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AMBIENT AIR QUALITY AT IGCAR CAMPUS, KALPAKKAM

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Noise pollution

Air quality

CPCB standard

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ABSTRACT

India has witnessed a phenomenal increase on industries and vehicles in the last decade along with the mushrooming Human population. As a consequence, there has been a dramatic deterioration in the quality of air in most regions of our country. We lack an effective air quality management system and pollution control mechanisms. As a first step, it is essential that any establishment with industrial component should monitor the air quality in order to create benchmark data for future impact assessments and also take preventive measures to control degradation of air quality. We have launched an initiative to assess the air quality at different locations of Indira Gandhi Centre for Atomic Research (IGCAR) campus since 2009. Various parameters like Oxygen, CO, CO_2, NO_2, Volatile Organic Compounds (VOC), Temperature, Relative humidity (RH) and sound levels were monitored. Results obtained from April 2009 to March 2010 are presented in this paper. Results have shown that monthly averages of RH varied in the range of 57.1-67.7% while that of temperature ranged from 31.2 – 34.9°C. Both VOC and CO levels were found to be BDL. Monthly average of CO_2 level ranged from 303.7 to 367.1 ppm. In addition, monthly average sound levels ranged between 49.7-57.0 dB which are below 75 dB limit. Preliminary study indicated that, the locality is unpolluted with respect to air quality.

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INTRODUCTION

Air pollution has become an increasingly important environmental issue in the developing countries. Since the pollution prevention concept emerged many years ago, there has been a growing concern about air quality in urban areas. To improve urban air quality, environmental policy makers express widespread interest in controlling and regulating major gaseous pollutants such as O_3, CO, NO, NO_2, SO_2 and VOC. Urbanization and industrialization have brought large concentrations of people in small areas. Cities are the focus of many environmental problems, owing to density of energy use and occupation (Brimblecombe and Maynard, 2001). It was reported that the 25 highest emitting districts account for more than 35% of all India CO_2 equivalent GHG emissions. Electric power generation has emerged as the dominant source of GHG emission followed by emissions from steel and cement plants (Garg *et al.,* 2001).

India has 23 major cities of over 1 million people and ambient air pollution levels exceed the WHO standards in many of them. Despite the increasing evidence of negative impact of air quality on human health not much data on ambient air quality, a prerequisite for health studies, is available for most of the medium size cities or towns in India, although a large population lives in these cities or towns. Long-term air quality data is necessary to understand the trends in depth that will lead to more realistic findings and conclusions (Kunzli *et al.,* 2000).

Monitoring any potential ecological effect of air pollution requires the simultaneous measurement of a number of relevant air pollutants, in order to evaluate the potential for the synergistic effects, either on plants or on human health (Miller and McBride, 1999). According to the WHO, noise pollution is nowadays the third most hazardous environmental pollution, preceded only by air (gas emission) and water pollution. Pollution in large cities is an evergrowing problem due to the fact that the urban environment is becoming increasingly crowded, busy and noisy. Since the seventies, "noise" has been largely considered as a major problem of annoyance in cities. Many field surveys have been conducted to evaluate the outdoor noise environment in several countries .Noise affects both health and behaviour of mankind. Intense sounds can damage physiological and psychological health. Long exposure to noise can cause noise-induced hearing loss. High noise levels can also contribute to cardiovascular effects. Urban noise is a disturbance to the human environment that is increasing at a high rate, primarily due to population growth, urbanization and technological development (WHO, 1999). In most urban areas community noise (noise emitted from all sources except noise at industrial workplace) has emerged as an ever present but often underestimated pollutant. Noise can have a detrimental effect on animals too. Realizing the need to control and monitor noise levels, the assessment of both air quality and noise levels were measured in and around IGCAR Campus. The assessment of air quality, using the available air quality data will help, in the long run, to generate information aiding in planning pollution control strategies to keep the pollutants within safe limits.

Study area description

Kalpakkam (12°33'N and 80°11'E) is located about 65 km south of Chennai city, on the east coast of India (Fig. 1). It is India's one of major nuclear complexes comprising the Madras Atomic Power Station (MAPS), a Fast Breeder Test Reactor (FBTR), a Centralized Waste Management Facility (CWMF), a Reprocessing and Development Laboratory (RDL), Kalpakkam Reprocessing Plant (KARP) and a host of allied laboratories. The MAPS has twin units of capacity 230 MWe each (Fig. 1). The area is bounded by the Bay of Bengal on the East, the Edaiyur Backwaters on the North and the Buckingham Canal to the West. The topography of the study area is slightly undulating with sandbars and depressions. The regional gradient is towards the eastern side. The altitude varies between 1 and 13 m above MSL. The population of this area is approximately around 1, 50, 000.

MATERIALS AND METHODS

A portable Multi-Gas analyzer, Model No: PA-2400, compact, portable, indoor-cum-outdoor air sampling equipment capable of sampling ambient air was used for the study. In the present study, the available data

concern the monthly averages of measurements of the concentrations of the gaseous pollutants, such as CO_2, CO, NO_2, VOC and Oxygen and meteorological parameters such as temperature and relative humidity. The ambient noise level was monitored using integrating / logging sound level meter (Quest Technologies, Model 1900, USA).

RESULTS AND DISCUSSION

The annual and seasonal variation of CO_2, O_2, NO_2, and VOC are given in Table 1. The concentration of CO_2 was found to be higher in locations that were close to the entry gates mainly due to vehicular traffic the lowest value of CO_2 was found to be 275 ppm and highest was around 345 ppm which is lower than the world average (387 ppm) (Fig. 2). The oxygen levels were found to be always in the range of 19.9-20.7 % which could be attributed to the dense green cover present at IGCAR Campus. Gaseous pollutants such as CO, NO_2 and VOC'S were always found to be below the detection levels and hence no threat was found due to gaseous pollutants which are of a serious problem in nearby cities like Chennai. The annual average temperature ranged between 27.5 -34.8°C the lowest during January and highest during March. The climatology for the study has been divided into three seasons, viz (i) post monsoon/summer (February - May) (ii) pre-monsoon or SW monsoon (June - September); and (iii) NE monsoon (October - January). The NE monsoon is active in this area and bulk (70%) of the rainfall occurs during this period. Due to the geographic location of this area, the monsoon reversal of wind and the subsequent change in current pattern is prominent here leading to a visible alternation in coastal milieu (Satpathy *et al.,* 2008). The relative humidity was in the range of 45.3-78.4%. The wind speed ranged from 0.2-1.4 m/sec.

Figure 1: Overview of the Study Area

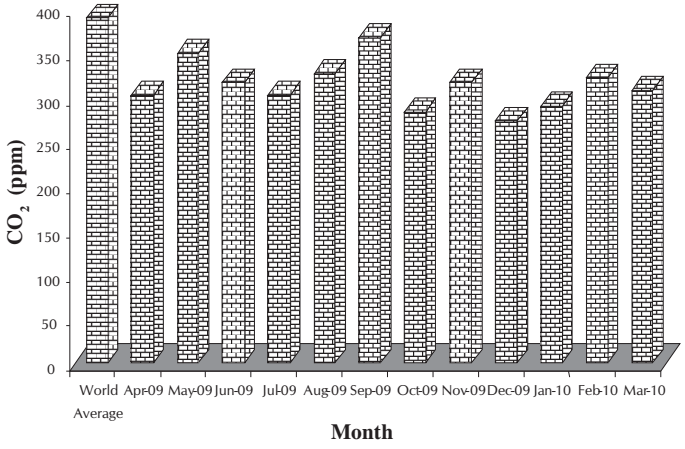

Figure 2: Monthly average of CO_2 emissions

Table 1: Seasonal average of all the gaseous constituents

Gaseous Constituent	Seasonal Monsoon	Pre-monsoon	Summer
CO_2(ppm)	307	320	292
NO_2(ppm)	BDL	BDL	BDL
SO_2(ppm)	BDL	BDL	BDL
O_2 (%)	20.2	19.9	20.3
VOC(ppm)	BDL	BDL	BDL

Fig. 2 provides a comparison of the average monthly CO_2 data for all the sampling locations in the IGCAR campus. In 2009, the CO_2 global average concentration in Earth's atmosphere was predicted to be about 387 parts per million by volume (ppm). The rates of CO_2 measured at our locations were always found to be below the world average of 387 ppm (IPCC, 2009). Despite the relatively small concentration in the overall atmosphere, CO_2 is an important component of Earth's atmosphere because it absorbs and emits infrared radiation thereby playing a vital role in the greenhouse effect. It is well known that every spring, when the flowers bloom and the trees are mantled in a fresh robe of new leaves, all the new growth sucks CO_2 from the atmosphere, and concentrations drop (Drewitt *et al.,* 2002).

During autumn (September to November) as the vegetation dies back, much of the CO_2 is released again. This phenomenon has been observed in our study area too. During the spring season (April - May) the levels of CO_2 are found to be lesser than in the monsoon (September and October). It has been observed that between October 2009 and January 2010, the ambient CO_2 could have been dispersed and diluted by frequent rainfall, and strong updrafts and downdrafts (Fig. 3). Thus, concentrations of air pollutants during monsoon were lower which implied that it was related to weather background, monsoon circulation and rainfall at Kalpakkam.

From Fig. 4 it is been observed that the monthly averages of oxygen were between 19.8 to 20.6%, the concentration of oxygen was at its highest during the spring season as growth of new trees pump in more levels of oxygen to the air.

Whereas oxygen levels were lowest in September (19.8 %) due to the influence of autumn season as the tress shed leaves and decompose. Analysis of air bubbles trapped in fossils, such as in fossil amber, show that air in earliest times contained about 35% oxygen. Today, the average oxygen content of air is approximately 21 % (Broecker, 1996). In some larger, more polluted cities, oxygen content in the air reported was at 12 - 15%. Thus the consistent measure of oxygen levels can be directly related to dense green cover If forest canopy cover is increased (more trees are added) and sustained through time, net carbon dioxide will be removed and oxygen can be produced. Between 1989 and 1994, the oxygen content of the atmosphere dropped at an annual rate of 2 ppm of 210, 00 ppm (Broecker, 1996). Changes in air pollution may have relatively considerable impacts on air quality and human health, the effects of urban forests on air pollution can be significant. Recently, the U.S. Environmental Protection Agency has introduced urban tree cover as a potential emerging measure to help meet air quality standards.

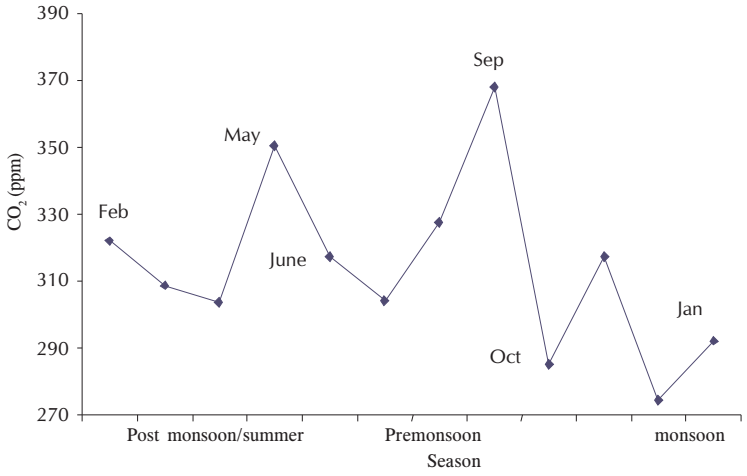

Figure 3: CO_2 Profile for pre-monsoon and post monsoon periods

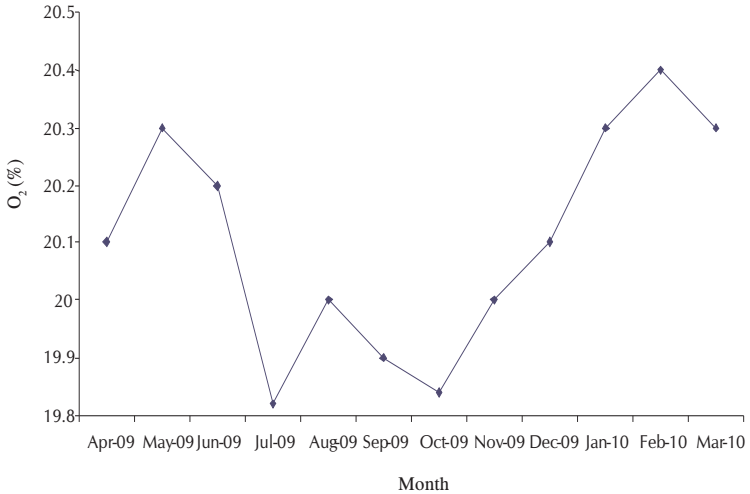

Figure 4: Monthly Average of Oxygen

Ambient noise levels

Noise affects both health and behaviour of mankind. Noise pollution caused by heavy industrial activity can cause distraction, discomfort and deprives peace of mind at workplace. Noise has a detrimental effect on animals too; one of the best known cases of damage caused to animals by noise pollution is the death of certain species of beach whales due to loud sound of military sonar

(NOAA, March 2000). Realising the need to control and regulate noise levels, the Ministry of Environment and Forest (MOEF), Government of India notified noise level standards and guidelines under environment protection rules, 1986 known as Noise pollution (regulation & control) rules, 2000. It has been observed that the noise levels at different locations around the IGCAR Campus were well below the prescribed noise level standard. Noise levels at IGCAR campus are very close to either silence or residential zone as prescribed by the CPCB Standards for noise level monitoring (Fig. 5).

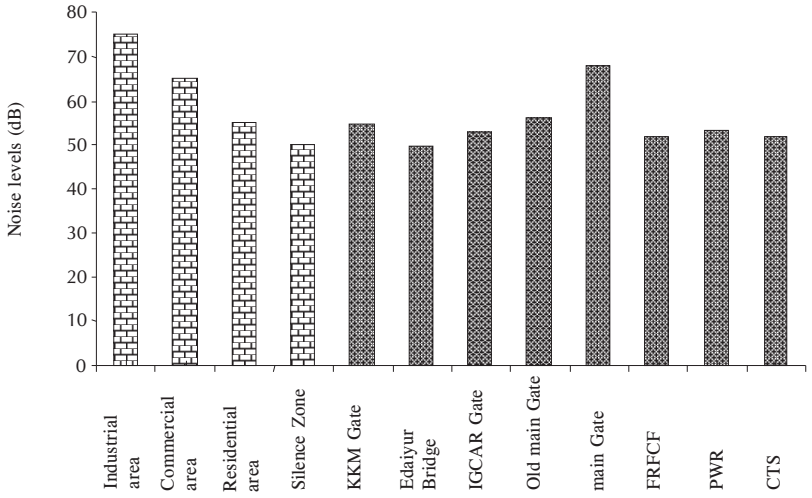

Figure 5: Noise levels at different locations and CPCB standards

All the measurements were recorded from locations that were in proximity to the IGCAR Campus. A maximum noise level range of 65 dB was observed close to the main gates of the Campus which is due to the vehicular traffic whereas a minimum 47 dB was recorded in places that were covered with dense green cover. It is known that green belts around industries can help in reducing the vulnerability of noise as it can traverse and act as noise breakers.

The IGCAR Campus at Kalpakkam has been declared as a rich biodiversity zone, which directly reflects on the pristine environmental quality, hence low level noise could have also been a contributing factor to this sustainability. Totally 300 species of animals have been identified and it has highlighted the potential for biodiversity in the campus. Some exotic species such as Indian civet and crested porcupine are elusive animals diminishing from wild and their presence at this campus is an indication of less human intervention (Jahir *et al.,* 2008). The effects of noise on the physiology of laboratory animals have been studied more thoroughly than effects on farm animals or wildlife. Although laboratory studies cannot be directly applied to effects of noise on wildlife in their natural habitats, they do describe a range of potential effects that may possibly occur. Hearing sensitivity, susceptibility to noise-induced hearing loss, and physiological effects of noise vary among animal species. Animals appear to be more sensitive to noise disturbance than humans (Borg, 1979).Hence constant maintenance of the ambient noise levels within limits has helped in the constant maintenance of the existing rich fauna that IGCAR can boast upon. Therefore it can be concluded that the ambient noise levels in the vicinity of the IGCAR Campus is well within the limits prescribed.

CONCLUSION

Results from the measurements of O_2, CO_2, NO_2, VOC and noise levels at different sites of IGCAR Campus, Kalpakkam during April 2009 to March 2010 revealed that the Ambient Air Quality at IGCAR Campus is not polluted and that all values observed were well below the prescribed limits for air pollution.

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