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Deterioration of air quality and human health in Naubasta village due to air pollution by J.P. cement plant Rewa (M.P.)

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Abstract

The air pollutants such as SPM, RPM, SO_2 and NO_x are monitored sites in Naubasta village, proximate to J.P. Cement Plant. Results indicate that average concentrations of SPM and RPM in the ambient air of the village are above the permissible limit whereas the gaseous pollutants (SO_2, NO_x) are well below the standard value prescribed by CPCB, New Delhi. Higher concentration of pollutants during winter months, moderate during summer and low during rainy months indicated marked seasonal variation of pollutants under present investigation. About 200 families of Naubasta village have been surveyed for prevalence of air pollution oriented diseases among the people. Results indicated higher incidence of respiratory diseases among the affected people.

Key-Words: Air pollutants, Monitoring, SPM and RPM, Diseases.

Introduction

Rapid progress in industrialization and mechanization has resulted the unlimited exploitation of natural resources. Lack of development of a culture of air pollution control in many industries has resulted in serious air pollution problems in developing countries. Air pollution is aggravated because of four developments: increasing traffic, growing cities, rapid economic development and industrualzaion. Cement in an essential commodity contribuang towards the progress of human society. The main environmental problems from the cement plants are SPM, RPM and gaseous pollutants such as sulphur dioxide (SO_2), oxide of nitrogen (NO_x), and CO_2. Other pollutants though significant but of less magnitude are heavy metals, carbon monoxide (CO), hydrocarbons, and other organic substances and silicon oxide (i.e. crystalline quartz). Monitoring of air quality around the cement industries in India has been a subject of many recent studies (Banejee and Panday 1988, Gupta 1994; Chandrasekharan et al, 1996, 1998; Agrawal and Khanam 1997; Tiwari and Kumar 1998; Shrivastava 1999). Health effect of air pollutants in humans are studied by pope (2000a, 2000b), HEI (1995, 2000a, 2000b), and WHO (2000a, 2000b).

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Present study is conducted to estimate the qualitative impairment of ambient air due to SPM, RPM. SO_2 and NO_x. The ill effects of these air pollutants on human health such as asthma, acute respiratory diseases, eye irritation, headache and skin diseases due to pollution are well documented.

Material and methods

Study area

The study area is bounded between $24^0$28'24" to $24^0$39'11" north latitude and $81^0$05'46" and $81^0$17'23" east longitude (Approx). Jaypee cement limited is operating a 2.8 MTPA cement manufacturing plant at Jaypee nagar which is 15 km from Rewa town. The study site Naubasta village which is close to from cement plant is situated about 1.5km towards NE direction from the source of emission. The population of village is 2046 and has surface area of 532. 67 hectare. The annual rainfall of this region is 1139.15 mms and average maximum and minimum temperature are 36.8^0C and 12^0C respectively. More than 90% annual rainfall occurs during the monsoon months. The mean wind speed in the study area is varied between 0-15km/hrs.

Apparatus and Procedure

Respirable Dust Sampler, Envirotech model APM- 460 BL-441 is employed to monitor the pollutants. The sampling duration was 8 hours period operated at an

average flow rate of 1.5 LPM. Monitoring is carried out once in a month at four sampling sites viz; Jyoti school, Vindhya gate, Naubasta colony and Narmada gate for one year (2003-2004). NEERI and CPCB recommended methods are followed to estimate air pollutants concentrations. Amount of Respirable Particulate Matter (RPM) was collected in the glass fabric filter paper whereas suspended particulate Matter (SPM) was collected on dust cup. Samples for determination of SO_2 and NO_x were collected by bubbling air samples in the appropriate absorbing media in impingers at flow rate of 1.5 LPM. These samples were analysed for SO_2 and NO_x spectrophotometrically. Impacts of air pollution on human health data were collected as per survey schedule.

Results and Discussion

A summarized data of average concentrations of air pollutants such as Suspended Particulate Matter, Respirable particulate Matter. Sulphur dioxide and Nitrogen oxides for three seasons of the study period are given in Table 1. The estimated SPM concentrations in the ambient air of four sampling sites varied between 275.28 µg/m^3 to 340.15µg/m^3, 210.40 µg /m^3 to 264.94 µg/m^3 and 150.84 µg /m^3 to 194.71µg/m^3 during winter, summer and rainy months respectively, Respirable particulate Matter (RPM) were found in the range of 105.15 µg/m^3 to 132.28 µg/m^3, 92.64.64µg/m3 to 105.19µg / m^3 and 78.49 µg / m^3 to 83.48. µg/m^3 during winter, summer and rainy months respectively. SO_2 values varied between 18.62 µg/m^3 to 24.48 µg/m^3, 13.49 µg/m3 to 18.74 µg/m^3, and 7.54 µg/m^3 to 8.98 µg/m^3 at four sampling sites during winter, summer and monsoon months respectively. All the sampling sites exhibited NO_x concentrations in the range of 22.28 µg/m^3 to 30.75 µg/m^3 (Winter), 19.86 µg/m^3 to 22.68 µg/m^3 (summer) and 10.34 µg/m^3 to 18.48 µg/m^3 (rainy months). Out of four sampling sites, the ambient air of Narmada gate and Naubasta colony showed maximum and minimum concentrations of SPM, RPM. SO_2 and NO_x concentrations.

The average concentration of SPM and RPM in the ambient air of studies sites are above the permissible limit (200µg/m^3 for SPM, 100 µg/m^3 for RPM) for residential and rural uses. Whereas, the gaseous pollutants (SO_2 and NO_x) are well within permissible limit (80µg/m^3) prescribed by CPCB, New Delhi for residential and rural uses: Results observed in the present study particularly for SPM are in agreement with the monitoring results obtained around different cement plants of the country (Baenrjee and Pandey, 1989; Agrawal and Khanam 1989; Shriv astava, 1999; Chandrasekharan et al; 1996).

Marked seasonal variation in the pollutant concentrations under present investigation may be attributed to variation in wind velocity, temperature, relative humidity as well as periodic rainfall (Agrawal and Khanam 1989). Comparatively higher concentrations of pollutants have been observed in winter months, moderate in summer and lower in rainy months. Winter and summer months are often considered critical periods for the accumulation of certain pollutants in the air. In summer months the low humidity and high winds facilitate concentration of SPM and RPM in the atmosphere. Due to calm condition, there is trapping of all atmospheric pollutants near the ground level duri9ng winter months. Falling rain drops are known to prompt a washing-out; solid material is dragged towards the ground and the air is thus cleaned to some extent during rainy months.

The most common route for pollutants to enter the human body is by inhalation. The inhaled air pollutants affect the lung and respiratory tract but can also be taken up and transported by blood stream through the body. People with health problems such as respiratory diseases (asthma, bronchitis, cough and common cold). Eye diseases, cancer, headache, hypertension and B.P and other disease may also suffer more when the air is polluted. Survey was conducted in 200 families for general incidence of various diseases among people of Naubasta village (Table 3). Results indicated that about 42.08% of total people (21.80% male and 20.28% female) were affected due to cement plant air pollution. Percentage of person suffering from respiratory disease was found to be maximum (19.63%) followed by headache (18.82%), eye irritation (17.78%), other diseases (17.43%) and skin diseases (15.93%).

Association between air pollution and lung function parameters has already been well documented (Schwela 2000; pope 2000a; WHO 2000b). Air quality monitoring data clearly showed lower concentrations of gaseous pollutants (SO_2 and NO_x)and higher concentrations of SPM and RPM in the ambient air of studied site. The incidence of higher rate of respiratory diseases among the people of selected village could be attributed to higher concentration of SPM and RPM in the ambient air. Under long term exposure, there is correlation between particle concentrations and mortality form lung disease (WHO 2000a,). Particulate matter in the ambient air have been found to cause acute effects such as increased daily mortality, increase rate of hospital admissions for exacerbation of respiratory disease etc. (WHO 2000a, 2000b). However, health effects of SPM in humans depend on

particle site, concentrations and exposure time. Exposure to 200 µg/m^3 of particulate matter can cause upper respiratory diseases and to 294- 470 µg/m^3 depress immune function in children. Exposure to SPM (With daily average concentration below 150µg/m^3) produced an increased frequency of attacks of asthma in some asthma patients (WHO 2000a).

The SPM and RPM concentrations in the ambient air of Naubasta village exceeded the standard value given for residential and rural uses throughout the study period. On the other hand the SO_2 and NO_x concentrations have been observed well below the prescribed standard value given by CPCB, India. This study suggests that prevalence of various diseases, particularly the respiratory diseases among the people of surveyed village could be due to higher concentration of particulate matter in the ambient air around Jaypee cement plant

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Table1: Seasonal variation of air pollutants in the ambient air of four sampling sites during 2003

S/N	Sampling sites	SPM (µg/m^3)			RPM(µg/m^3)			SO_2(µg/m^3)			NO_x (µg/m^3)		
		W	S	R	W	S	R	W	S	R	W	S	R
1	Jyoti School	310.41	262.82	185.46	118.43	98.75	80.8	21.84	15.98	7.54	24.32	18.95	16.48
2	Vindhya gate	321.54	248.80	190.34	120.41	104.85	80.34	22.56	17.81	8.32	29.36	21.64	18.92
3	Naubastacolony	257.28	210.40	150.84	105.15	92.64	78.49	18.62	13.49	7.86	22.28	19.86	10.34
4	Narmada gate	340.15	264.94	194.71	132.38	105.19	83.48	24.48	18.74	8.98	30.75	22.68	18.48

Table 2: Annual concentration of different air pollutants in the ambient air of four sampling sites

S/N	Samling Site	SPM (µg/m^3)	RPM(µg/m^3)	SO_2(µg/m^3)	NO_x (µg/m^3)
1	Jyoti School	252.89	99.32	15.12	19.91
2	Vindhya gate	253.56	101.86	16.23	23.04
3	Naubastacolony	212.17	92.09	13.32	17.49
4	Narmada gate	166.60	107.01	17.40	23.97
5	**Average**	246.30	100.07	15.52	21.10

Table 3: **Occupational health diseases among the people of Naubsta village due to air pollution on village**

S/N	Disease	Number of people affected						Total
		Male			Female			
		Child	Adult.	Old	Child	Adult.	Old	
1	Respiratory diseases	20	30	38	22	38	31	170
2	Headache	19	38	28	18	35	25	163
3	Skin diseases	20	25	28	15	28	30	138
4	Eye irritation	18	38	28	15	30	25	154
5	Heart & BP Problems	8	16	22	6	18	20	90
6	Other disease	22	28	32	14	25	30	151