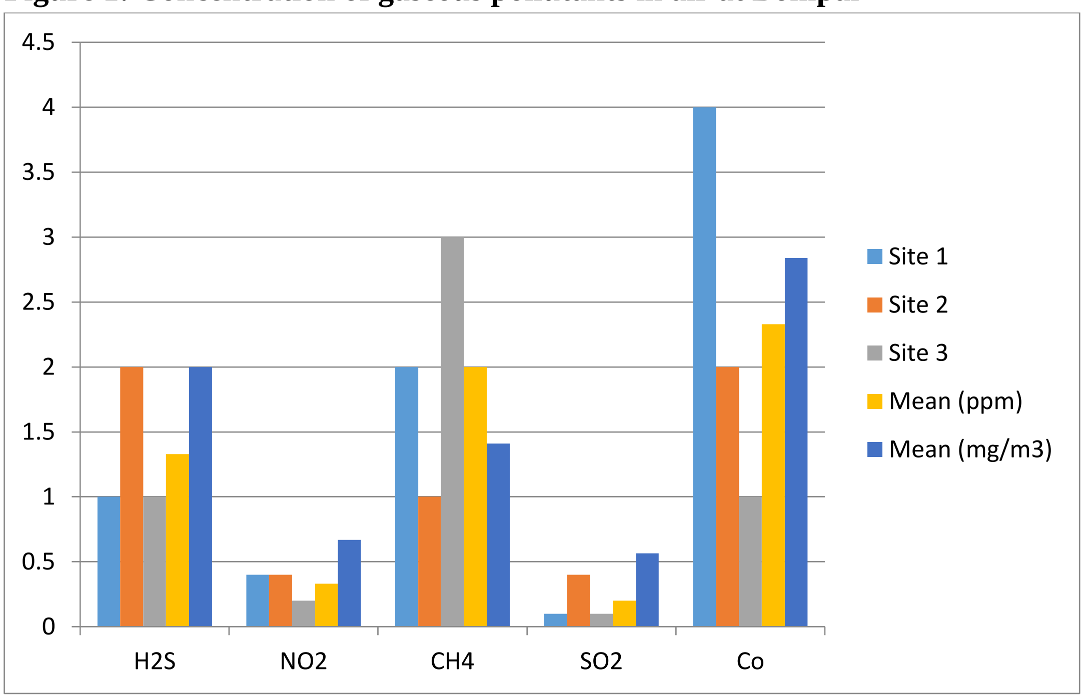

Figure 2: Concentration of gaseous pollutants in air at Sharada

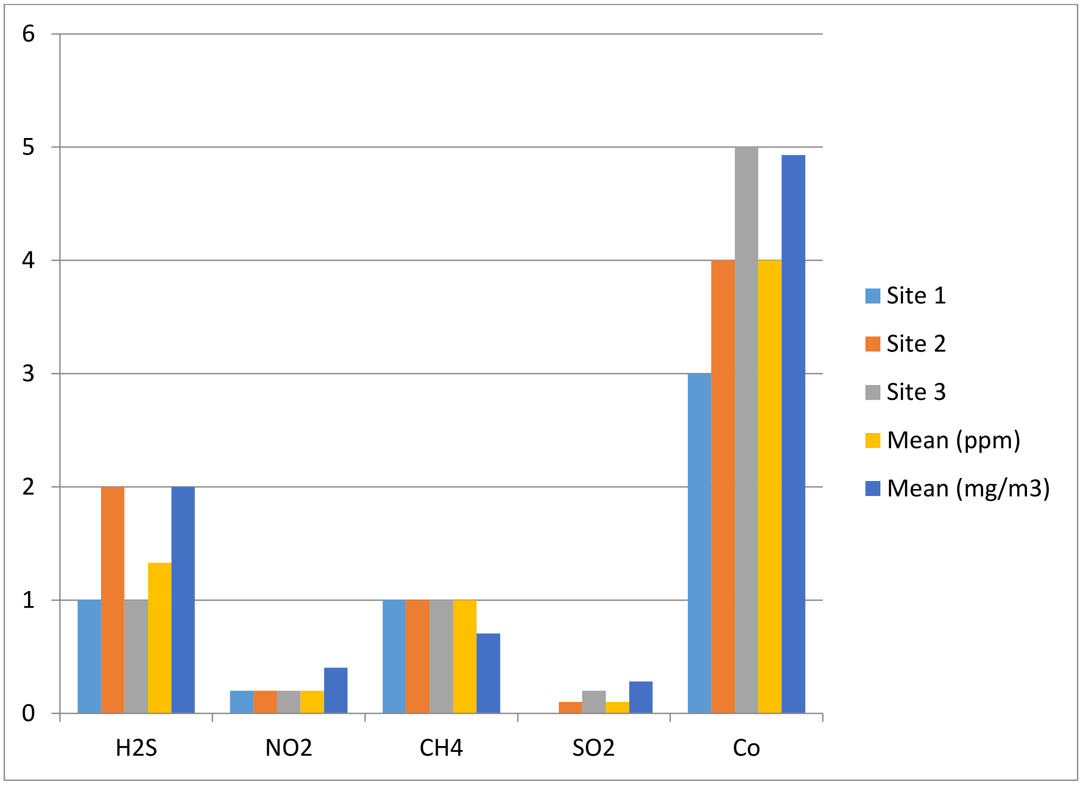

Figure 3: Concentration of gaseous pollutants in air at Gunduwawa

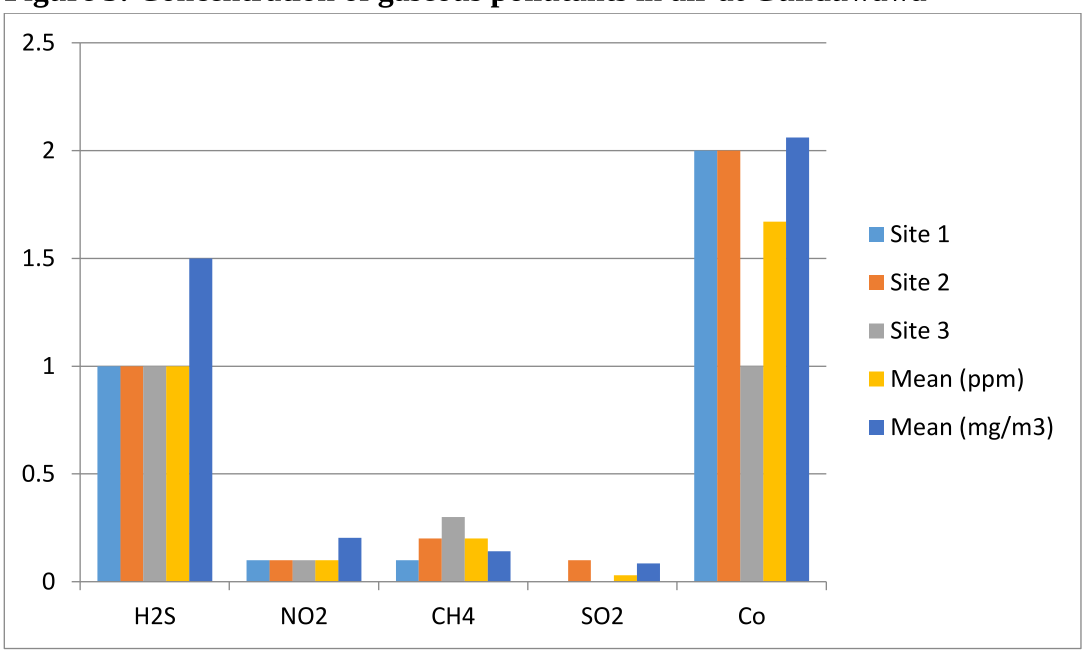

Figure 4: Concentration of gaseous pollutants in air at BUK new site

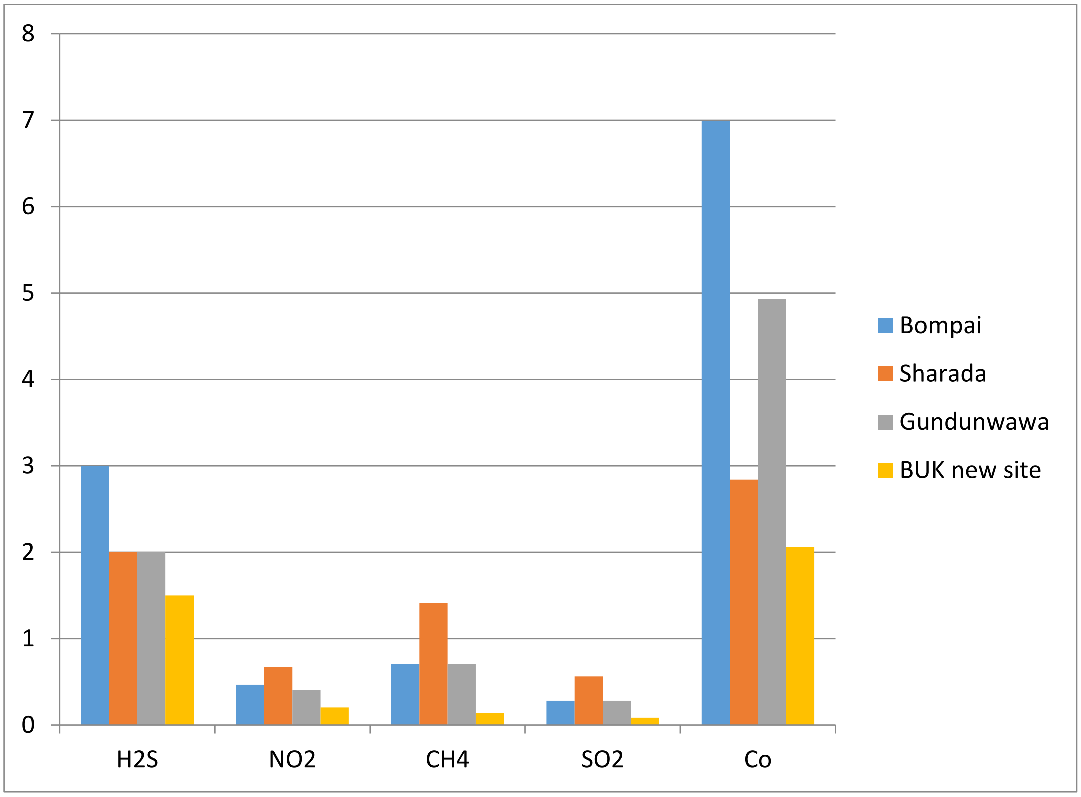

Figure 5: Summary of average/ Mean Concentration of gaseous pollutants in the research area

Discussion

Hydrogen Sulfide

Table 1.1 shows that the concentration, in air, of hydrogen sulfide in Bompai is in the range 1.00-3.00 ppm with a mean concentration of 2.00ppm. From Table 1.2, we observe the concentration of hydrogen sulfide in Sharada in the range 1.00–2.00 pm with the mean value of 1.30 ppm. Table 1.3 shows the concentration of hydrogen sulfide in Gunduwawa area in the range 1.00–2.00ppm, with a mean concentration of 1.30ppm. From Table 1.4, we observed that the concentration of hydrogen sulfide in BUK new site (control site) is 1.00ppm, with a mean value of 1.00ppm. We can also observe from Table 1.5 that, the overall mean value of the concentration of hydrogen sulphide in the industrial estates of Kano State is 002ppm. The concentration of the pollutant, hydrogen sulfide is higher in the selected industrial areas than the one obtainable at BUK new site (control site). We may attribute the high concentration of hydrogen sulfide in the industrial areas to traffic flow, industrial processes, decay of organic matter, and other human and natural activities.

Nitrogen Dioxide

Table 1.1gives concentration of nitrogen oxide in Bompai, one of the industrial areas considered in this research, the distribution of this pollutant is in the range 0.10 – 0.40ppm, with an average concentration of 0.23 ppm. In table 4.2, we observed the concentration of nitrogen dioxide in Sharada to be in the range 0.20-0.40 ppm, with the mean concentration, in the area, of 0.33 ppm.

Table 4.3 also indicates the concentration of nitrogen dioxide in the Gunduwawa area to be 0.20 ppm. From table 4.4, the concentration of nitrogen dioxide is seen to be 0.10 ppm, with an average concentration of 0.10 ppm in BUK new site area this then shows that the concentration of nitrogen dioxide in Bompai, Sharada, and Gunduwawa which comprise industrial areas, is higher than the concentration of the same pollutants in BUK new site, a non-industrial area. The higher concentration of nitrogen dioxide in the industrial areas can then be attributed to the burning of fossil fuels from both automobiles and stationary sources, and several industrial processes that produce nitric acid as a by-product for the synthesis of ammonium nitrate fertilizer, as well as from the synthesis of plastics, explosives, dyes, drugs, etc. once, in the atmosphere, nitric oxide is oxidized to nitrogen dioxide by reaction with ozone.

Methane

From table 4.1, the concentration of methane in the atmosphere in the Bompai area is 1.00 ppm, with an average concentration of 1.00 ppm

Table 4.2 shows that the concentration of methane gas in the air in the Sharada area is between 1.00-3.00 ppm, with an average concentration of 2.00 ppm. In table 4.3, the concentration, in the atmosphere, of methane in the Gunduwawa area is measured to 1.00 ppm, with a mean concentration of 1.00 ppm. While in table 4.4, the concentration of methane in the air at the BUK new site, which is the control area, is in the range 0.10-0.3 ppm, with the mean concentration of 0.20ppm. Volatile organic compounds known as hydrocarbons found in the air are either from fuel supplies or are remnants of fuel that did not burn completely. The use of internal combustion engines accounts for about 45 percent of the hydrocarbon released into the air, and refineries and other industries contribute an equivalent amount. Therefore, 90 percent of hydrocarbons are from vehicles and industrial activities. This, however, explains the more elevated concentration of methane in the atmosphere recorded in the industrial areas; Bompai, Sharada, and Gunduwawa, and a lower concentration recorded in the control area, Bayero University Kano, new site.

Sulfur dioxide

In table 4.1, the concentration of sulfur dioxide in the air in the Bompai area was measured to be 0.10ppm, with an average concentration of 0.10 ppm.

Table 4.2 shows that the concentration, in the atmosphere, of sulfur dioxide in the Sharada industrial area is in the range 0.10-0.40 ppm, with an average concentration, of 0.20ppm.

From table 4.3, we observed the concentration of sulfur dioxide in the atmosphere in Gunduwawa is in the range 0.00-0.20 ppm, with an average concentration, in the area, of 0.10 ppm. The concentration of sulfur dioxide in the air in BUK new site in the area, as shown in Table 4.4, is in the range 0.00-010 ppm, with the mean concentration of 0.03 ppm.

The observed elevated concentrations of sulfur dioxide in the industrial areas are due to the fact that over 60 percent of sulfur dioxide released into the atmosphere is from power plants, primarily those that burn coal and sulfur-containing fossil fuels.

Carbon monoxide

In table 4.1, the concentration of carbon monoxide in the Bompai area is observed to be in the range of 3.00-5.00 ppm, with an average concentration of 4.00 ppm. From table 4.2, the concentration of the same pollutant in the specific Sharada area is between 1.00-4.00 ppm, with an average concentration of 2.33 ppm in the area.

Table 4.3 shows that the concentration of carbon monoxide in the Gunduwawa area is between 3.00-5.00 ppm, with an average concentration of 4.00 ppm. In table 4.4, the concentration, in air, of carbon monoxide in the BUK new site is seen to be between 1.00-2.00 ppm, with an average distribution of 1.67 ppm. From the average concentration of carbon monoxide obtained in Table 4.1-4.4, we observed the concentration of carbon monoxide in the industrial areas is higher than the concentration of the same pollutant in the control area. The possible reason for this is not far-fetched; this is because 60 percent of carbon monoxide in the air typically comes from moving vehicles and 30 percent comes from motorized vehicles not used on roads. The remainder comes from other processes that typically involve burning in power plants, industry, and burning leaves, etc. In urban areas, as much as 90 percent of carbon monoxide is from motor vehicles.

Summary, Recommendation and conclusion

Summary

Pollution represents any addition of matter or energy that degrades the environment for humans and other organisms. Because human actions represent the principal cause of pollution, we can do something to prevent or manage it. There are several natural sources of gases and particles that degrade the quality of air, including materials emitted from volcanoes, dust from wind air, and gases from the decomposition o dead plants and animals. Since humans do not control these events; much cannot be done to handle them. However, automobile emissions, chemical odour, factory smokes, and similar materials are considered man-induced air pollution. We directly related the problem of air pollution to the number of people living in an area and the activities in which they are involved. When the population is modest and its energy use is low, the impact on people is minimal. The pollutants released into the air are diluted, carried away by the wind, and washed from the air by the rain. It can also react with oxygen in the air to form harmless materials. In this manner, the general negative effect is slight.

However, our urbanized, industrialized civilization has a dense concentration of people that consume large quantities of fossil fuels for manufacturing, transportation, and domestic purposes. These activities release enormous quantities of polluting by-products into our environment. In industrialized urban areas, it cannot always dilute sufficiently pollutants before the air reaches another city where it is further polluted. Hence, the need to monitor and make sure the concentrations of these pollutants does not exceed the air quality standard set by various environmental agencies. Considering this, we selected some industrial areas in Kano, namely: Bompai, Sharada, and Gunduwawa, with BUK new site as control area and the concentrations of some air pollutants; hydrogen sulfides, nitrogen oxides, methane, sulfur oxide, and carbon monoxide were measured using Crowcon Gasman Detection instrument.. We analyzed the data obtained through the proper use of tables and mean/averages. The consistent result of the study has shown the concentrations of air pollutants in the industrial areas are higher than the concentration of the pollutants in the non-industrial area and therefore, the activities of our polluting industries should be carefully monitored.

Conclusion

The pollutants; hydrogen sulfide, nitrogen dioxide, methane, sulfur dioxide, and carbon dioxide gases are dispersed throughout the metropolis' atmosphere in a concentration not high enough to cause significant health problems (Miller, 1990). The result of this study indicated that the concentrations of these pollutants didn't pose an immediate threat to the environment of the metropolis because their concentrations are still far below allowable standard concentrations. However, the concentrations of these gases were more elevated in the industrial areas of the metropolis and if not monitored and checked may constitute a serious threat to lives as well as properties in the nearest future.

Recommendation

To ensure the concentration of pollutants in the environment does not exceed the allowable limits. The researcher recommends the following;

i. Information about the distribution of these pollutants should be utilized for the improvement of environmental quality, for example, in the planning of reduction of industrial pollution emission, in controlling the direction for subsequent development of industries, in reduction of pollution in industrialized urban areas, and in creating pollution-free zones.

ii. Although increased fuel efficiency and the use of catalytic converters have appreciably reduced carbon monoxide emission per kilometer driven, but carbon monoxide, however, remains a fundamental problem, so standards should be set about the maintenance of automobiles, and pollution control equipment should be incorporated into them.

iii. A clean Air Act, if none has existed, should be enacted, with agencies involved empowered to efficiently implement it.

iv. Government at all levels should begin massive orientation and war against corrective actions that naturally degrade our atmosphere and properly render it dangerous for usage.

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