
PARTICULATE AIR CONTAMINATION IN ABAKALIKI, EBONYI STATE, NIGERIA

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ABSTRACT

This work is both a review of existing knowledge as well as a Ph.D experimental project carried out between July 2007 and July 2008 to ascertain whether the air inhaled in Abakaliki is fit for consumption. It has been observed that there have not been any air quality monitoring around Abakaliki with the presence of expressways and resident quarries. The study has been repeated between March and April 2011 with the replacement of quarries by construction companies. It has been observed that the number of people complaining of eye and respiratory complications increase with the number of quarries, etc. Users of Biomedical engineering equipment report of frequent breakdown when they site them close to the areas with abundant particulate matter(dust). See EBSUTHAI record of **Biomedical Engineering** repair from 2004 to 2005(included).The need for this repeat study arose when The Ebonyi State Government decided to remove all quarries to Ezza North to see whether any improvement will be shown from the readings gotten by an experiment personally carried out by me on the instruction of my Supervisor. Out of coincidence, new double lane roads took over from where the quarries stopped as shown from the readings gotten using the chemical balance. This study was initially carried out as a project in the Catholic University of Puerto Rico by Richard R. Eckert between 1976 and 1977. In the initial research, they were able ableto verify that the results of the monitoring were correct and the particulate pollution determinations were along with the Federal standards specified by the 1970 "Clean Air Act". This specifies too that the particulate contamination should not be greater than 260/ug/m³ on one day during a given year. It also specifies that the long term average should not exceed 75/ug/m³. The study recommend ways of compating and cushioning the effects of Particulate air Contamination.

INTRODUCTION

Particulate Air Contaminants are various kinds of impurities or harmful substances which when exposed to the atmosphere, pollute the air and thus, makes it unfavourable for Man to inhale. There are several sources of air contaminants ranging from:

(1) Out door Air Contaminants, for example , -combustion of fossil fuels, Ozone layer Depletion, Nitrogen Dioxide, Sulphur Dioxide, Acid Aerosols.

(2) In door Air Contaminants include:-Gas, Cooking stoves and furnaces, -wood stoves and Tobacco smokes, - Construction Materials, -Furniture, -Radon and Dustmite, - Allegens associated with fungal spores and Bacteria.

(3)Industrial Exposures.

HEALTH EFFECTS

In many countries such as the USA and other industrialized developing countries like Nigeria, air pollution has posed a serious problem despite some standards set, many of these

industries still do not meet up with the standard. Epidemiological research, human clinical studies and animal toxicologic studies have gone a long way to provide evidence of adverse health effects of ambient air pollutants even at exposure levels below the current standards. The adverse effects of this air contaminants are Death, respiratory disease affecting the human system mainly the lungs, which is the major target organ, and the most vulnerable are children, asthmatics and people with chronic lungs or heart disease.

For instance , Ozone which is the major component affects exercising children and adults to as 0.08ppm and subsequently produces cough, chest discomfort and inflammation of the lungs. Ozone also causes the inflammation of the upper respiratory tract which leads to damage of the epithelial lining. The World Health Organisation explains that about 2.4 million of people die yearly from causes directly attributable to air pollution , with 1.5 million of these deaths caused by Indoor Air pollution. A study by the University of Birmingham has shown a strong correlation between pneumonia related deaths and Air pollution from Motor Vehicles. Direct causes of Air pollution related deaths include aggravated asthma, bronchitis, emphysema, lung and heart diseases and respiratory allergies and respiratory allergies. The USEPA estimates that a proposed set of changes in diesel engine technology could result to 12,000 fewer premature mortalities, 15,000 fewer heart attack, etc.

The worst short term Civilian pollution crisis in India was the 1984 Bhopal disaster. In this case, methylisocyanate was accidentally released resulting in 3000 deaths due pulmonary oedema. The United Kingdom suffered its worst Air Pollution event when when the December 4 Gaat smog of 1952 formed over London. In six days, more than 4000 died and 8000 died within the following month.

The worst single incident of Air Pollution to occur in the USA occurred in Donora, Pennyslavania in late October 1948 when up to 20 people died and over 7000 were injured. The human health effects of poor air quality are far reaching but principally affects the body respiratory system and the cardiovascular system. Individual reaction to Air Pollutants depend on the type of pollutant a person is exposed to, the degree of exposure , the individual's health status and genetics.

For Centuries, Physicians have recognized that occupational exposures contributed to human disease. The Ancient Greek Physicians: Hippocrates, Pliny and Celsus described respiratory symptoms, associated with mining as PHTHISIS. The spectrum of human disease associated with occupational exposures almost affected the all organs resulting in acute toxicity or irritation, hypersensitivity reactions, toxicity fibrosis and cancer. The chronic effects of occupational exposure are complex, including degenerative changes in the nervous system, etc. A good example of this is the "quarry industry locally situated at every nook and corner of Abakaliki, Ebonyi State. Carbon Dioxide had contributed to global warming and recently has been recopgnised by Climate Scientists as essential for plant life through photosynthesis even though they are sources of air contamination.

THE MONITORING PROCEDURE

Method 1: The initial method of using a high-volume sampler was used as was the case in Puerto Rico. Other Meteorological measurements like temperature, relative Humidity, atmospheric pressure, wind speed and direction were done by improvising the instruments. The sampling area was between the Teaching Hospital and the Physics Laboratory of the Ebonyi State University, Abakaliki

Method 2: A study carried out in Gwalior in Northern India using both direct and gravimetric sampling of respirable dust by quarry workers where work shifts were 12hours in length with changes at 9a.m and 9pm, the work was continuous with no formal break periods.

The scale classification of dust particle under study is about (particulate matter) $PM < 2.5/\mu m$, $PM 2.5$ m diameter.. See table1.

Table 1.

Area of exposure	No. of people exposed
1. People at work(Quarry industry)	130
2. People within general environment	15
3. People inside their home	10

INTERPRETATION

Results from the case study were as follows, viz:

- After one week, the arithmetic mean(A.R)was 8-hour time weighted average(TWA) of the total
- Inhalable dust exposure was $150\text{mg}/\text{m}^3$
- Respirable dust was $39.7\text{mg}/\text{m}^3$ and
- Crystalline silica exposure to the lung was measured and the result was $5.29\text{mg}/\text{m}^3$

Those data showed peaks in exposure under certain working conditions, for instance quarry workers who are directly exposed have high amount of lung deposits, the general environmental and domestic $PM 2.5$ exposure were also high.. The exposure of these particles to the atmosphere not only causes environmental discomfort but also serious health hazards like lung disease, cystic fibrosis, asthma, sleep apnea and acute silicosis, etc

Method 3: Three 10ml test tubes were filled with 5ml water and placed at three locations at a height of the nose (whether sitting or standing position)and readings were taken for five days at 11am daily. The weight increased daily as a result of the dust and the difference between the test tube with water and the test tube with water and dust. The difference is in ppm(parts per million)

OTHER STATISTICS FROM FURTHER LITERATURE REVIEW

This was from the internet - taken from the most polluted cities in the World by Particulate Matter(PM_{40}).

Particulate Matter /ug/m ³	city
169	Cairo, Egypt
150	Delhi, India
128	Kolkata, India(Calcutta)
125	Tianjin, China
123	Chongqing, China
109	Kanpur, India
104	Jakarta, Indonesia
109	Lucknow, India
101	Shenyang, China
150	Abakaliki, Nigeria

Air Pollution is usually concentrated in densely populated Metropolitan areas especially in developing countries where environmental regulation are generally lax or non-existent.. Literature review shows that 10 6tons of carbon Dioxide are emitted yearly. Details are given below:

Amount per year	City
2,790	United State
2,680	China
661	Russia
583	India
400	Japan
356	Germany
226	Australia
222	South Africa
212	United Kingdom
185	South Korea

Per capital carbon dioxide emissions are viz:

Tons of CO ₂ per year per capital	City
10	AUSTRALIA
8.2	US
3.2	UK
1.8	CHINA
0.5	INDIA

GENERAL DISCUSSION /REDUCTION EFFORTS IN AIR CONTAMINATION

The major challenge in this report is the violation of the natural Particulate matter standardsroughly correlated with population density. There are various air pollution control technologies and urban planning strategies available to reduce air pollution. Efforts to reduce pollution from imobile sources include primary regulation(many developing countries have permissive regulations), expanding regulation to new sources(such as cruise and

transport ships form equipment and small gas – powered equipment such as Lawn trimmer, Chainsaws and snow mobile) increase fuel efficiency.

Some of these regulating body include the United states Environmental Protection Agency(EPA). This regulate primary particulate emission(which can also be emitted from modern diesel engine and precursions taken against secondary emission(nitrous oxide, sulphur and ammonia). In European Union regulation in directives 1994/30/OC and 96/62/EC, the European commission has set up for particulate matter in the air. See table below:

	Phase 1 From January 2005	Phase 2 From January 2010
Yearly average (24hrs)	40/ $\mu\text{g}/\text{m}^3$ 50/ $\mu\text{g}/\text{m}^3$	20/ $\mu\text{g}/\text{m}^3$ 50/ $\mu\text{g}/\text{m}^3$
Allowed No. of excesses per yr.	35	7

Particles emitted from modern diesel engine(commonly referred to as diesel particulate matter. These are typically in the size range of 100 nanometer(0.1micrometer). In addition the soot particles also carry carcinogenic components like benzopyrenes adsorbed on their surface. It is becoming increasing clear that the legislative limits for engines , which are in terms of emitted mass, are not a proper measure of the health hazard.

From the statistics we have gotten, the air quality in Abakaliki does not conform to the FederalClean Air Act and measures to control such be introduced and enforced to avoid the figure escalating. Proposals for new regulation exist in some counties with suggestion to limit the particulate surface area or the particle area or the particle number. Therefore, any control given to the population density of a particular area then transform the ation and industrial activities would be of help. In addition, Particulate Air filters and monitor should also be strategically stationed to reinforce the regulation.

CONCLUSION

In conclusion, studies have shown that particulate matter exposures experienced by the quarry workers and those residing near the quarry industries are likely to to have impaired lung function within a short time.

Simple measures to reduce the rate of particulate matter exposure from both occupational sources and use of biomass fuel in homes and similar sites should be introduced to minimize the rate of lung problem.

Some of the measures to minimize the problem in Abakaliki are:

- The machines used in the quarry industries should be covered,
- There should be a water sprinkler or wind breaker to minimize the dust
- The workers and residents around the quarries should be wearing face masks and respirators to prevent or reduce the quantity of dust inhaled.
- Residential houses should not be sited close to quarries

- e) The government should make a policy forbidding locating quarries near residential houses , set up team to monitor and enforce that.
- f) I suggest that whatever roads are being constructed should be done speedily to minimize long exposure to dust arising from such source.
- g) Centralising quarries are the best policy for humans residing in Abakaliki

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