Civil and Environmental Research
ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online)
Vol.6, No.5, 2014


# Environmental Health Effects of Exposure to Air Pollution in Industrialized Areas

Otti, V.I. & Ogbuagu F.U
Department of Civil Engineering, Federal Polytechnic, Oko

**Abstract**
Naturally, most people tend to associate air pollution problem with the coming of industrial revolution in the early 60's. Such problems in one form or another have plagued the human race for centuries. The earliest pollutant noted in the atmosphere was probably of natural origin. Ash, fumes, smoke and forest fires, sand and dust from windstorm in arid region, dews during dry season were part of our environment long before human – induced or anthropogenic problem came on the scene. Although polluted air may not be ideal from the biological point of view, we may treat its behaviour with respect to temperature and pressure as if it were ideal. Therefore, we assume that at the same temperature and pressure, different kinds of gases have densities proportional to their molecular masses. Consequently, the concept of pollution control begins with minimization of the general waste. In Nigeria, Environmental Protection Agency was established under Decree No. 58 of 1988 to investigate and describe the environmental effect of any air pollutant emitted by stationary or mobile source, that may adversely affect human health or the environment. Example is the indiscriminate burning of solid waste at open dumps,which generates air contaminants like dust,smokes,mist and odour causing injurious to human,plant,animal or property.

## [1]INTRODUCTION

There are two main types of pollution namely, water and air. Air pollution is addition of harmful substance to the atmosphere resulting in damage to the environment, human health and quality of life, Cooper and Alley (1994). Air pollution which consists of indoor and outdoor pollutant has been a public concern in Nigeria.
The indoor air pollution occurs inside homes, school and offices ,as results from product of use in construction material and emission of Nitrogen oxide, and sulphur oxide in air-conditioned houses, gas stove and some volatile organic compounds like Alkanes and furmaldchyde. In cities like Nkalagu, Gboko, Lagos, Kano, Port Harcourt and Ibadan, across Nigeria, acid rain and ozone pollution create an environmental impact and affect human health unknowingly as a result of cement factories located in these areas. Some outdoor pollution consist of natural contaminants such as pollen, fungispores, smoke, dust particles from forest fires. It contains also naturally occurring carbon monoxide, Hydrogen Sulphide ($H_2S$) and methane from the anaerobic decomposition of organic matter.
Consequently, air pollution consists of five mechanism of deterioration from which have caused environmental impact and also contributed to abrasion, deposition and removal, direct chemical attack and electrochemical corrosion, Ferris (1978).
A pollution of Sulphurdioxide may have a direct chemical attack on building (cement $CaCo_3$). Mostly, direct human health effects of hazardous air pollutants are experienced by industrial worker who are exposed to air pollution especially in industrialized areas. Bompai in Kano etc.
In most cases, the outdoor atmosphere is contaminated with the presence of pollutants which consists of dust, fumes, smoke and odour in sufficient quantities of such characteristic which can threaten to be injurious to human, plant and animal life and some property (Hardoy, J. et al (2001). Obviously, pollution in the air reasonable interferes with the comfortable enjoyment of life and property.
Usually, the atmosphere blankets the planet with air pollution which could make the earth un-inhabitable, if there is a long range of effects of the pollution. Below is the table for different pollutants

**Table 1: Classification of Air Pollutants**

| Class | Subclass | Member of Substance |
|---|---|---|
| Particulate | Solid<br>Liquid<br>Hydrocarbon | Dust, smoke, funes, etc<br>Mist, spray<br>Methane, Ethylene, butane etc |
| Gases<br>(organic) Gases<br>(inorganic) | Oxide of carbon<br>Oxide of sulphur<br>Oxide of Nitrogen<br>Others | Carbon monoxide, Carbon monoxide, carbon dioxide,<br>Sulphuric dioxide, sulphuric trioxide<br>Nitrogen dioxide, Nitric oxide<br>Hydrogen sulphide,<br>Hydrogen fluoride and amonia |

## [2]SOURCE OF AIR POLLUTION

It has been established that all air contains natural contaminants, dust particles and naturally occurring carbon

 

monoxide from the breakdown of methane hydrocarbon in the form of terpenes from the pine trees and methane from the anaerobic decomposition of organic matter.

There is also air pollution emitted from in indiscriminate dumping of solid waste which decomposes to a number of gases, that are present in the exposed dumping solid waste, including ammonia ($NH_3$), carbon dioxide ($CO_2$) Carbon monoxide (CO), Hydrogen $H_2$, Hydrogen Sulphide ($H_5S$), Methane ($CH_4$), Nitrogen ($N_2$) and an exposed solid waste can produce some odourous material in the atmosphere (methane and carbon dioxide), can be released by both convective flow and diffusion to different strata of soil, (CO) Carbon monoxide, (SP) Suspended or settled particle (HC) Hydrocarbon, ($NO_2$) Nitrogen Oxide, ($SO_2$) Sulphur oxide. Prasad (1995).

**Table 2: Source & content of pollutant**

| | Source | CO | SP | $SO_2$ | HC | $NO_2$ | Total |
|---|---|---|---|---|---|---|---|
| A | Transport | 3.5 | 0.07 | 0.045 | 0.039 | 0.455 | 4.415 |
| B | Fuel combustion (power heating) | 0.05 | 0.07 | 0.95 | 0.01 | 0.53 | 1.665 |
| C | Industrial process solid waste disposal | 0.29 | 0.165 | 0.19 | 0.54 | 0.035 | 1.24 |
| D | Forest Fire Agriculture Burning | 0.31 | 0.045 | .0. | 0.12 | 0.01 | 0.485 |
| | Total | 4.27 | 0.39 | 1.185 | 1.09 | 1.035 | 7.97 |

*Source: Pollutant (1000 T/Yr) 2005 Report*

The major pollutants are generated from anthropogenic air pollutant, therefore when the smoke from the industrial cities of the nation becomes the smoke from burning furnaces in heavily populated cities like Lagos (Apapa, Amuwo Odofmo etc) Kano (Bompai), Port Harcourt gas flaring and refineries, Ibadan, the effects of pollution has become severe enough to alarm the inhabitants of these cities of the adverse effect of pollution. Air pollution in Nigeria is a public problem. Also indoor air pollution result from products used in construction like cement, asbestos roofing and ceiling sheet and inadequacy of general ventilation indirectly provokes some damages to human health. Moreover, industrial and mobile sources contribute enormously to air pollution that contaminate the ambient air, that surround us outdoor, the cement industries, Gboko in Benue, Nkalugu (Ebonyi State) etc, the transport of this ambient air pollutant over large distance and their global impact has create enough effects on the environment and populace

Patterson and Herein, in the emission from combustion engines and their control made a policy statement on air pollution and its control state that air pollution in presence of the outdoor atmosphere of one or more air contaminants (i.e. Dust, smoke, mist odour or gas) in sufficient quantities, of such characteristic and of such duration as to be or to threaten to be injurious to human, plant or animal life or to property or which reasonably interferes with the comfortable enjoyment of life or property.

## [2,1]ATMOSPHERIC COMPOSITION OF AIR AND STRUCTURE

In the atmosphere, the air which we breathe consist by volume of 78% nitrogen ($N_2$) 21% oxygen ($CO_2$) 1% Ar and 0.03 carbondioxide. The layer of troposphere which most living things exist, is contaminated with, chemical, acid rain which is as a result of gaseous emission of sulphur oxides ($SO_2$) and Nitrogen oxide ($N_2$) in the atmosphere and interaction with water vapour and sunlight and are chemical converted to strong acidic components such as sulphuric acid ($H_2$ $NO_3$).

These compounds, along with other organic and inorganic chemicals are deposited on the earth as aerosols and particles to the earth by raindrops or dew. This acid deposits from acid rain has caused considerable damage to building in both highly industrialised and low industrialised areas, Bompai in Kano, Ilepoju in Lagos, Port Harcourt in Rivers State, Aba and Ibadan.

More so, some pollutants that are generated in one country and deposited in another, have become a matter of international concern and international negotiation, (1982). Twelfth annual report of the council on environmental quality Washington D.C. An example is the dangerous waste carried from ltaly to Koko in Delta State, in 1988.

Recently, the federal Government protection Agency (FEPA) UNDER Decree No 58, in conjunction with World Health Organisation initiated another air monitoring programme of environmental impact assessment (EIA) in urban areas to reduce the environmental effects on living things (i.e. Human, fish and animal) see below natural air pollution emission by pollutants 2000- 2008 ($10^2$) from environmental impact Assessment Report (EIAR):- (FEPN)$10^{2t/yr}$

 

**Table 3: Year and Quantity of pollutant**

| Year | CO | SP | $SO_2$ | HC | $NO_2$ | Total x ($10^2$) Tonne |
|---|---|---|---|---|---|---|
| 2000 | 1.71 | 0.9 | 1.012 | 0.027 | 1.015 | 4.124 |
| 2001 | 2.01 | 0.75 | 1.015 | 0.035 | 1.018 | 4.828 |
| 2002 | 2.23 | 0.66 | 1.110 | 0.050 | 1.025 | 4.481 |
| 2003 | 2.59 | 0.62 | 1.209 | 0.076 | 1.048 | 5.537 |
| 2004 | 3.07 | 0.58 | 1.201 | 0.085 | 1.047 | 6.072 |
| 2005 | 3.30 | 0.53 | 1.197 | 0.090 | 1.045 | 6.935 |
| 2006 | 3.75 | 0.47 | 1.191 | 0.100 | 1.041 | 6.552 |
| 2007 | 4.08 | 0.41 | 1.189 | 0.120 | 1.039 | 6.838 |
| 2008 | 4.27 | 0.39 | 1.815 | 1.09 | 1.035 | 7.970 |

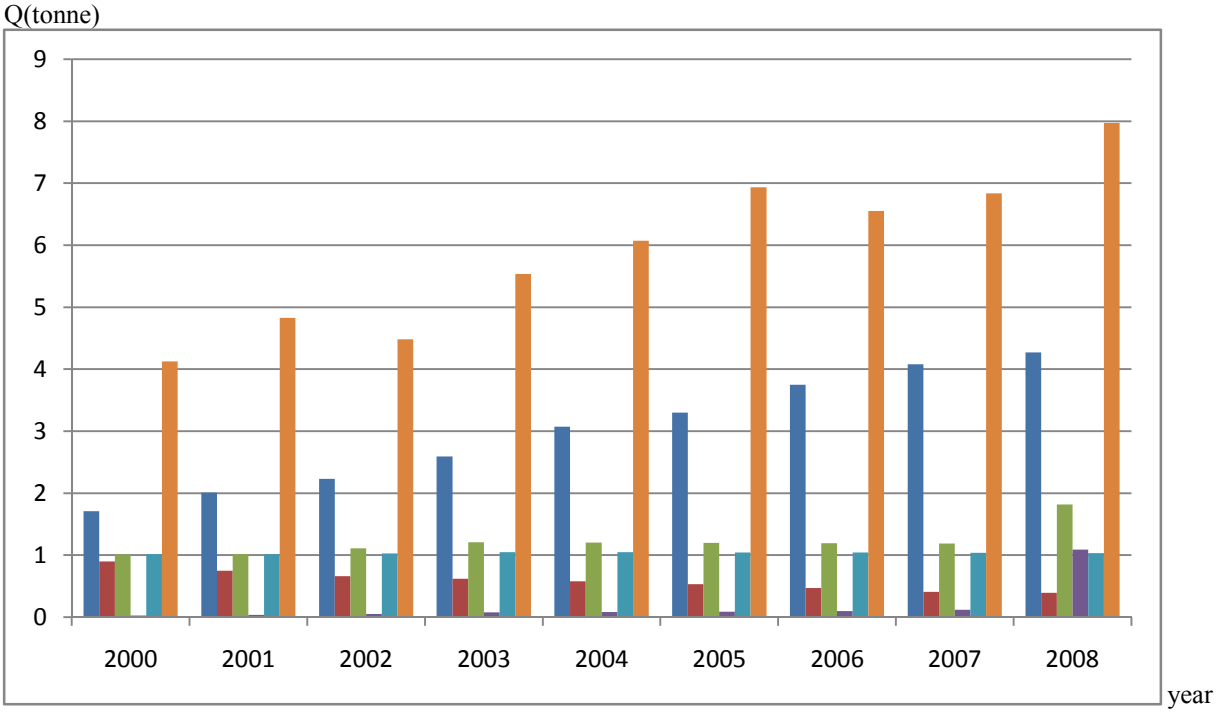


Figure 1: Bar chart showing report on EIAR

**[2,2]Effects of Air Pollution**

The pollution problem arises from the confluence of atmospheric contaminants, adverse meteorological condition and at times, certain topographical conditions that restricts dispersion of contaminants causing them to accumulate to harmful proportions, Tchobanoglous et al (1985).

Therefore three important effects of air pollution in Nigeria are considered as follows, the effects on human, vegetation and on material.

**[2,3]Effects on Human Health:** The respiratory system is the primary indicator of air pollution effects in humans as carbon dioxide diffuses through the capillary wall into the alveolus while oxygen diffuses out of the alveolus into the blood cell. The difference in partial pressure of each of the gas causes it to move from the higher to lower respiratory track causing a great cardio-respiratory ailment amongst the heavy smokers and people living in industrial areas. Some chronic respiratory disease like Bronchial-Asthma are aggravated by air pollution, example, former workers of Nkalagu cement industry in Enugu State.

Carbon monoxide, an air pollutant reacts with haemoglobin in the blood to form carboxylhaemoglobin (COHb) which effectively deprives the blood of oxygen. The excess COHb can cause a severe heart disease which can limit the patient from performing certain exercise. Ferris (1978) stated that a concentration of 20ppm of carbon monoxide for eight hours will result in a carboxyl haemoglobin level of about 2.8% and the average concentration of carbonmonoxide inhaled in cigarette smoke is 200 to 400ppm. This shows that in some industrialized cities, their sensitive population are those with heart and circulating ailments, chronic pulmonary disease and developing fetuses.

The effects of hazardous air pollutants in the lungs of most industrial workers are generally higher than in the ambient air and this is obvious because the low level of toxic air is found in ambient air Nitrogen dioxide ($NO_2$) also has effect that can result in cough and irritation of respiratory tract. According to Hardoy, (2001), at 5ppm, Nitrogen dioxide has a pungent odour and the concentration in tobacco smoke is high, can slightly increase the respiratory illness and decrease in pulmonary function associated with concentration of Nitrogen oxide.

 

**Table 4: Public health effects**

| Chemical Equation | Reaction to Health |
|---|---|
| $NO + ½ O_2 \leftrightharpoons NO_2$ | Irrates the alveoli of the lungs, results in coughing. Premature death of ill cigarette<br>Irritates the alveoli of the lungs, results in coughing. Premature death of ill cigarette smokers and elderly person |
| $SO_2 + H_2O \leftrightharpoons H_2SO_3$ (Sulphuric acid)<br>$SO_3 + H_2 \leftrightharpoons H_2SO_4$ (Sulphuric acid) | Irritates the mucous membrane of respiratory tract and foster the development of chronic respiratory disease. It decreases exercise tolerance in healthy persons. |
| $CO + Hb \leftrightharpoons COHb$ | Reduces the capacity of the blood to carry oxygen. Reduces physical activity in heart and lung diseases. |
| $C_2O + H_2aO_9N \rightarrow 11CH_4 + 9CO_2 + NH_3$ (Hydrocarbon) (ammonia) | Irritating and choking, aggravates unhealthyfylnes. Suspended particulates, settleable particulates, particulate matter, poses health hazards to humans, particularly those susceptible to respiratory illness, Pope (2002). |

[2,4].**The Effect on Vegetation**: There are always effects of particulate matter on vegetation. An example is when a dry cement-kiln dust appears to cause little damage if deposited on a leaf surface in the presence of moisture imparts damage on the plant tissues at Nkalagu, Ebonyi state in 70s on yam and maize farms. These dust coating on the leaves inhibited growth and consequently reduced the process of photosynthesis, which resulted in low harvest those years. Even their goats that ate from these cement kiln dust coated on the plants, suffered some ill-effect and died.

The Effects on Material: Material deterioration occur when the following factors, moisture, temperature and sunlight are involved. This mechanism of deterioration has been attributed to air pollution. It also involves five systems, namely abrasion, deposition and removal, direct chemical attack, indirect chemical attack and electrochemical corrosion. Some solid particles of large enough sizes and travelling at high enough speeds can cause deterioration by abrasion. Liquid and solid particles that settle on exposed surfaces causes enough-aesthetic deterioration on certain monuments and building. Solubilization and oxidation/reduction reaction occur directly by chemical attack on some materials, example is the chemical reaction between sulphur dioxide ($SO_2$) and limestone ($CaCO_3$) in the presence of water to form calcium sulphate ($CaSO_4$) and gypsum ($CaSO_4.2H_2O$). More so, some pollutants react with some components indirectly. There always would be chemical attack on the material that might lead to destruction, when leather absorbs some sulphur dioxide ($SO_2$) which reacts to form sulphuric acid and the leather becomes totally brittle. Investigation showed that those people living in Lagos at Ilepuju Industrial Layout complained of rapid deterioration of their leather seats because of sulphur dioxide emitted from some of the industries, also Kano, Gboko and Nkalagu residents suffered from the ordeal on their buildings.

**[3]CONTROL**

Air pollution problem surfaced initially in Nigeria in the 1960's during the first phase of industrialization of the Nation and subsequently in the 70's. The military Government in order to overcome the increasing air pollution or prevent further pollution established the Federal Environmental Protection Agency. Recently, the Federal Environmental Protection Agency divided the air control technology into two sources as follows:

a) Air pollution control stationary source
b) Air pollution control of mobile source

1**) Control of Stationary Source**: This control is subdivided into six general classifications namely: incineration, adsorption, absorption, condensation and combustion are used for the control of hydrocarbon, carbon monoxide, nitrogen oxide and sulphur oxide.

2) Control of Mobile Source: This is done by reduction of mobile source of combustion. It is of a paramount importance that FEPA must control the automobile emission coming from both diesel engine and gasoline-engine to avoid excess of CO, $CO_2$ and some hydrocarbon in the air.

Moreover, air can be controlled of the polluted air from the exposed dumped solid waste with waste materials by controlling gas and liquid that come out of these exposed solid waste is done by rapid evacuation to landfill dump and ambient air quality is controlled at landfill (waste material) site to possible movement of gaseous contaminants from the boundary layer of the landfill site involves:

a) The control of ambient air quality at and around the landfill site.
b) The control of landfill gases extracted from the landfill (waste materials).
c) The control of the gases from any processing or treatment facilities.

 

## [4]CONCLUSION

The enforcement of the ambient air quality statement concerning the emission standard for stationary source and mobile source is the responsibility of the Federal Environmental Protection Agency (FEPA) and some of her power must be delegated to the state government for an effective monitoring and control.

Moreover, the most effective method of control is to minimize the rate of production of pollutant in the first place. All the equipment using gasoline and diesel must be maintained to reduce excessive production of incomplete combustion of organic particles. Consequently, all the house roofs that are constructed with asbestos sheet should be changed to corrugated aluminium to avoid cancerous effects.

A recent publication in a Journal of American Heart Association (Champion Newspaper, Dec. 2003) showed that air pollution has caused twice as many deaths from heart disease as it does from lung cancer and other respiratory ailments.

Pope, in the ( 2002) issue of the Journal of American Medical Association of researchers stated that studies contained strongest evidence yet linking air pollution with lung cancer deaths, and incidence of heart attacks and other cardiovascular diseases, and respiratory diseases crushed those numbers with air pollution data for more than 150 cities kept by the Environmental Protection Agency.

Therefore,air pollution affects human health by respiratory system as cobondioxide diffuses through the capillary wall causing cardio-respiratory ailment and rise in blood pressure especially those living industrial areas.

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