International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(5): 1713-1716

Received: 15-07-2017
Accepted: 16-08-2017

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Assessment of ambient air quality in different areas of cement industry, Chandrapur, Maharashtra, India

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Abstract
The term air quality means the state of the air around us. Ambient air quality refers to the quality of outdoor air in our surrounding environment. It is typically measured near ground level, away from direct source of pollution. The paper present air pollutants (such as particulate matter 2.5, particulate matter 10, sulphur dioxide and oxide of nitrogen) emitted from cement plant, chandrapur, maharashtra. This study was undertaken to investigate the air quality around the cement plant within 5 km radius. The air temperature, relative humidity, wind speed and predominant wind direction were studied for the sampling days. Data for all four air pollutants were collected for a study period at four different locations (Awarpur, Palgaon, Nanda and Naokari). Results indicate that both particulate matter (PM2.5 and PM10) and gaseous pollutants (SO_2 and NO_2) are within the permissible limit prescribed for industrial, residential and rural uses by CPCB, New Delhi. The average value of concentration of all the air pollutants under the permissible limits due to industry have installed air trapping devices which control air pollution and helps to minimize the dust in the surrounding area.

Keywords: air quality, cement plant, $PM_{2.5}$, PM_{10}, SOx, NOx

Introduction
Air pollution is becoming serious because of four developments: increasing traffic, growing cities, rapid economic development and industries. Cement plants a vital role in contributing towards the progress of human society. The main environmental problems from the cement plants are PM2.5, PM10 and gaseous pollutants such as sulphur dioxide (SO2), oxide of nitrogen (NOx). Monitoring of air quality around the cement industries in India has been a subject of many recent studies (Banejee and Panday 1989; Gupta 1994; Chandrasekharan et. al, 1996, 1998; Agrawal and Khanam 1997; Shrivastava 1999) [6, 9, 7, 4, 20]. Effect of air pollutants in human health are studied by Pope (2000a, 2000b) [17, 18], HEI (1995, 2000a, 2000b) [12], and WHO (2000a, 2000b) [24].

Air pollution is the introduction of unwanted materials such as chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment, into the atmosphere (Chouhan et.al 2012) [10].

Air Pollutants means any solid, liquid or gaseous substance present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment (Abdullah and Iqbal 1991) [7].

The air is a composition of gases and is utilized by all the living organisms in respiration to liberate chemical energy for their survival. The composition determines the quality and is being changed in the recent past due to emission of large amount of unwanted materials in the atmosphere by industries and automobiles. This changed quality of air has become a great threat for the survival of life, materials and ecosystem as a whole. In order to arrest the deterioration in air quality, it is necessary to assess the present and anticipated air quality through continuous air quality monitoring programs (Acosta et.al 2007; Adamson et.al 1994; Bache et.al 1991) [2, 3, 5].

Air pollution is a problem faced by both developing and developed countries and India is one of them. Increasing industrialization for economic development of nation to meet the specific requirements of the ever-increasing population is proving to be extremely dangerous for all living beings and ecosystems which alter their characteristics features. Air pollutants do not

limit their boundaries and spread all around in the atmosphere. The complex among the natural disturbances, industrial emissions and transportation is not easily quantifiable.

Cement making is a unavoidably a dusty operation as it is much concerned with hot dry powders. Various operations like crushing of stone or raw material, transport, storage and packaging in the cement factory produce fugitive dust emissions.

Cement dust contains high concentrations of many metals known to have toxic effect not only on plants and animals but also on humans (Shukla et.al 1990; Hirano et.al 1995) [21, 15].

According to the World Health Organization (WHO), air pollution is responsible for increasing regular visits of patients due to respiratory and cardiovascular diseases, hospital admissions and mortality.

Present study is conducted to estimate the qualitative impairment of ambient air due to PM2.5, PM10, SO2 and NO2.

Materials and methods

Study area

The study was carried out in the month of January-May entitled "Assessment of ambient air quality in different areas of cement industry, Chandrapur, Maharashtra." Chandrapur is a district in Nagpur Division of the Indian state of Maharashtra. It has large deposits lime stone which is main constituent of the cement. It is located in the eastern edge of Maharashtra in Nagpur division and forms the eastern part of 'Vidharbha' region. It is situated at 19º57′N latitude and 79º18′E longitude. It is at the height of 189.90m from mean sea level.

Methodology

The standard procedures were adopted as per method suggested to determine the $PM_{2.5}$, PM_{10}, NOx and SOx. Effect of cement dust on human health was carried out at each sampling site through personal interview.

Table 1: Parameter to be analysis.

Pollutant	Method of Measurement
Particulate Matter (PM2.5)	Gravimetric Method
Particulate Matter (PM10)	Gravimetric Method
Sulphur Dioxide (SO2)	Improved west & Geake Method
Nitrogen Dioxide (NO2)	Jacob& Hochheiser Modified (NaoH-NaAso2) Method

Source: CPCB Guidelines for the Measurement of Ambient Air Pollutants Volume-I

Sampling Schedule

The sampling was done continuously for 24 hours for $PM_{2.5}$, PM_{10}, SOx and NOx with a frequency of twice a week.

Meteorological data analysis

Meteorological data was monitored during the period of study. It is very useful for proper interpretation of the baseline information as well as for input predication models for air quality dispersion.

Study site

The present investigation on monitoring and assessment of ambient air quality at different locations of cement plant was analyze in the laboratory.

Table 2: Location of Study Sites.

S. No.	Experimental Site No.	Experimental sites	Map Distance from cement plant in km
1.	S_1	Awarpur	1.9km
2.	S_2	Palgaon	300m
3.	S_3	Nanda	3.9km
4.	S_4	Naokari	850m

Results and discussions

A summarized data of average concentrations of air pollutants such as Particulate Matter 2.5, Particulate Matter 10, Sulphur dioxide and Nitrogen oxides from Jan-May of the study period are given in Table 4.

PM2.5 concentration of different sites ranged from 13.0 to 26.0 µg/m^3. The ambient air at Naokari (20.5 µg/m^3) exhibited higher concentration to be followed by Palgaon (20.0 µg/m^3), Awarpur (19.0 µg/m^3), and Nanda (18.0 µg/m^3) fig.no.1. The values observed for all the stations were within the permissible limit (60µg/m3). Similar results was also reported by (Parithielamvazhuthi R. 2013) [16].

PM10 concentration of different sites ranged from 40.0 to 74.5 µg/m^3. The ambient air at Naokari (59.5 µg/m^3) exhibited higher concentration to be followed by Palgaon (57.3 µg/m^3), Awarpur (57.0 µg/m^3), and Nanda (56.5 µg/m^3) fig.no.2. The values observed for all the stations were within the permissible limit (100µg/m3). Similar results was also reported by (Parithielamvazhuthi R. 2013) [16].

SO2 concentration of different sites ranged from 9.4 to 13.4 µg/m^3. The ambient air at Naokari (12.2µg/m^3) exhibited higher concentration to be followed by Palgaon (11.8 µg/m^3), Awarpur (11.2 µg/m^3), and Nanda (10.8µg/m^3) fig.no.3. The values observed for all the stations were within the permissible limit (80µg/m3). Similar results was also reported by (Rai P., Mishra RM and Parihar S. 2013) [9, 19].

NO2 concentration of different sites ranged from 11.4 to 15.8 µg/m^3. The ambient air at Naokari (14.2µg/m^3) exhibited higher concentration to be followed by Palgaon (14.0 µg/m^3), Awarpur (13.7 µg/m^3), and Nanda (13.2µg/m^3) fig.no.4. The values observed for all the stations were within the permissible limit (80µg/m3). Similar results was also reported by (Chaurasia S., Karwaria A. and Gupta A.D. 2013, Rai P., Mishra R.M. and Parihar S. 2013) [9, 19].

The ambient air quality for all pollutants are within the permissible limit prescribed by CPCB, New Delhi for industrial area. Out of four sampling sites, the ambient air quality values of Naokari was found to be maximum followed by Palgaon, Awarpur and Nanda for PM2.5, PM10, SO2 and NO2 concentrations. Among all the pollutants the highest values was found for PM10, followed by PM 2.5, NO2 and SO2. Similar results was also reported by (Tiwari M.K., Mishra R.M. and Dwivedi S. 2011 Chaurasia S., Karwaria A. and Gupta A.D. 2013) [23, 9].

Table 3: Average concentration of PM2.5, PM10, SO2 and NO2 in the Ambient Air Quality at various sampling sites in Chandrapur, Maharashtra.

S/No.	Sampling sites	PM2.5 (µg/m3)			PM10(µg/m3)			SO2(µg/m3)			NOx (µg/m3)		
		Min.	Max	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.
1.	Awarpur	14.0	24.0	19.0	44.0	70.0	57.0	9.6	12.7	11.2	11.6	15.7	13.7
2.	Palgaon	14.0	26.0	20.0	40.0	74.5	57.3	10.2	13.4	11.8	12.2	15.7	14.0
3.	Nanda	13.0	23.0	18.0	43.0	70.0	56.5	9.4	12.1	10.8	11.4	15.0	13.2
4.	Naokari	15.0	26.0	20.5	46.0	73.0	59.5	10.1	14.1	12.2	12.6	15.8	14.2

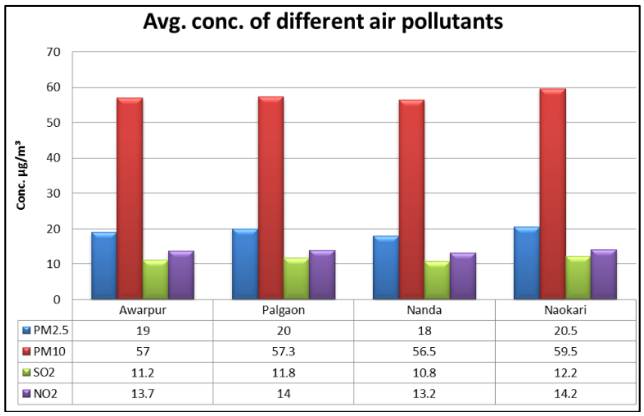

Fig 1: Avg. conc. of different air pollutants in the ambient air of four sampling site

Conclusion

From the study it was concluded that:

All the sites shows the average concentration value below the permissible limits (CPCB) standards value of all parameters i.e. $PM_{2.5}$, PM_{10}, SO_2 and NO_2. On the basis of result the study site 4 (Naokari) was found to be most affected having $PM_{2.5}$ ranges from 15.0 µg/m^3 to 26.0 µg/m^3, PM_{10} ranges from 46.0 µg/m^3 to 73.0 µg/m^3, SO_2 ranges from 10.1µg/m^3 to 14.1µg/m^3 and NO_2 ranges from 12.6µg/m^3 to 15.8µg/m^3. Site 3 (Nanda) was found to be least affected having $PM_{2.5}$ ranges from 13.0µg/m^3 to 23.0µg/m^3, PM_{10} ranges from 43.0µg/m^3 to 70.0µg/m^3, SO_2 ranges from 9.4µg/m^3 to 12.1µg/m^3 and NO_2 ranges from 11.4µg/m^3 to 15.0µg/m^3. Among all four sites the quality of air follows as-

Site 4>Site2>Site1>Site3.

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