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RESEARCH ARTICLE

Ambient Air Quality Around Maihar Cement Plant

[1]Dr. Sadhana Chaurasia
[2]Dhanraj Gupta

[1]Head Dept of Energy & Environment, MGCGV, Chitrakoot Science and Environment Facility MGCGGV Chitrakoot

Corresponding author:
sadhanamgcgv@gmail.com

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ABSTRACT

Ambient air quality was monitored at four sites of Maihar Cement Plant. Four pollutants mainly Particulate Matter (PM_{10}), Particulate Matter ($PM_{2.5}$), nitrogen dioxide (NO_X), Sulphur dioxide (SO_X), It was observed that maximum average concentration of PM_{10} was found 82.00 ug/m^3 at S_1 (Near Guest House) and minimum 75.00 ug/m^3 at S_2 (Director Banglow).The maximum average concentration of $PM_{2.5}$ was observed 42.50 ug/m^3 at S_1 Near guste house and minimum was observed 39.25 ug/m^3 at S_2 (Director Banglow).Gaseous pollutants SO_X and NO_X were found billow the permissible limit. Air Quality Index was in satisfactory range (50-100) at all sampling site in Mahair cement plant. Overall ambient Air Quality Index of Maihar cement plant was observed to be satisfactory during this study period.

Keywords- Air Pollution, PM_{10}, $PM_{2.5}$, SO_X, NO_X, Air Quality Index.

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INTRODUCTION

Air pollution is a major problem in developed and developing countries. It causes respiratory diseases and chronic illness and affects the environment (Gidde 2007). Both human activities and natural environmental processes are sources of air pollution. Particulate matter and gaseous pollutant emission from industries and auto exhausts are responsible for rising discomfort, increasing airway diseases and deterioration of artistic and cultural patrimony in urban centres. The urban population is exposed to high levels of air pollution including metals as well as fine and ultrafine particles **(Bhuyan et al 2010)** from the vehicular emission. Every city has its own characteristics which becomes the progress, if not checked poses risk to environment and health of the people. In recent times there has been significant development activity in terms of industrialization and urbanization in almost all cities in Central India. Different industrial activities degrade various environmental components like air, soil, water and vegetation **(Chaurasia and Gupta 2013).** The chemical composition of the atmosphere is being altered by the addition of gases, particulate matter and volatile substances, which may be toxic to living beings. Cement industry is a potential anthropogenic source of air pollution. It is a major contributor to dust, nitrogen oxides (NOx), sulphur oxides (SOx), and carbon monoxide (CO) in metropolitan areas. Furthermore, it contributes about 5% of the global CO_2, the famous greenhouse gas. In cement industries, dust is emitted from stock piles, quarrying, and transportation of raw materials, kilns operation, clinker cooling and milling. Stone Crushing industry is an important industrial sector in the country engaged in producing crushed stone of various sizes depending upon the requirement which acts as raw material for various construction activities, such as concentration of roads, highways bridges, building, canals, etc. it was found that there were 12,000 stone crusher units approximately in India .Air pollution occurs due to the presence of undesirable solid or gaseous particles in the air in quantities that are harmful to human health and environment **(Chaurasia et al., 2013).** It can be defined as presence of foreign matter either gaseous or particulate or combination of both in the air which is detrimental to the health and welfare of human beings. Air pollution is one of the major problems faced by urban areas. It causes more ill effects on human health (Rai et al 2013), environment as well as building structures. The growing level of industrialization in urban areas with poor management strategy and inadequate separation among working, living and moving space associated air pollution problems. In developing countries, the large numbers of urban population in worldwide are exposed to high levels of air pollutants. Such levels of air pollution have drawn attention towards regular monitoring and mitigation of city air quality. There are several sources of air pollutants in urban areas such as tail pipe emission from vehicles, gen sets, industrial operations, burning of solid wastes from urban kitchen, resuspension of soil, etc. These sources generally generate a number of pollutants in the air namely particulate matter (PM), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and other inorganic (trace elements) and organic pollutants

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poly aromatic hydrocarbon (PAHs) etc. Major sources of these pollutants are arising due to burning of fossil fuels **(Shandilya et al 2007).** Due to change of technologies and change of fuel consumption patterns, the composition ratio of each pollutant is changing over time. The changing scenario demands continuous assessment of air quality. Pollutants released in the ambient environment interact with other existing pollutants and micrometeorological factors may form more intricate pollutants and that are more harmful to human health.

So it is necessary to identify the pollutants **(Mansoury and Hamidian 2013)**. Ambient air pollution in urban cities is serious concern in world due to many reasons such as Urbanization, transportation, industrialization, power generation and anthropogenic activities. An "Air Quality Index" may be defined as a single number for reporting the air quality with respect to its effects on the human health **(Chaurasia et al., 2013).** Air pollution is now widely known to have impacts over human health, agriculture, ecology, buildings, and climate. It affects the respiratory, cardiovascular, cardiopulmonary and reproductive systems and can also lead to cancer. Air Quality Index is a tool for effective communication of air quality status to people in terms, which are easy to understand. It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and color. All atmospheric substance that is not gases but may be suspended droplets, solid particle or mixture of the two is generally referred to as particulates. Oxides of nitrogen cause respiratory problem, asthma, lung irritation

MATERIAL AND METHODS:

Air sampling was done as per the CPCB [12] guideline for manual sampling and analysis. Four stations were selected for sampling in this study. Sampling sites were selected to represent industrial area and residential area as per NAAQS-1994[13].PM10, PM2.5 SO_X and NO_X were selected for studied at all the sampling stations. Sulphur dioxide from air is absorbed in a solution of potassium tetrachloromercurate (TCM). Air was bubbled in 30ml of absorbing solution (TCM) in an impinge for 4hr at the flow rate of 1l/min. Similarly, ambient nitrogen dioxide (NO_2) was collected by bubbling air through a solution of sodium hydroxide and sodium arsenate. Monitored parameters were PM!), PM_{10}, $PM_{2.5}$ Gaseous SO_2 and NOx was used for air sampling and analyzed as per standard methods. The samples collected and transported to the laboratory. SO_2 and NOx concentration are calculated by measuring absorbance through spectrophotometer. The locations of sampling stations are given in table-**1** Study was conducted for 45 days at the internal of 7 days at each site. 8hrs samples were collected APM 550 was used for sampling.

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Table-1. Showing station code& detail.

S.No.	Station Code	Site Detail
1.	S_1	Near Guest House
2.	S_2	Director Banglon
3.	S_3	Near Unit 2 Gate
4.	S_4	Near Filtration Plant

RESULT & DISCUSSION:

Particulate matter (PM_{10}): - The PM_{10} was measures at four station with the help of RDS.The maximum average concentration of PM_{10} was observed 82.00 ug/m^3 at S_1 (Near Guest House) and Minimum value was observed 75.00 ug/m^3 at S_2 (Director Banglow) table-2 which are in permissible limit of 100 µg /m^3 (Table-6). PM_{10} observed at various sampling site is depicted in fig-1

Particulate matter ($PM_{2.5}$): -$PM_{2.5}$ was measures at four ambient air quality station with the help of ambient fine dust sampler. The maximum average concentration of $PM_{2.5}$ was observed 42.50 ug/m^3 at S_1 Near guste house and minimum value was observed 39.25 ug/m^3 at S_2 (Director Banglow) table-2 which are in the permissibe limit of 60 µg/m^3 (Table-6). $PM_{2.5}$ observed at various sampling site is depicted in fig-2

Table-2. PM_{10} (µg/m^3) at Different Sampling Station.

S. No.	Sampling Code	Sampling site				Avg.
		1	2	3	4	
1.	S_1	86	84	84	79	82.00
2.	S_2	78	75	75	72	75.00
3.	S_3	79	80	80	78	79.25
4.	S_4	85	75	80	82	80.50

Table-3. $PM_{2.5}$ (µg/m^3) at Different Sampling Station

S. No.	Sampling Code	Sampling site				Avg.
		1	2	3	4	
1.	S_1	45	40	43	42	42.50
2.	S_2	43	36	40	38	39.25
3.	S_3	40	38	40	41	39.75
4.	S_4	44	38	41	38	40.25

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Table-4. SO_X (µg/m^3) at Different Sampling Station.

S. No.	Sampling Code	Sampling site				Avg.
		1	2	3	4	
1.	S_1	04	07	03	09	5.75
2.	S_2	05	05	08	07	6.25
3.	S_3	11	12	15	12	12.50
4.	S_4	13	14	14	14	13.75

Table-5 NO_X (µg/m^3) at Different Sampling Station.

S. No.	Sampling Code	Sampling site				Avg.
		1	2	3	4	
1.	S_1	06	08	07	10	7.75
2.	S_2	05	07	11	08	7.75
3.	S_3	09	09	16	11	11.25
4.	S_4	14	13	14	15	14.00

Table-6. Average Value of Different Parameter at Different Sampling Site.

Sr no	Station code/ Standerd value	Sampling Site	$PM_{2.5}$	PM_{10}	Sox	Nox
	Standerd value	---	60.00	100.00	80.00	80.00
1	S_1	Near Guste House	42.50	82.00	5.75	7.75
2	S_2	Near Director Banglow	39.25	75.00	6.25	7.75
3	S_3	NearUnit-2 Gate	39.75	79.25	12.50	11.25
4	S_4	NearFilteration Plant	40.25	80.50	13.75	14.00

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Table-7 National Ambient Air Quality Standards

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1.	Sulphur Dioxide (SO_2), µg/m3	Annual* 24 hours**	50 80	20 80	- Improved West and Gaeke - Ultraviolet fluorescence
2.	Nitrogen Dioxide (NO_2), µg/m3	Annual* 24 hours**	40 80	30 80	- Modified Jacob & Hochheiser (Na-Arenite) - Chemiluminescence
3.	Particulate Matter (size less than 10 µm) or PM_{10} µg/m3	Annual* 24 hours**	60 100	60 100	-Gravimetric - TOEM - Beta attenuation
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ µg/m3	Annual* 24 hours**	40 60	40 60	-Gravimetric -TOEM - Beta attenuation

Table-8. Air Quality Index Value Remark And Health Effects

Index Value	Remark	Health Effects
0-50	Good	Minimal Impact
51-100	Satisfactory	Minor breathing discomfort to sensitive people
101-200	Moderate	Breathing discomfort to the people with lung,
201-300	Poor	Minor breathing discomfort to sensitive people
3001-400	Very Poor	Respiratory illness to the people on prolonged exposure
>401	Severe	Respiratory effects even on healthy people

Table-9. AQI of Various Sampling Site.

S.No.	**Sampling Code**	**AQI**	**Category**
1.	**S_1**	82	Satisfactory
2.	**S_2**	75	Satisfactory
3.	**S_3**	79	Satisfactory
4.	**S_4**	81	Satisfactory

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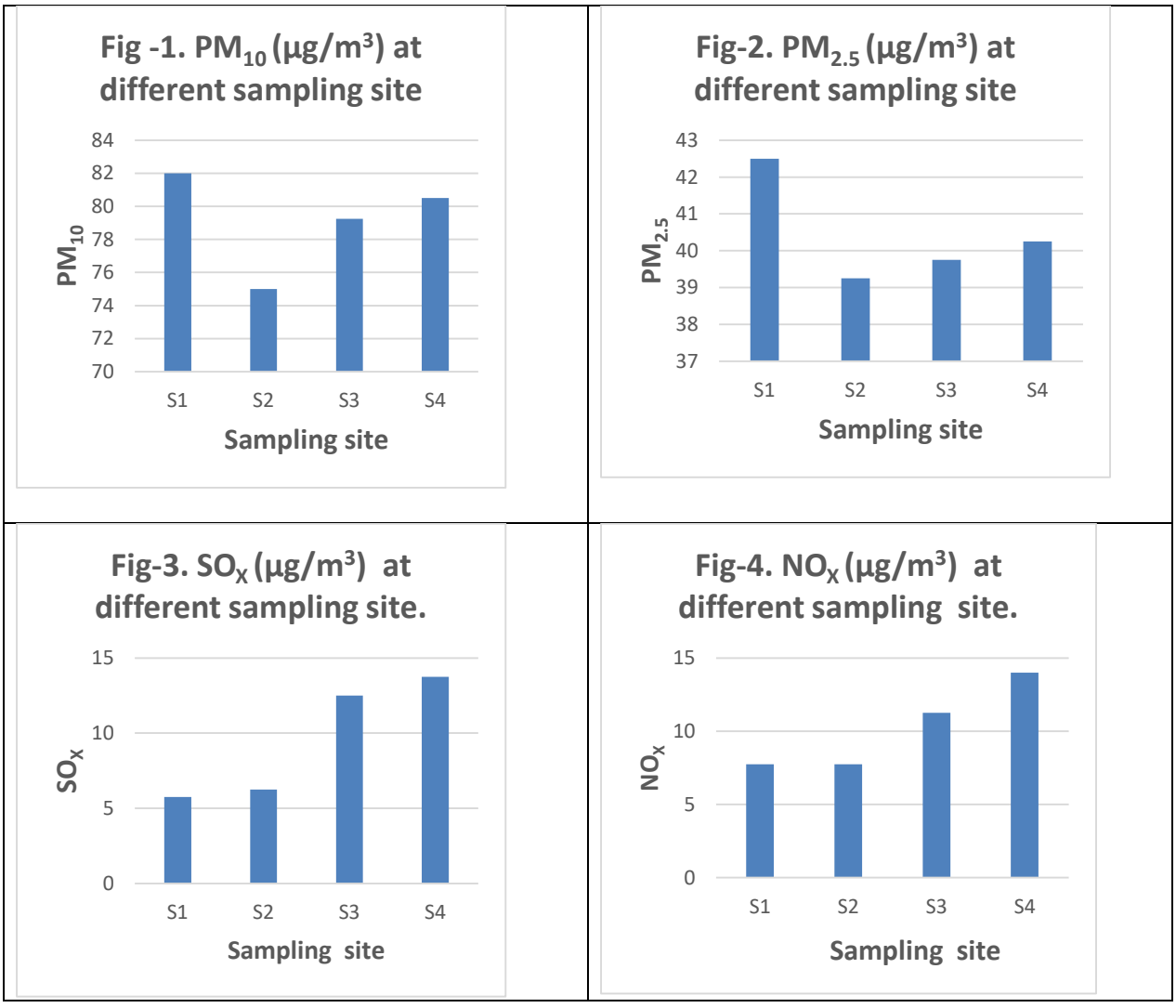
SOx: -The concentration of SO_x in Ambient air is almost neglegible but some time it found in little amount. The maximum average value of SO_x was observed 13.75 ug/m^3 at S_4 (near filteration plant) and minimum value was found 5.75 ug/m^3 at S_1 (Near Guest House) table-3 which are within the permissible limit of 80 µg/m^3 (Table-6). SO_X observed at various sampling site is depicted in fig-3

NO_x :-The concentration of NO_x in Ambient air is almost neglegible but some time it found in little amount.The maximum average value of NO_x was observed 14.00 ug/m^3 at S_4 (near filteration plant) and minimum value was observed 7.75 ug/m^3 at S_1 / S_2 (Near Guest House / Director Banglow) which are within the permissible limit of 80 µg/m^3 (Table-6).). NO_X observed at various sampling site is depicted in fig-4



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AQI:

AQI OF various selected lotion were calculated and given in table-7 all the station were found with in rang of 50-100. Which indicate satisfactory air quality at all the station.

CONCLUSSION:

The main pollutants of cement manufacturing process are particulate matters SO_x & NO_x pollution. To determine the air quality of Maihar cement part ambient monitoring is carried out once in a weak which include PM_{10}, $PM_{2.5}$, SO_x & NO_x .MCP is equipped with various prevention equipment such as Bag Houses, ESP, and bag filter for control of particulate flue gas.

From the study it was concluded that all the studied parameters were within the permissible limit hence there is no adverse effect on environment as well as on flora & fauna of satna city due to the Maihar Cement plant , hence Maihar Cement Plant is an least polluting & eco-friendly company.

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