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STUDIES ON AIR QUALITY OF SATNA INDUSTRIAL AREA (M.P.)

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ABSTRACT: This paper presents ambient air quality status of industrial area of Satna city (M.P.). The Air quality was assessed based on New National Ambient Air Quality Standards. The outcome of the study has been presented in the form of Air Quality Index. The ambient air quality survey was carried out in 2015 and 2016. Sampling time was 24 hrs. at three different locations with respect to SO2 , NOx, PM10 and PM2.5. PM10 and PM2.5 was always found beyond the permissible limit at all the sampling site. The relative AQI was found in severe air pollution range. Significant positive correlation was found for all the parameter during study period.

Keywords: Satna Industrial Area, pollutants, particulate matter, AQI, relative.

INTRODUCTION

Environment means all the surrounding conditions, which influence the growth and development of life. The environment is composed of gases and substances, which exist in a certain proportion. When for any reason, one of the constitutions increases or decreases the balance of the whole atmosphere is disturbed. This imbalance of the constituents is called pollution of the environment. Pollution is the introduction of contaminants into an environment that causes instability, disorder, harm or discomfort to the ecosystem i.e. physical systems or living organisms. Pollution can take the form of chemical substances, or energy, such as noise, heat or light energy. Pollutants, the elements of pollution, can be foreign substances or energies, or naturally occurring; when naturally occurring, they are considered contaminants when they exceed natural levels. Pollution is often classed as point source or non-point source pollution. The pollution is chiefly two types - Air and water pollutions.

Today we breathe in the industrials pollution every moment. On the other hand we add that in one way and the other. We have slums cropping up like mescal in tops side by side the sooty chimneys and take pride in our industrial progress. Pollution means of the addition of any foreign material (Inorganic, biological, or radiological) or any physical change in the natural water, which may harmfully affecting the living life (human, agricultural or biological) directly or indirectly. After some times or very long times.

According to general thinking of people "pollution means the introduction in to natural water of anything that to them appears to be foreign. The addition of something to water which changes its natural quality.

The environmental pollution is the unfavorable alternation of our surrounding. Wholly are largely as a byproduct of mains action. Through direct or indirect effect of changes in energy patterns. Radiation levels chemical and physical constitution and abundance of organisms.

The rapid industrialization leading to urbanization, unplanned and excessive exploitation of natural resources have been causing pollution problems in cities and towns of developing countries. Manmade and natural sources of emissions have polluted the air with toxic substances. The national average per capita SOx emission was 4.2 kg per person in 1990, which rose to 5 kg in 1995, an increase of almost 20% in 5 yr. In 1990, coal consumption contributed 64% of total SOx emissions in India, oil products 29%, biomass 4.5% and non-energy consumption 2.5% (Garget,al,2001) . Total SOx and NOx emission from India were 3542 and 2636 respectively (1990) and 4638 and 3462(1995) growing at annual rate of around 5.5%. The sectoral composition of SO_2 emissions indicates a predominance of electric power generation sector [46%]. Power and transport sector emissions equally dominate NOx emissions contributing nearly 30% each (Garg et, al, 2001). A recent study in middle-income homes of Delhi found PM10 levels to be as high as 170–810 μg/m3 even in homes where there was no cooking or smoking activity (Kumar, 2001).

A report showed that SPM concentrations in Shanghai, New Delhi, Mumbai, Guangzhou, Chongquin, Calcutta,

Beijing and Bangkok exceeded WHO limits (90 µg/m3) by three, five, three, three, four, four, four and two times respectively. It also showed that PM10 exceeded the USEPA limit (50µg/m3) by several times in a number of cities, most notably by over four times in New Delhi and Calcutta. Data from Tokyo shows that TSP increased rapidly from 40 µg/m3 in the early 1980 to over 70 µg/m3 in the early 1990; after that TSP has been decreasing or stagnating, but it is becoming an increasing challenge to contain TSP and NOX. (Saksena et al, 2003).

A study for assessment and management of air quality was carried out in the Ib Valley area of the Ib Valley coalfield in Orissa state, India. The 24 h average concentrations of total suspended particulate (TSP), respirable particulate matter (PM10), sulfur dioxide (SO_2) and oxides of Nitrogen (NOx) were determined at regular intervals throughout one year at twelve monitoring stations in residential areas and six monitoring stations in mining/industrial areas. The 24 h average TSP and PM10 concentrations were124.6-390.3 µg/m3 and 25.9–119.9 µg/m3 in residential areas, and were 146.3–845.2 µg/m3 and 45.5–290.5 µg/m3 in industrial areas. During the study period, 24 h and annual average TSP and PM10 concentrations exceeded the respective standards set in the Indian national ambient air quality standard (NAAQS) protocol as well as USEPA, EU, WHO and World Bank standards at most of the residential and industrial areas. However, concentrations of SO_2 (annual average: 24.6–36.1 µg/m3 and 24 h, average: 17.0–46.3 µg/m3) and NOx (annual average: 23.6– 40.9 µg/m3 and 24 h average: 18.3–53.6 µg/m3) were well within the prescribed limit of the NAAQS and international standards in both residential and industrial areas (Chaulaya, 2004).

Monitoring of ambient respirable suspended particulate matter or PM10 and total suspended particulate (TSP) levels around a large coal-fired power station in India was carried out. Geometric mean values of PM10 and TSP concentrations at sites of downwind direction are found in ranges of 74–144 µg/m3 (PM10) and 459–647 µg/m3 (TSP) in post rainy season,154–207 µg/m3 (RSPM) and 437–610 µg/m3 (SPM) in summer season and 180–275 µg/m3 (PM10) and 933–1578 µg/m3 (TSP) in winter season (Sharma et. al, 2005).

The rural-industrial site at Satna shows significant different from urban, urban-industrial, rural, rural-remote and rural–urban influenced sites. With a minimum of one daily sample at each site, mean PM10 concentration at the rural-industrial Satna site varied from 65.5 to147.5 µg/m3, and from 205.0 to 320.3µg/m3 at the urban-industrial Delhi site. With a minimum of one daily sample at each site, the mean TSP concentration at the rural-industrial Satna site varies from 283.9 to 678.0 µg/m3, while at the urban industrial Delhi site mean TSP concentration varies from 553.4 to 827.6 µg/m3. The maximum TSP concentration in Satna, 678.0 µg/m3, was on December 9, 2000. Maximum TSP concentration in Delhi, 827.6 µg/m3, occurred on October 23, 2000. Levels of TSP in Ashok Vihar, a residential area in Delhi, reached 10 times the permissible limit in October 2000 (Kaushik et,al, 2007).

STUDY AREA -

Satna is located 24.34N 80.55E with an evaluation of 315meters in central India and a municipal corporation in Satna district in the Indian state of Madhya Pradesh. Satna is a border city of the state and is touched by the border of state of Uttar Pradesh. Satna district has Uttar Pradesh on the north. Rewa on the east Shahdol on the southwest. Umariya and Katni on the south & Panna on the west. The District is part of Rewa Division, the Satna District is divided into the Tehsil of Amarpatan, Maihar, Nagod and Raguraj Nagar. Satna town is situated in Raghuraj Nagar Tehsil, the place in renown for dolomite mines & limestone.

Satna is in the limestone belt of India. It contributes around 8-9 % of India Total cement production. There is Abundance of dolomite and limestone in the area, the city has seven cement factories that are producing cement and exporting the same other part of the country. The electrical cable factory “Universal Cables” in Satna is among the pioneers in the country. The city of Satna is known as commercial capital of Baghelkhand. The city is amongst few most promising cities of Madhya Pradesh because of several new industries as- Iron industries, plywood factory, Detergent factory, Stone crusher, medical hospital, transport auto workshop electrical motor & submersible manufacturing diesel rail engine workshop heavy motor workshop & other new planned by some of the reputed industrial houses in the country. Present major problem faced in city may Inter alia include electricity, water pollution, air pollution due to atmospheric wastes of cement factories. Satna is known as cement city in India. Due abundance of lime stone and dolomite in the region.

The study area is surrounded by Cement factories. Due to these industries the study area is under immense Environmental stress.

MATERIAL AND METHOD:

The present work is aimed to assess the Environmental status of the Satna industrial area. The study is focused only on two parameters – Air quality monitoring and water quality monitoring parameters. Based on both

parameters, well versed methodology is made separately for each parameter. Standard methods of air analysis prescribed by CPCB.

RESULTS & DISCUSSION:

In order access air quality of Satna Industrial area ambient air monitoring have been done. For this purpose air pollutant RSPM, SOx, NOx & CO in ambient air of study area has been analysed.

To assess the air pollution in Satna Industrial area various sampling site for ambient air analysis were selected . The different sampling stations are given below –

1. Santoshi Mata Mandir (A1) : App. 3 Km. Distance from Semariya Chowk.
2. Sagmaniha (A2) : App. 3.5 Km. Distance from Semariya Chowk.
3. Gaharwar petrol Pump (A3) : App. 4 Km. Distance from Semariya Chowk.
4. Biruhali Railway Station (A4) : App. 6 Km. Distance from Semariya Chowk.
5. Raj Stone Crusher (A5) App. 7 Km. Distance from Semariya Chowk.
6. Semariya Gate (A6) App. 8 Km. Distance from Semariya Chowk.

Air quality of Satna Industrial area was monitored for two successive years i.e. 2015-2016 at various sites for RSPM, SOx NOX & CO .

The various results are given in Tables. These parameters are regularly monitored in each season in every year.

At Santoshi Mandir site RSPM was found to be above the Permissible limit in almost every season in the year 2015 except in monsoon in 2016 when its value was recorded 115 µg/m3. Its range was from 115 µg/m3 to 140µg/m3 (2015) and 135 µg/m3 to 143 µg/m3 (2016), Sulphur dioxide and oxides of nitrogen were found to be within permissible limit. The concentration of SOx was found to be in between 13 µg/m3 to 20.4µg/m3 (2015) & 16 µg/m3 to 16.7 µg/m3 (2016) ,Similarly Nox was observed in the range between 21.6 µg/m3 to 24.6 µg/m3 (2015) &. 21.5 µg/m3 to 24 µg/m3 (2016). The CO concentration falls within the ranges of 1 to 1.8 µg/m3 (2015) & 1 to 1.7 µg/m3 in 2016.

In 2015 Air quality at Sagmaniha which is situated about 3.5 Km. from Semariya Chowk was found to be within the Permissible limit except RSPM value. At this site RSPM was assessed in the range of 129 µg/m3 to 132 µg/m3 and Value of SOx was observed in between 14.2µg/m3 to 20.6 µg/m3, while NOx was range between 23.3 µg/m3 to 27 µg/m3.The concentration of CO was recorded in the range of 1.1 to1.9 µg/m3.

While in 2016 at this site RSPM was assessed in the range of 132 µg/m3 to 140 µg/m3 and Value of Sox was recorded from 15.8 µg/m3 to 25 µg/m3. Nox was observed in between 21 µg/m3 to 24.5µg/m3 while CO was in the range between 1 µg/m3 to 1.8 µg/m3.

During the pollution assessment of Sagmaniha monitoring station. It indicates the higher trend of Respirable suspended Particulate matter dispersion into surrounding environment especially in 2016 in respect to 2015 year because of heavy transportation in nearby area

Table – 1 Different site in air sample year 2015

Sample Site		So_x			No_x			CO			RSPM		
	Unit	W	S	M	W	S	M	W	S	M	W	S	M
A-I	**µg/m^3**	15	13	20.4	21.6	23.9	24.6	1.8	1	1.6	140	120	115
A-II		14.2	14.0	20.6	23.3	24.7	27	1.10	1.4	1.9	132	130	129
A-III		15.5	13.5	20.2	20.1	23	23.9	1.9	1.4	1.5	142	134	121
A-IV		14.5	13.5	20.1	24.6	24.7	20.9	1.1	1.10	2	140	125	120
A-V		16.5	15	20	25.9	24.3	25.6	1.10	1.8	1.8	119	121	120
A-VI		**16.0**	**14.5**	**19.5**	**20.1**	**23**	**26.6**	**1.15**	**1.6**	**1.10**	**149**	**135**	**125**

W= Winter S= Summer = Mansoon

Table – 2 Different site in air sample year 2016

Sample Site	So_x			No_x			CO			RSPM		
	W	S	M	W	S	M	W	S	M	W	S	M
A-I	16.7	16.2	16	24.2	21.5	21.7	1.10	1.7	1	143	141	135
A-II	25	15.8	15.9	24.5	22.7	21	1.8	1	1.7	140	138	132
A-III	18	17.7	17	24.4	21	21.10	1.7	1.4	1	139	136	132
A-IV	17.5	17	16.9	29.7	19	19.9	1.2	0	1.2	141	140	136
A-V	17	16.3	16.9	20.7	20	20.1	1	0	1	136	130	128
A-VI	20.9	20	18.7	23	22.9	20.5	1.20	1.15	1.10	142	140	140

In 2015 at Gaharwar petrol pump which is situated at 4 Km distance from Semariya chowk, the RSPM was found to be higher than the permissible limit. The concentration range of RSPM was from 121 µg/m3 to 142 µg/m3 and at this site Sox was assessed in the range of 94.36 µg/m3 to 156.42 µg/m3. The concentration of SOx and NOx was found in the range of 13.5 µg/m3 to 20.2 µg/m3 and 20.1µg/m3 to 23.9 µg/m3.

While in 2016 the RSPM was found to be higher than permissible limit at bamboo gate. The concentration range of R.S.P.M was from 135 µg/m3 to 143 µg/m3 and at this site Sox was assessed in the range of 16 µg/m3 to 16.7 µg/m3. The concentration of Nox & CO was found in the range of 21.7 µg/m3 to 24.2 µg/m3 and 1 µg/m3 to 1.7 µg/m3.

The RSPM value at winter season in 2015 & 2016 was recorded maximum i.e. 142 &143 respectively. At the same season both values are higher than the permissible limit. It can be due to weather condition and Vehicular activities at the site.

In 2015 The concentration of RSPM at Biruhali Railway Station (6 Km.) was found to be in the range 120 µg/m3 to 140µg/m3 ,which is above the permissible limit as prescribed by CPCB. The range of Sox was found to be in between 13.5 µg/m3 to 20.1 µg/m3, while the range of Nox was in between 20.9 µg/m3 to 24.7 µg/m3. The value of CO was 1.1 to 2 µg/m3 .So values of all these parameters fall within the permissible limit as prescribed by Central Pollution Control Board & M.P.P.C.B.

While in 2016 The value of R.S.P.M was in the range of 136 µg/m3 to 141 µg/m3. The range of Sox was found to be in between 16.9 µg/m3 to 17.5 µg/m3,While the range of Nox was in between 19 µg/m3 to 29.7 µg/m3 while the value of CO ranges from 0 to 1.2 µg/m3.So values of all these parameters except RSPM fall within the permissible limit as prescribed by Central Pollution Control Board & M.P.P.C.B.

Dispersion of air pollutant is depend on wind speed, wind direction and location of monitoring stations, The monitoring station selected for the present study, is also located at North direction. which is most of the time, wind direction facing point therefore in 2016 results are comparatively higher than 2015 study i.e. RSPM values due to unlocalized distribution of air born dust, where as Sox, Nox parameter are not effected on the monitoring studies.

At Raj stone crusher site RSPM was found to be above the Permissible limit in almost every season in the year 2015 and 2016 except in winter in 2015 when its value was recorded 119µg/m3. Its range was from 119 µg/m3 to 121µg/m3 (2015) and 128 µg/m3 to 136 µg/m3 (2016), Sulphur dioxide and oxides of nitrogen were found to be within permissible limit. The concentration of SOx was found to be in between 15 µg/m3 to 20 µg/m3 (2015) & 16.3 µg/m3 to 17 µg/m3 (2016) ,Similarly Nox was observed in the range between 20.9 µg/m3 to 24.7 µg/m3 (2015) &. 20 µg/m3 to 20.7 µg/m3 (2016). The value of CO was 1.1 to 1.8 µg/m3 (2015) & 0 to 1 µg/m3 in 2016.

In 2015 The concentration of RSPM at Semariya Gate (8 Km. from semariya chowk) was found to be in the range 125 µg/m3 to 149µg/m3 ,which is above the permissible limit as prescribed by CPCB. The range of Sox was found to be in between 16.0 µg/m3 to 19.5 µg/m3, while the range of Nox was in between 20.1 µg/m3 to 26.6 µg/m3. The value of CO was 1.1 to 1.6 µg/m3 .So values

of all these parameters fall within the permissible limit as prescribed by Central Pollution Control Board & M.P.P.C.B.

While in 2016 The value of R.S.P.M was in the range of 140 µg/m3 to 142 µg/m3. The range of Sox was found to be in between 18.7 µg/m3 to 20.9 µg/m3,While the range of Nox was in between 20.5 µg/m3 to 23 µg/m3 .The value of CO ranges from 1.1 to 1.2 µg/m3.So values of all these parameters except RSPM fall within the permissible limit as prescribed by Central Pollution Control Board & M.P.P.C.B.

CONCLUSION:

Air pollution and air quality was measured at Satna city industrial area indicates that PM10 and PM2.5 always found beyond the permissible limit but SO2 and NOx were always below the permissible limit at all the sampling site in both the months. The relative AQI was found in severe air pollution range. It may cause serious aggravation of heart or lung disease, it is indication of increased risk of cardio respiratory symptoms in general population.

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