



Study on Ambient Air Quality at Jaypee Cement Plant Rewa M.P.

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ABSTRACT –:

Cement industries are the most rapidly growing industries in the world, due to the population growth and the demand of current lifestyles, the Cement is the most popular and easily available resource for various purposes of constructions like in making roads, construction of dams, canals, sewerage etc. Cement industries are extremely helpful for the growth of any countries economy and utilizing the mineral resource of that area but also causes some major disruptions in the environmental condition of that area. Cement industries are responsible for emission of major air pollutant like SO_2 , NO_2 , PM_{10} and $PM_{2.5}$.

Keywords –: *Cement, Air, Pollution, Emission, Ambient.*

INTRODUCTION

Air pollution is a major environmental problem affecting both the developing and the developed countries of the world. Air pollution from man's industrial and domestic activities is an important problem which may have significant and occasionally devastating effects on plants and soils under both, cultivated and natural conditions and on human health. Air pollution caused due to discharge of toxic fumes, gases, smoke and dusts into the atmosphere (Park and Park, 1985). The Cement industry plays a major role in living standards all over the world by creating direct employment and providing multiple cascading economic benefits to associated industries. Despite its popularity and profitability, the Cement industry faces many challenges due to environmental concerns and sustainability issues. Air pollution continues to receive a great deal of interest worldwide due to its negative impacts on human health and welfare. Several studies reported significant correlation between air pollution and certain disease including shortness of breath, sore throat chest pain, nausea, asthma, bronchitis and lung cancer (Dockery and Pope, 1994). Extreme effects of air pollution include high blood pressure and cardiovascular problems (Pope, 2002; Sanjay 2008). Epidemiological studies suggests that more than 500,000 Americans dies each year from cardiopulmonary disease linked to breathing fine particle air pollution (American chemical society, 2008). Cement industry is the potential anthropogenic source of air pollution. It is a major contributor to dust, nitrogen oxide (NO_x), Sulfur oxides (SO_x) and carbon monoxide (CO) in metropolitan areas. Furthermore, it contributes about 5% of the global CO_2 , the famous green house gas (Ian and David, 2002). In Cement industries, dust is emitted from stock piles, quarrying, transportation of raw materials, kilns operation, clinker cooling and milling (EIPPC2001). Oxides of carbon, nitrogen, sulphur are mainly produced as a byproduct of fuel for power generation. (Marland et al., 1989; Ruth, 2000; Battele Institute, 2002; Ian and David, 2002). In addition; SO_2 is produced from oxidation of volatile Sulfur present in the kind of limestone used as a raw material (Jeff and Hans, 2004). It has been reported that 1kg of Cement manufactured in Egypt generates about 0.07kg of dust in the atmosphere (Hindy et al., 1990).

Cement industry presents one of the most energy intensive sectors within the Indian economy and is therefore of particular interest in the context of both local and global environmental discussions. Cement dust contains heavy metals like nickel, cobalt, lead, chromium, pollutants hazardous to the biotic environment, with adverse impacts for vegetation, human and animal health and ecosystem (Baby et al., 2008). The main environmental issues associated with the Cement production are emissions to air and energy use. One of the most critical impacts of Cement manufacturing is the dust generated during transport, storage packing etc. (NGHI Son Cement corporation project, 1996). The public health implications of the emission of CO, O_3 , toxicants and particulates are substantial (Meena et al., 2012). Among air pollutants, particulate matter (PM) is a dangerous and it's especially a major problem due to its adverse health effect, visibility reduction and soiling of buildings (Chaurasia et al., 2013). It is observed that Nitrogen oxide has an important role in the formation of ozone in the atmosphere and sulphur dioxide is a highly reactive gas which affects the environment adversely (Hasan et al., 2018). There is a large amount of evidence in the literature that ambient air pollution can affect human health to various degrees, children are believed to be more affected by ambient air pollution than adults because they do not have a complete defense mechanism and because they inhale a higher volume of air per body weight. Higher rates of allergen sensation, worsening asthma and decreased lung function have been associated with higher exposure to fine particles in ambient air (Salvi, 2007). There is also sufficient evidence that air pollution can result in higher congenital disability rates (Ritz et al., 2002), lower birth weight, premature birth, and can cause respiratory deaths in postneonatal period (Sram et al., 2005). Long term exposure to ambient air pollution has been found to increase cardiovascular morbidity and mortality (Kunzli et al., 2005).

Study area - Jaypee Cement plant Rewa is situated in Rewa district, which is situated on the north eastern part of Madhya Pradesh state, central part of India. The founder of Jaypee group is Shri Jaiprakash Gaur ji. It lies between Latitude $24^{\circ}31'37''N$ and Longitude $81^{\circ}10'05.04''E$. It is situated in Nabusta town Jaypee Nagar Distt. Rewa (M.P.).The Cement plant is encircled with the coal and limestone mines which gives the necessary raw material needed for the running of plant.

Topographically, the area is almost flat land. The ground level of the plant is about 307 m above mean sea level (aMSL).

Meteorological data at the site was monitored during summer season. It was observed that during study period temperature ranged from $17.5^{\circ}C$ to $42.7^{\circ}C$, during the same period of observation, the relative humidity recorded was ranged from 22% to 44%. Predominant wind directions during study period from West to East.

Based on the field studies and review of published literature, it is observed that there are no endangered and protected floras and fauna in the core zone (plant area). The one schedule-1 species that occurs in the study area is peacock for which a conservation plan has been formulated there are no wildlife sanctuaries and National parks within the study area of 10 km radius from the plant boundary.

Study sites- There are four sites that are used for the monitoring of the ambient air quality at Jaypee Rewa plant, washing ramp, Narmada gate, Bhagirathi gate, Estate office these sites are located at four different directions of the Cement plant. The purpose of this study was to investigate the ambient air quality of the Jaypee Cement plant Rewa, Rewa (M.P.) and to study its adverse impacts on the environment and to compare the ambient air quality of the Cement plant with the air quality standards according to the standards NAQI(National ambient air quality index) by CPCB. Ambient air quality was monitored for four locations of the Cement plant. The sampling locations are shown in table (1)

Table 1: sampling stations for ambient air quality monitoring.

S.NO.	NAME OF LOCATION	STUDY AREA
1.	NEAR NARMADA GATE	JRP
2.	NEAR ESTATE OFFICE	JRP
3.	NEAR WASHING RAMP	JRP
4.	NEAR BHAGIRATHI GATE	JRP

*JRP- Jaypee Rewa Cement plant.

MATERIALS AND METHODS

The study on ambient air quality of Jaypee Rewa plant was done in the month of February in the year 2020, by taking the samples from the above four locations of Jaypee Cement plant these sites are located in different directions and covered the four different directions north, south, East and West. The ambient air quality of any area can be measured by the methods that are prescribed by the Central pollution control board. The methods prescribed for the gases and particulate matters SO_2 , NO_2 , PM_{10} and $PM_{2.5}$ are modified west and Geake method, modified Jacob and Hochhesier method and gravimetric method.

RESULTS AND DISCUSSION

AMBIENT AIR QUALITY

PARTICULATE MATTER (PM_{10}):- The PM_{10} was monitored at Jaypee Rewa plant at four stations in different directions with the help of RDS. The concentration of PM_{10} ranged from $41.83 - 45 \mu g/m^3$. The minimum concentration was found $41.83 \mu g/m^3$ near Narmada gate and the maximum values was found near washing ramp $45.00 \mu g/m^3$ within the limit prescribed by NAAQM ($100 \mu g/m^3$). As shown in table2 and fig.1.

PARTICULATE MATTER ($PM_{2.5}$):- The $PM_{2.5}$ was measured at Jaypee Rewa plant at the four stations in different directions with the help of FDS. $PM_{2.5}$ Concentration ranged from $32.00-35.00 \mu g/m^3$. The minimum concentration was found near washing ramp and the maximum concentration was found near Bhagirathi gate within the limit prescribed by NAAQM ($60 \mu g/m^3$). As shown in table 3 and fig.2.

GASEOUS POLLUTANT

SO_2 :- Its concentration was monitored at four stations in Jaypee Rewa Cement plant with the help of RDS. The concentration of SO_2 ranged from $8.33-10.33 \mu g/m^3$. The minimum concentration was found near washing ramp and the maximum concentration was found near Bhagirathi gate, within the limit prescribed by NAAQM ($80 \mu g/m^3$). As shown in table 4 and fig.3

NO_2 :- Its concentration was monitored at four stations in Jaypee Rewa plant with the help of RDS. The concentration of NO_2 ranged from $14.66-16.33 \mu g/m^3$. The minimum concentration was found near Bhagirathi gate and the maximum concentration was found near Narmada gate, within the limit prescribed by the NAAQM ($80 \mu g/m^3$) as shown in table 5 and fig.4

Table -: 2 PM_{10} Concentration at four sampling stations.

S.NO.	DATED	Washing ramp	Narmada gate	Estate office	Bhagirathi gate
1.	04/02/2020	37.00	40.0	50.00	46.00
2.	08/02/2020	51.00	53.0	48.00	43.00
3.	12/02/2020	40.00	43.00	41.00	47.00
4	17/02/2020/	47.00	38.00	50.00	39.00
5.	20/02/2020	42.00	40.00	43.00	39.00
6.	24/02/2020	53.00	37.00	38.00	41.00
Min		37.00	37.00	38.00	39.00
Max.		53.00	53.00	50.00	47.00
Mean (\pm)/S.D.		45.00 \pm 6.356	41.833 \pm 5.845	45 \pm 5.059	42.5 \pm 3.499
Standard Error		2.595	2.386	2.065	1.408

Table-:3 $PM_{2.5}$ Concentrations at four sampling stations.

S.NO.	Dated	Washing ramp	Narmada gate	Estate office	Bhagirathi gate
1.	04/02/2020	28.00	38.00	38.00	37.00
2	08/02/2020	32.00	30.00	34.00	35.00
3.	12/02/2020	33.00	33.00	35.00	39.00
4.	17/02/2020	29.00	33.00	39.00	36.00
5.	20/02/2020	37.00	34.00	29.00	32.00
6.	24/02/2020	33.00	37.00	30.00	31.00
Min		28.00	30.00	29.00	31.00
Max		37.00	38.00	39.00	39.00
Mean (\pm)/S.D.		32.00 \pm 3.244	34.166 \pm 2.926	34.166 \pm 4.070	35 \pm 3.033
Standard error		1.324	1.194	1.661	1.238

Table -: 4 SO_2 Concentration at four sampling stations.

S.NO.	Dated	Washing ramp	Narmada gate	Estate office	Bhagirathi gate
1.	04/02/2020	10.00	9.00	11.00	9.00
2	08/02/2020	6.00	7.00	8.00	9.00
3.	12/02/2020	8.00	8.00	6.00	10.00
4.	17/02/2020	6.00	11.00	7.00	11.00
5.	20/02/2020	9.00	6.00	10.00	6.00
6.	24/02/2020	11.00	10.00	13.00	17.00
Min		6.00	6.00	6.00	6.00
Max.		11.00	11.00	13.00	17.00
Mean (\pm)/S.D.		8.33 \pm 2.065	8.5 \pm 1.870	9.166 \pm 2.693	10.333 \pm 3.669
Standard error		0.843	0.763	1.099	1.498

Table -:5 NO_2 concentrations at four sampling stations

S.NO.	Dated	Washing ramp	Narmada gate	Estate office	Bhagirathi gate
1.	04/02/2020	13.0	9.00	16.00	16.00
2.	08/02/2020	20.00	7.00	17.00	12.00
3.	12/02/2020	13.00	8.00	11.00	17.00
4.	17/02/2020	15.00	11.00	16.00	13.00
5.	20/02/2020	16.00	6.00	17.00	12.00
6.	24/02/2020	18.00	10.00	15.00	18.00
Min		13.00	6.00	11.00	12.00
Max		20.00	11.00	17.00	18.00
Mean (\pm)/S.D.		15.833 \pm 2.786	8.5 \pm 1.870	15.333 \pm 2.250	14.666 \pm 2.658
Standard error		1.317	0.763	0.9187	1.085

From the above data of all the different parameters we calculated the average ambient air quality of Jaypee Rewa plant which is summarized below in the table-6

Table -:6 Average ambient air quality at various sampling stations.

S.NO.	Parameters	Name of stations			
		Washing ramp	Narmada gate	Estate office	Bhagirathi gate
1.	PM_{10}	45.00	41.00	45.00	42.5
2.	$PM_{2.5}$	32.00	34.166	34.166	35.00
3.	SO_2	8.33	8.5	9.166	10.333
4.	NO_2	15.833	8.5	15.333	14.666

Table -: 7 National ambient air quality index (NAQI) Standards

S.NO.	Parameters	Standards($\mu\text{g}/\text{m}^3$)
1.	PM_{10}	100
2.	$PM_{2.5}$	60
3.	SO_2	80
4.	NO_2	80

*National ambient air quality shown in table 7

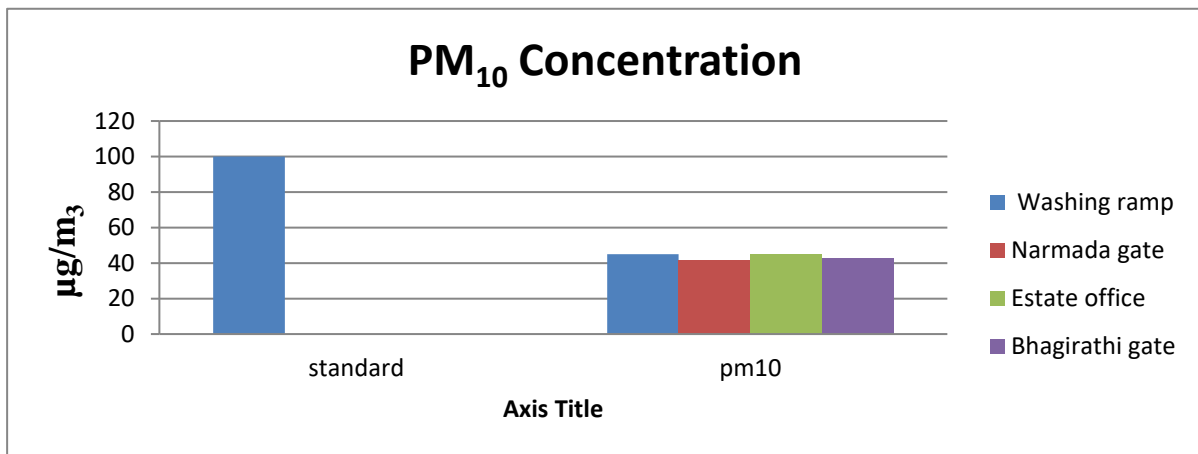


Figure 1: PM_{10} Concentration at different sampling station

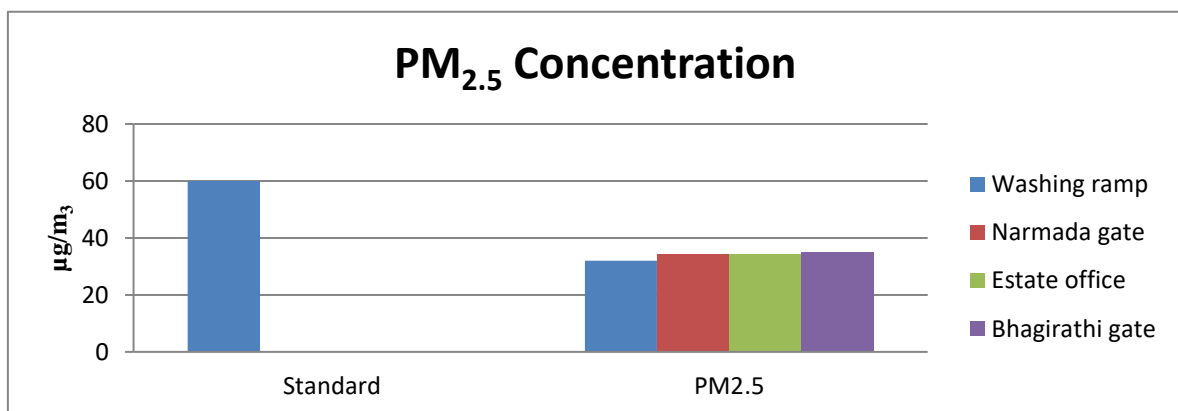


Figure 2: $PM_{2.5}$ concentration at different sampling stations

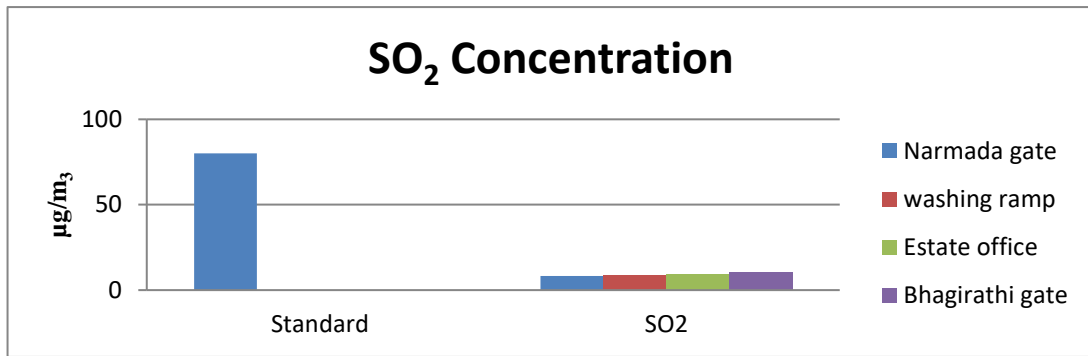


Figure 3: SO₂ concentration at different sampling stations

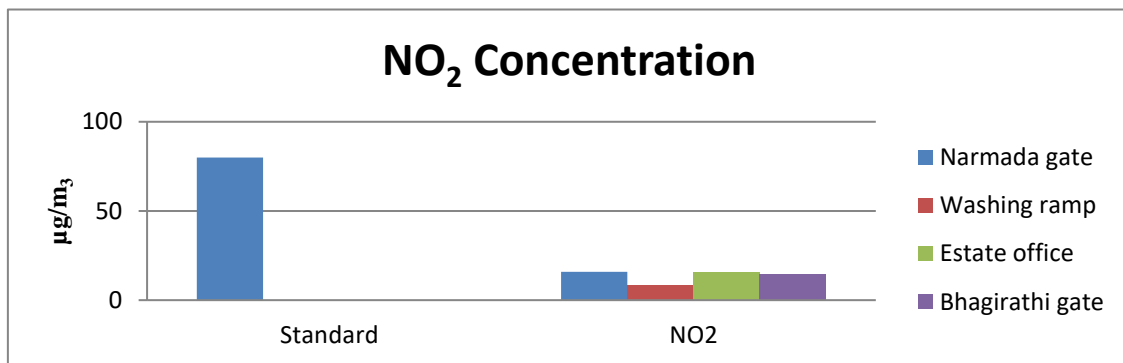


Figure 4: NO₂ concentration at different sampling stations

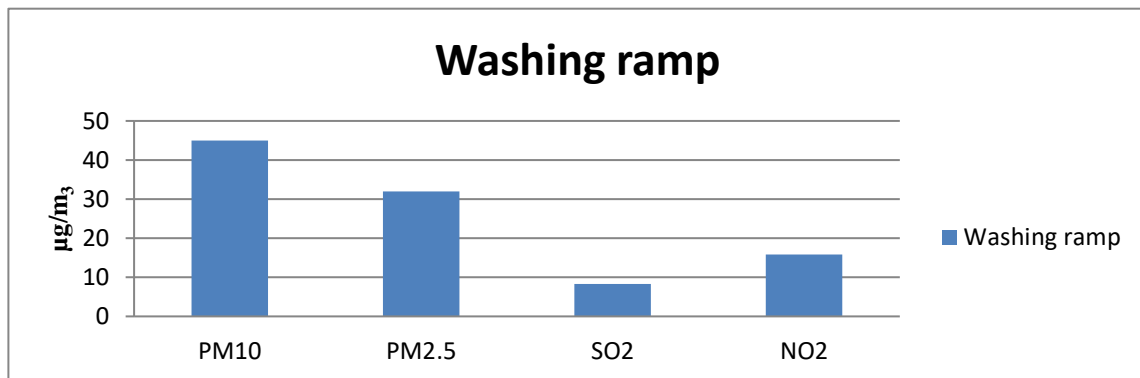


Figure 5: Ambient air quality at washing ramp

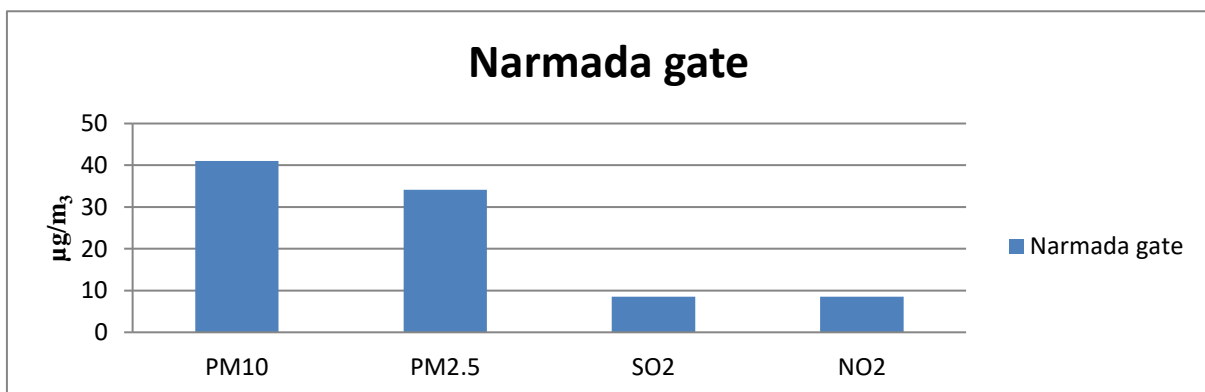


Figure 6: Ambient air quality at Narmada gate

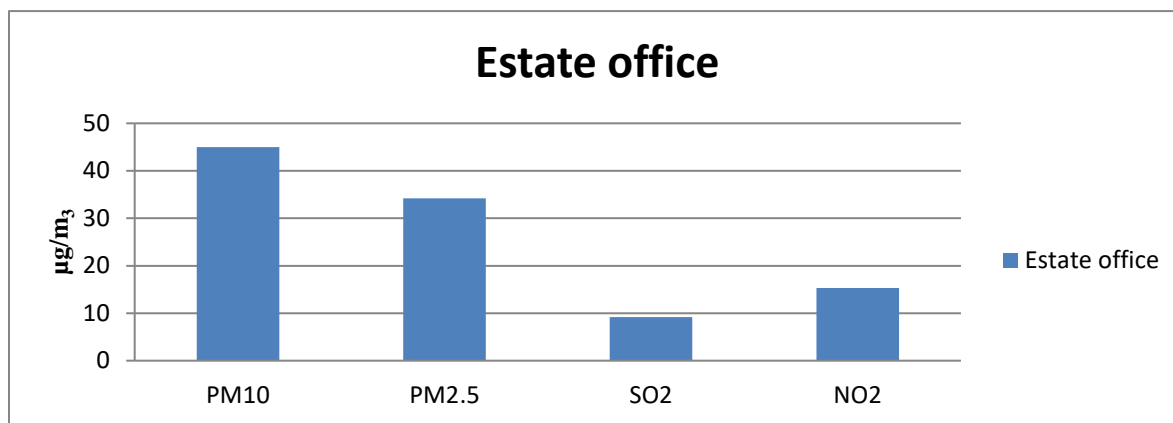


Figure 7: Ambient air quality at Estate office

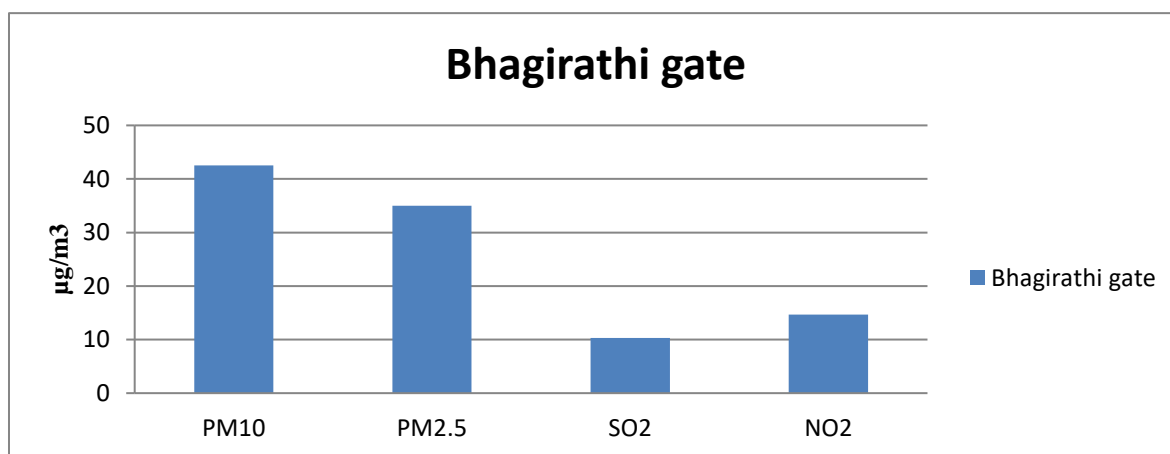


Figure 8: Ambient air quality at Bhagirathi gate

DISCUSSIONS

Air pollution is the serious problem throughout the world which causes tremendous loss to human health and environment. And Cement industries are considered one of the major sources of air pollution. According to our study which is conducted in the Jaypee Rewa Cement plant for studying its ambient air quality, the average concentration of PM_{10} ranged from 41.83 to 45 $\mu\text{g}/\text{m}^3$, $PM_{2.5}$ ranged from 32 to 35 $\mu\text{g}/\text{m}^3$, SO_2 ranged from 8.33 to 10.33 $\mu\text{g}/\text{m}^3$ and NO_2 ranged from 14.66 to 16.33 $\mu\text{g}/\text{m}^3$ and all these concentration were within the permissible limit prescribed by NAAQM, which suggests that the quality of ambient air was good in Jaypee Rewa Cement plant. But what we observed there was that, there are workers who were suffering from some kind of respiratory diseases due to the long term exposure in the industry, some suffered from dermatological diseases due to continuous contact of Cement dust and the atmosphere of the Cement plant was also not so clean and dust free, which indicates the higher concentration of particulates matter in the Cement plant.

CONCLUSION

The main Environmental issue associated with Cement production is the emission of pollutants (SPM, SO_2 & NO_2) in the atmosphere. These air pollutants have long been associated with prevalence of various diseases in human beings. Due to the large production of Cement in the industry, heavy air pollution was there mainly due to dust particles. But according to our analysis all the analyzed values are under the permissible limit, and it is possible only because the air quality management system of Jaypee Rewa Cement plant, the Environment cell of the plant is very strict about its environmental condition and always tries to reduce the pollution effect naturally, the roads of are made up of Cement inside the plant so that there is less pollution due to vehicular transport system inside the plant. Covered reclaiming belt conveyor also helps in reducing dust emission during transportation of raw materials. A large bag house for controlling air pollution especially SPM set up in Jaypee Rewa Cement plant which controls the air pollution effectively. Overall by our analyzing result we can conclude that the ambient air quality at Jaypee Rewa Cement plant is good and that is due to the air quality management system, and it is properly working. Cement industry is a place where the problem of air pollution is very obvious but it is important for us that how we control it by our effective management.

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