Studies on Atmospheric Chemical Turbulance and their Impact on Residents Health in Satna District

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ABSTRACT *Air pollution is a basic problem in today's world. Therefore the study on air pollution and related impacts on human health have a special consideration today. Air pollution occurs when the air contains substances in quantities that could harm the comfort or health of humans and animals, or could damage plants and other materials. These substances are called air pollutants and can be either particals, liquids or gaseous in nature. These air pollutants cause physiological response in organisms and wide range of health effects in humans. Satna region is one of notified industrial area in madhya pradesh state of India. Satna is known as the cement city on India, due to abundance of lime stone and dolomite in the region. Satna city has 7 cement factories. Major problem in the city is air pollution due to atmospheric wastes of cement factories. Satna is an industrial area, and a little change in the concentration of pollutants in ambient air can make a strong effect on the existing living stock causing many adverse effects on health and skin.*

Keywords: *Air quality, Gaseous pollutant, Particulate pollutants, human health.*

INTRODUCTION

The environment is an integral part of human life. The quality of which plays a critical role in human health. The air we breathe contains emissions from many different sources industry, motor vehicles, heating and commercial sources, household fuels as well as tobacco smoke[1-5]. Industrialization has provided humanity with materials and social benefits. It has also brought in wake up many unwanted substance and social problems. One of these problems is the degradation of the environment. These environmental problems are becoming threats to the existence of living beings[6,7]. Air pollution is a mixture of particulate matter (PM), gases and vapor phase molecules[8-13]. These air pollutants cause physiological response in organisms and a wide range of health effects in humans. Most of the cities in developing countries suffer from serious outdoor air pollution due to improper maintenance of vehicles[14] such increase demand of vehicles has increased the air pollutants concentration all over the world[15]. Such activities cannot be stopped as they are directly related to the development of the society. In India outdoor air pollution is restricted mostly to urban areas, where automobiles are the major contributors and to a few other areas with concentration of industries and thermal power plants. Apart from rapid industrialization, urbanization has resulted in the emergence of industrial centers without a corresponding growth in civic amenities and pollution control mechanisms. Satna is known as the cement city on India, due to abundance of lime stone and dolomite in the region. City has 7 cement factories. The city is amongst the few most promising cities of Madhya Pradesh because of several new industries planned by some of the reputed industrial houses in the country. Major problem in the city is Air Pollution due to atmospheric wastes of cement factories. Two critical gaseous pollutants and particulate pollutants are in abundance in Satna. Satna is an industrial area and a little change in the concentration of pollutants in ambient air can make a strong effect on the existing living stock causing many adverse effects on health and skin. The quality of Air in the study area is estimated from the air quality index[16-19]. The air quality index was calculated from the observed TSP, PM_{10}, NO_x and SO_2 values using the formula.

$$AQI = 1/4 \left(I_{TSP} / S_{TSP} + I_{PM10} / S_{PM10} + Iso_2 / Sso_2 + I_{NOx} / S_{NOx} \right) X\ 100$$

Methodology

According to Central Pollution Control Board (CPCB) the methods prescribed for the pollutant gases and particulate pollutants are very sensitive and the percentage of error in results in very low.

Concentration of NO_2 in Air sample

Modified Jacob and Hochheiser method had been applied for determination of NO_2 concentration in air sample.

$$\mu gNO_2/m^3 = \frac{\mu gNO\,2 \text{ x } Vs}{Va \text{ x } 0.82}$$

Where, concentration in air sample
μg NO_2 = NO_2 concentration in analyzed sample
Va = Volume of air sample
Cu-m 0.82 = Sampling efficiency
D = Dilution factor
(D = 1, no dilution)
(D = 2, for 1:1 dilution)
Vs = Volume of sampling solution the NO_2 concentration is calculated
The NO_2 concentration may be calculated as ppm using

$$ppm\ NO_2 = (\mu gNO_2\ /m^3) \text{ x } 5.32 \text{ x } 10^{-4}$$

Determination of SPM total suspended particulate matter in Air sample
For determination of TSP high volume method had been used.

$$SPM = \frac{(w_{f-}w_i) \times 10^6}{v}$$

Where,
SPM = Mass concentration of suspended particles in μg/m^3
w_i = Initial weight of filter in g
w_f = Final weight of filter in g
V = Volume of air sampled in cu-m
10^6 = Conversion of g to μg

Determination of respirable suspended particulate matter (PM_{10})
For determination of (PM10) cyclonic Flow technique had been applied.
(PM_{10} = Particulate matter less than 10μm diameter in air sample)

$$PM_{10} = \frac{(w_p + w_f) - (w_i + w_j)}{v} \times 10^6$$

Where,
w_p = Weight of material that was collected on the pan including the weighing paper in gm.
w_j = Initial weight of weighing paper in gm.
w_f = weight of exposed filter in gm.
w_i = Total weight of filter in gm.

Determination of Sulphur dioxide in air
For determination of SO_2 in air sample modified west and crake method had been used. The amount of sulphur dioxide per ml. in the standard solution is calculated as follows.

$$C = \frac{(V_1 - V_2) \times N \times K}{V}$$

Where,
C = Concentration of SO_2 in μg / ml
V_1 = Volume of thiosulphate for blank solution.
V_2 = Volume of thiosuphate for sample
N = Normality of thiosulphate solution
K = 32,000 (millie equivalent weight SO_2 / μg)
V = Volume of standard sulphite solution
The concentration of SO_2 in μg /m^3 in the sample is calculated as follows

$$C\ (SO_2\ \mu g/m^3) = \frac{(A - A_0 \times 10^3 \times B)}{V}$$

Where,
A = Sample absorbance
A_0 = Reagent blank absorbance
10^3 = Conversion litres to cubic meters
B = Calibration factor
μ_g = Absorbance
V = Volume of air sample in litres

MONITORING SITES

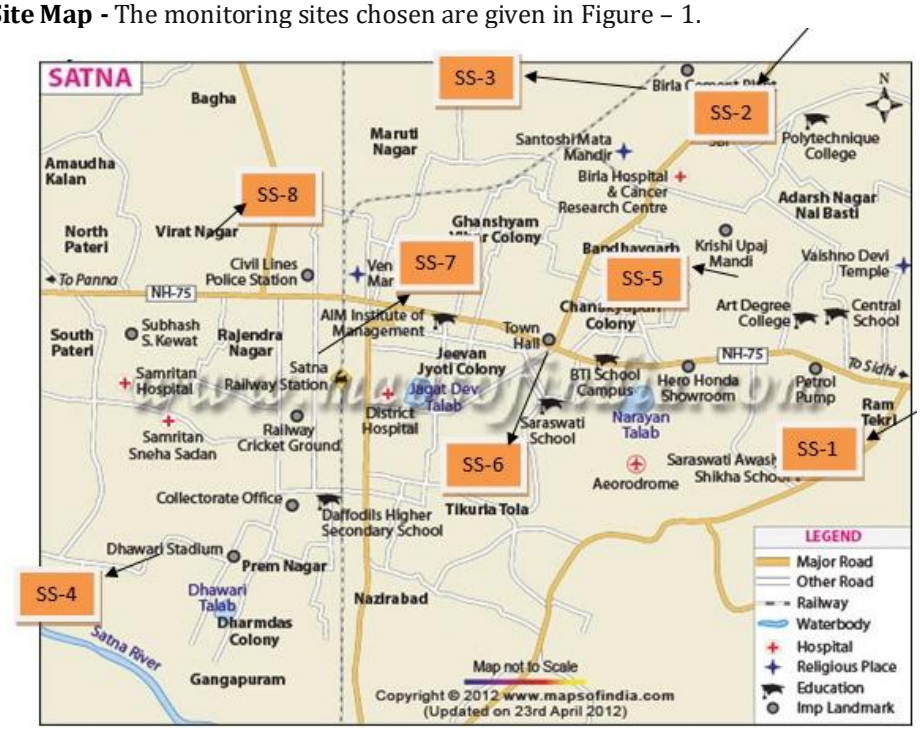
The main concern of the project is to measure the concentration of sulphur dioxide NOx, TSP and PM, taking greadings at different station with the help of respirable dust sampler. The two gaseous pollutants and the particulate pollutants are in abundance in Satna. Since Satna is an industrial and mineral such place. A little change in concentration of in ambient air can make a strong effect on existing living stock causing many adverse effects on health and skin. We decided to choose the sampling stations covering whole Satna city.

Chosen monitoring stations are -

1. Near Prism cement Satna
2. Near J. P. Birla Babupur plant Satna
3. Near Birla Carporation Satna
4. Dhawari Satna (Residential area)
5. Light machinery Satna
6. Semariya Chowk Satna (Dense traffic area)
7. Pannilal Chowk Satna
8. Civil line Chowk Satna

The sampling was done at the roof tops of the respective sites, so it was well above the prescribed height i.e. 1.5 m and was free from any obstruction to flow of air.

Monitoring Site Map - The monitoring sites chosen are given in Figure – 1.



OBSERVATION

The determination and calculation of pollutants in air samples of different monitoring stations was done. The observed data is tabulated as follows:

Table 1 - **Pollutant Results**

S N	Name & Sampling Station	SPM (µg/m³)			RSPM (µg/m³)			SO_2 (µg/m³)			NOx (µg/m³)		
		W	S	R	W	S	R	W	S	R	W	S	R
1	Near Prism Cement Satna	316.4	317.1	313.8	193	206.7	199.1	94.5	87.3	85.5	89.2	85.3	78
2	Near J.P. Birla Babupur plant Satna	281.1	295.1	284.5	182.8	185.1	177.8	82.4	79.3	78	78.4	72.6	68
3	Near Birla Carporation	302.2	325.2	300.4	198.2	204.4	180.4	99.1	89.6	87.2	92.5	86.1	81
4	Dhawari Satna (Residential area)	115.4	112.8	112.3	93.8	90.3	85.2	37.6	31.1	27.4	24.2	18.3	22

5	Light machinery Satna	198.4	169.7	150.5	141.1	121.8	113.3	70.5	64.6	59.6	59.5	54.4	48.3
6	Semariya Chowk Satna (Dense traffic area)	194.3	207	191.1	130.5	144.3	122.2	31.6	27.6	28.5	26.3	22.4	20.6
7	Pannilal Chowk Satna	82.8	84.5	88.7	71.1	78.2	68.7	29.2	26.4	24.1	22.2	18.3	17.6
8	Civil line Chowk Satna	90.6	93.8	90.8	75.6	83.6	71.2	26.6	24.5	22.1	22.3	18.5	17.3

Table 2 - **Air quality category based on Air Quality Index.**

S N	Sampling Sites	SPM ($\mu g/m^3$)	RSPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_X ($\mu g/m^3$)	AQI	Description of Ambient Air Quality
1	Near Prism Cement Satna	315.7	196.6	89.1	57.5	89	Polluted
2	Near J.P. Birla Babupur plant Satna	286.9	181.9	79.9	73.0	85	Polluted
3	Near Birla Carporation	309.2	194.3	91.9	86.5	94	Polluted
4	Dhawari Satna (Residential area)	113.5	89.7	32.0	21.4	59	Moderately Polluted
5	Light machinery Satna	172.8	125.4	64.9	54.0	99	Polluted
6	Semariya Chowk Satna (Dense traffic area)	197.4	132.3	29.2	23.1	84	Polluted
7	Pannilal Chowk Satna	85.3	72.6	26.5	19.3	47	Fairly Clean
8	Civil line Chowk Satna	91.7	76.8	24.4	19.3	47	Fairly Clean

Table 3 - **Occupational health diseases among the people of Industrial colony Satna due to air pollution.**

S.N.	Disease	Number of people affected						Total
		Male`			Female			
		Child	Adult	Old	Child	Adult	Old	
1	Respiratory diseases	35	42	54	36	44	32	242
2	Headache	22	49	32	19	38	27	187
3	Skin diseases	24	26	30	18	30	32	160
4	Eye irritation	19	31	32	17	36	28	163
5	Heart & BP Problems	12	18	24	08	20	23	105
6	Other disease	24	30	34	16	27	34	165

RESULTS AND DISCUSSION

The table reveals the prevalence of high concentration of coarser particulate matter (RSPM) in the ambient air in commercial areas ranging from 182.4 - 198.2 $\mu g/m^3$ during the winters, followed by rainy reason (177.9 -199.1 $\mu g/m^3$) and summer (185.1 - 206.7 $\mu g/m^3$) The main environmental issue associated with cement plants is the emission of pollutants. (SPM, SO_2 and NOx) in the atmosphere these air pollutants have long been associated with prevalence of various diseases inhuman beings. Results revealed higher concentration of SPM in the ambient air the monitoring sites, than permissible limit of 200 $\mu g/m^3$ prescribed by central pollution control board New Delhi. Contrarily in the ambient air SO_2 and NOx concentrations have been estimated below the permissible limit of 80 $\mu g/m^3$ described by CPCB New Delhi. Result indicated, maximum peoples of all selected sites are suffering with respiratory and cardio vascular

diseases than other problems. In Satna region the levels of air pollutants (SO_2, NOx, SPM, RSPM) the values of all these pollutants are observed to be little higher than national ambient air quality standards except Pannilal Chowk and Civil line Chowk. Blooming of cement factories has resulted in the environmental deterioration and in turn degrades the human health status. This increase in AQI at some sites is probably due to the emissions of cement plants and vehicular emissions due to increased transportations and traffics.

CONCLUSION

From the study it can be concluded that overall management and control of air pollution and management is not satisfactory. Air quality data and health problems shows that poor health condition is associated with the low quality of air. In Satna the air quality is giving holistic view of air pollution levels. From obtained results of present study, it is evident that for the time being the ambient air in Satna city needs attention for the policy makers to formulate some ways to counteract the increase in air pollution at specific sites. The human populations of all selected sites were surveyed for prevalence of various diseases such as respiratory diseases, headache, skin diseases, blood pressure, eye diseases and other diseases. Result indicated, maximum peoples of all selected sites are suffering with respiratory and cardio vascular diseases than other problems.

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