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Effect of Naked Lamp on Levels of Air Pollutants in Port Harcourt, Nigeria

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Abstract: The effect of burning naked lamp on the levels of air pollutants, SPM, NO_2, SO_2, THC and CO was determined in Diobu area of Port Harcourt metropolis, Nigeria using active sampling methods involving a high volume sampler, a train of impingers and a digital gas monitor. The concentrations of SPM ranged between 10.7 and 682.8 μg m^{-3}, NO_2 ranged between 35 and 180.8 μg m^{-3}, THC ranged between 9.1 and 10.9 μg m^{-3}, CO ranged 1.0 and 3.5 ppm while SO_2 (<6.5 μg m^{-3}) did not vary. The levels of pollutants measured during burning naked kerosene lamp were higher than those measured without the naked lamp. In particular the differences in the levels of SPM and NO_2 between the burning naked lamp measurements and without the naked lamp measurements were found to be significant ($p<0.05$). The levels of SPM and NO_2 measured during the burning naked lamp exceeded their permissible limits recommended by local and international agencies. The regular use of naked lamps in homes and night markets were therefore discouraged.

Key words: Air, pollutants, naked, lamp, Port Harcourt, night market

INTRODUCTION

Atmospheric pollution which had received little attention in the past, has become a subject of national interest in the last few years. There are numerous human activities, which result in the release of potential toxic substances into the atmosphere (Aas *et al*., 1999; Campbell *et al*., 1994). The identity of these sources has been established in most cases but their quantitative importance is only rarely determined (Fähnrich *et al*., 1993). The chemical composition of all the emission sources varies strongly. In order to track down the pollution sources and to determine the extent of the anthropogenic contribution; a fundamental study of the chemical composition is necessary (Berkowiez *et al*., 1997). Several authors have determined the Nitrogen dioxide constituents of atmospheric air (Kelly *et al*., 1994). Nitrogen dioxide (NO_2) has irritating effects on mucous membrane and higher doses of NO_2 cause bronchitis and respiratory problem (Bylin, 1993). An exposure towards 150-200 ppm (μg m^{-3}) of NO_2 results in Bronchiolitis "firbosa obliteteous" a dangerous disease which occurs within 3-5 weeks after the exposure. Inhalation of 500-600 ppm of NO_2 for 2-10 days results in death. Other effects of NO_2 include lowering of resistance to influenza and eye irritation (Pavlenko and Volberg, 1991). Nitrogen dioxide (NO_2) at 100 ppm level is generally most fatal because of pulmonary edema (Ferm and Svangerg, 1993).

Airborne particulate matter, also called Suspended Particulate Matter (SPM) can be found in ambient air in the form of dust, smoke or other aerosols. SPM may be of anthropogenic and/or natural origin. Direct sources of SPM include burning of fossil fuels (coal, oil, wood) for power generation, heating and transportation; construction and industrial activities; as well as soil erosion (wind blown dust), forest fires, volcanic eruptions and pollen. SPM can occur as a secondary aerosol resulting from atmospheric transformation of gaseous pollutants emitted from combustion sources (e.g., power plants and automobiles) or natural sources such as forests. Particles can also result from condensation of volatile elements and species in the atmosphere to form very small particles or absorb on the surface of already formed, finely divided particles.

Carbon Monoxide (CO) is emitted into the atmosphere mainly as a product of the incomplete combustion of carbonaceous material. The major sources of CO exposure for the general, non-smoking population are exhaust emissions from combustion engines and the burning of fossil fuels. Smoking provides an addition to source of CO for the non-smoking public. In addition to these exogenous sources, CO is generated endogenously

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mainly from the breakdown of haem proteins. Healthy individuals can tolerate low-level exposures to CO but it can be hazardous at higher concentrations and even at low concentrations for those with unusual susceptibility.

The real health effects of air pollution depend on the concentrations experienced by people rather than those recorded by stationary air quality monitors located outdoors. Two key features of people which strongly influence their exposure are their mobility and the time spent indoors. Recent estimates suggest that the average proportion of time spent indoors by the population in developed countries is about 90%, with considerable variation between individuals (GB Parliament House of Commons Environment Committee, 1991; Dimitroulopoulou *et al*., 2001).

Air pollution could be serious. This is more so in Nigeria because in addition to increased vehicular and industrial activities in the country most households in the rural areas use lanterns and cook with kerosene stoves. The situation is similar in the urban areas owing to irregular electricity supply and frequent scarcity of gas.

Major air pollutants include carbon oxide usually derived from forest and decaying organic matter, incomplete combustion of fossils fuels and other organic matter; sulphur oxides resulting from sulphur containing coal and oil in homes, industries, power plants, smelting of sulphur containing ores etc., nitrogen oxides from high temperature fuel combustion in motor vehicles and from industries and fossil power, hydrocarbons derived from incomplete combustion of fossil fuels in automobiles and furnaces, oil spills, forest fires and plant decay, photochemical oxidants from sunlight acting on hydrocarbons and nitrogen oxides. Others are particulates, dust and sooth derived from forest fires, coal burning, flaring, construction, other land clearing activities, automobile exhaust etc; in-organic compounds such as hydrogen sulphide, ammonia, sulphuric acid all derived from the chemical industry; radio-active substances from nuclear processing industries, herbicides and pesticides resulting from agricultural activities and so on. Most of these pollutants are common in large urban centers of the world where a concentration of automobiles as well as manufacturing industries exist.

Kaladumo (1996) reported aggravation of asthma, increased hospital admission for respiratory conditions, to long term responses such a chronic lung diseases, bronchitis and accelerated ageing of the lungs as being associated with the petroleum industry in the Niger Delta region.

This study investigates the effect of naked kerosene lamps on the concentrations of some air pollutants in order to create awareness on those who use them indoors and in the night markets.

MATERIALS AND METHODS

The study area, Port Harcourt lies within latitudes 4° 43′ 07″ and 4° 54′ N and longitudes 6° 56′ 04″ and 7° 03′ 20″ E with a mean annual rainfall of over 2000 mm and a mean annual temperature of about 29°C (NMS, 1998).

Sample collection and analyses: Samples were collected with burning naked lamp using kerosene and without the lamp (i.e before and during burning naked lamp). Three samples were collected at each sampling period using hourly averaging time. The sampling equipment used include a high volume sampler for SPM, a train of impingers fitted with bubbler devices for NO_2 and SO_2 and an automatic gas monitor for Carbon Monoxide (CO).

The Suspended Particulate Matter (SPM) were collected on previously weighed glass fiber filter using the Hi-volume sampler and then analysed gravimetrically (WHO, 1988; Lahmann, 1992). The principle of the Hi-volume technique used is based on drawing in air by the Hi-volume sampler into a covered housing through the filter by means of a heavy duty turbine blower at a flow rate of 1.3 m^3min^{-1} which allows suspended particulate matter of size range of 0.1-100 μm diameter to be collected on the glass fiber filter. The mass concentration of particles was computed by dividing the mass of collected particulate matter by the volume of air sampled in m^3.

The Griess Saltzman method was used for the collection and measurement of NO_2. The technique is based on the reaction of nitrite ion with diazotizing coupling reagents to produce a deeply coloured azo-dye which is measured in a spectrophotometer (Spectronic 21D) (Saltzman, 1954; Lahman, 1992).

The West Gaeke method was used for the collection and measurement of SO_2. Its principle is based on the interaction of sulphur dioxide with Potassium Tetrachloro mercurate solution. The resultant complex reacts with pararosaniline and formaldehyde to produce a coloured complex which is measured on a spectrophotometer (Spectronic 21D) (WHO, 1976; Harrison, 1982).

The total hydrocarbon in the air was absorbed in an organic solvent such as toluene and analysed by spectrophotometric method (Manahan, 1979).

The digital neotronics automatic gas monitor with non dispersive infra-red technique was used for the measurement of CO (WHO, 1976).

The SPM soiled filter papers were put in envelopes while collected gaseous samples were stored in amber bottles and placed in a cool box.

RESULTS AND DISCUSSION

The results of the levels of air pollutants measured are presented in Table 1.

The concentrations of SO_2 (<1.0 μg m^{-3}) in this study did not vary. The concentrations were below detection limit of 6.5 μg m^{-3}. This could be attributed to the low level of sulphur in the fuel being burnt in the area. The main source of SO_2 is the combustion of sulphur containing fossil fuels. The concentrations of SO_2 were significantly below the standard permissible limit of 260 μg m^{-3} recommended by the Federal Ministry of Environment (FME, 1991) and therefore do not pose health concern presently.

The concentrations of Total Hydrocarbon (THC) slightly varied between 10.9 μg m^{-3} with lamp and 9.1 μg m^{-3} without lamp. Although, the concentrations of THC measured with lamp were higher than those measured without lamp the difference between them was significant ($p<0.05$) with high positive correlation ($r = 0.9993$). The levels of THC measured with or without lamp were lower than permissible limits (160 μg m^{-3}) recommended by FME and therefore do not pose serious health concern.

The concentrations of CO varied slightly between 1.0 and 3.5 ppm. The measured CO levels were higher using the lamp than without the lamp. These values are however below the permissible limit of 10 ppm recommended by the Federal Ministry of Environment (FME, 1991). The measured CO values probably arose from natural sources. The major source of CO is from incomplete combustion of carbon-containing materials and industrial processes (Wark and Warner, 1976; WHO, 1987).

The mean concentrations of SPM were 668.9 μg m^{-3} with lamp and 12.15 μg m^{-3} without lamp. The difference between them was significant ($p<0.05$) with high positive correlation ($r = 0.9456$). This implies that the use of naked lamps contributed to the levels of SPM. The mean concentrations of NO_2 were 174.15 μg m^{-3} with naked lamp and 37.2 μg m^{-3} without naked lamp. The difference between them was significant ($p<0.05$) with low positive correlation ($r = 0.4025$). The levels of SPM and NO_2 exceeded their permissible limits of 250 and 75 μg m^{-3} respectively (FME, 1991; Lahmann, 1992; WHO, 1994; WHO/EURO, 1987; USEPA, 1990). This implies that the concentrations of SPM and NO_2 call for serious health concern for the population.

This study was carried out in the night during calm period (mean wind speed 0.3 m s^{-1}) when vehicular, industrial and other human outdoor activities were scarcely seen. This implies that measured concentrations of the pollutants were mainly contributed by the emissions from the naked lamp. This is more so as the concentrations of the pollutants measured with the burning naked lamp were higher than those measured without the lamp.

Table 1: Concentrations of air pollutants measured during the experiment

	Pollutants				
Experiment	SPM μg m^{-3}	NO_2 μg m^{-3}	SO_2 μg m^{-3}	THC μg m^{-3}	CO ppm
With lamp 1	664.2	152.7	<6.5	10.0	3.5
2	655.0	167.5	<6.5	10.6	3.0
3	682.8	180.8	<6.5	10.9	3.0
Without lamp 4	12.5	37.5	<6.5	9.1	1.0
5	10.7	35.0	<6.5	9.8	1.0
6	13.6	39.4	<6.5	10.1	1.0

Most households in both rural and urban areas, especially at night markets along street corners, use hurricane lanterns and locally made naked lamps or cook with firewood or kerosene stove which generate large amount of SPM. Common complaints of traders in night markets include irritation and redness of the eyes by smoke, irritation of nostrils and impairment of breathing. Studies of the human health effects of air pollution carried out in China showed that air pollution suppresses the immunological function, decreases lung function and increases respiratory symptoms as well as respiratory disease (Yin Xianren, 1993).

CONCLUSION

In general, the findings of this study have shown that the use of naked lamps adversely affects the quality of air and is detrimental to human health. The use of naked lamps should therefore be discouraged and the quality of air in areas where it is used should be regularly monitored to create awareness among the populace.

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