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Study of Ambient Air Quality of Jalna (MS), India

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Abstract

In the present research work, the ambient air quality of Jalna City, India has been investigated by using air quality index (AQI). The paper examines the significance differences in monthly variation of air pollutants concentrations at S. P. Office residential area of Jalna, Maharashtra over a two year period are presented. Keeping in the need of monitoring of air pollution study was carried out particularly in the residential area. The study reveals that, the problem of air pollution (SO_2, NOx, RSPM and SPM) is not so much serious at Jalna city. It may be because of strict government policy, efficient treatment plants, proper wastage disposal system etc. The biannual mean concentrations of all four pollutants measured at residential site were found within the permissible limits of Indian National Ambient Air Quality Standards (NAAQS).

Key words: Ambient air quality, Air pollution, Gaseous pollutants, Particulate pollutants.

Introduction

Environment pollution is the most serious problem, that world facing today. Nature gets affected by globalization, human or nature activities. Various coworkers[22,28](Mazahar *et.al.* 2002; Megha *et.al.*, 2015) reported the large numbers of research articles on monitoring of water qualities and status of water pollution but very limited work is done on ambient air quality. This may be due to specific apparently samples and procedures required for air quality determination. The determination of air quality particularly in metro cities evidenced and intensified day by day. In Delhi and Mumbai special measures have been taken to tackle with the air pollution posed particularly due to heavy vehicular traffic, Lack of sufficient public facilities and industrialization of other sources of air pollutants. Sulpher dioxide, oxides of nitrogen are found to be the main potential pollutants, identified by environmental protection agency (EPA). The concentration of gaseous and particulate pollutants varies from place to place and time to time. Concentration of pollutants depends on several factors like type of pollution sources, strength and distributionof pollution sources, metrological and topographical conditions of areas etc.

Literature Review:

Due to the industrial emission, status of air pollution Manali industrial area, near Chennai, shows high risk[26] (S.Tayalakhsmi, 2014). Monitoring for air

quality is critical phenomenon, one which requires a pollutant-specific systematic approach. Without an approach based on stated objectives and guidelines, proper ambient air quality assessment cannot be accomplished. Failure to recognize the complexities associated with ambient air quality has led to the present situation, the inability to document the relationship between sources and exposure or between exposure and effect[13].

In developed countries generally Peoples are spend 90% of their time indoors with vulnerable individuals (the elderly young children, and people with compromised health) spending on even larger proportion of their time indoors. It has been estimated that approximately 60% of this time is spent in the home[27]

In contribution to our earlier work[1], we in this paper made an attempt to investigate monthly trend in ambient air quality of selected monitoring sites(S. P. office) of Jalna city of Maharashtra, India.

Research Methodology/ Experimental Procedure:

Study Area: Jalna district is approximately situated at the centre part of Maharashtra state and in northern direction of Marathwada region in India. The Jalna district lies between 19°1' to 21°3' North Latitudes and 75°4' to 76°4' East Longitude. It covers an area of 7,612 Km2, which is 2.47% of total area of Maharashtra State in India. The district has a sub-Tropical climate, in which the bulk of rainfall is received from the southwest monsoon, between June to September. The average annual rainfall of the district ranges between 650 to 750 mm. The district often experiences drought with rainfall recording as low as 400 to 450 mm. The rainy season is followed by winter, which last up to February, during which the minimum temperature ranges between 9 to 10°C and maximum temperature ranges 30-31°C. The winter is followed by hot summer, which continues up to June. The maximum day temperature ranges between 42 & 43°C during summer[9,11].

Jalna is having good Industrial background, especially famous for the Seed and Steel industries. The industrial development at Jalna is widely based on Engineering, Plastic and Agriculture. At present six industrial areas are under Maharashtra Industrial Development Corporation (MIDC), Jalna accommodating Pulses mills, oil mills, refineries, steel re-rolling, plastic, tiles & cement pipe, fertilizers, insecticides, pesticides and the co-operative sugar factories. These industries and growing number of the automobiles are the major sources of air pollution in the city[14,29].

Sample Collection and Analysis Particulate Pollutants (RSPM and SPM): The samples of RSPM, SPM, SO_2 and NOx were collected twice in a week from January – December, 2013-14 in selected industrial and residential site. High Volume air sampler (Model: RDS APM 460 NL with Gaseous sampling attachment APM 411 TE, Make: Envirotech India Pvt. Ltd) was used to collect the samples by running the equipment for a period of 24 hours. The samples for particulate pollutants *i.e*. RSPM and SPM were collected by drawing the air at a flow rate of 1.1 to 1.2 m3 per minute for eight hours. The air inside the sampler passed through a combination of cyclone separator and filter in two stages. At the first stage, the cyclone separator was used to collect the bigger particles *i.e.* non respirable particulate matter (NRSPM) (particles size >10µm) in a previously weighed dust collector. The rest of the particulates i.e. RSPM (size <10µm) were collected over a previously dried and weighed glass micro fibre filters (Whatman GF/A, 203 X 254 mm). The concentration of RSPM and SPM were calculated gravimetrically as per standard methods[8].

Gaseous Pollutants (SO_2 and NOx): The ambient air samples for sulphur dioxide were collected by absorbing SO_2 from known volume of air in (TCM). A stable dichlorosulphitomercurate complex formed was then made to react with pararosaniline and methyl sulphonic acid. The absorbance of the colored solution was measured at 530 nm using spectrophotometer. The concentration of sulphate ions formed in absorbent was calculated according to Modified West &Gaeke Method. (IS 5182(Part 2): 2001;[8]).

Ambient nitrogen dioxides were collected by bubbling known volume of air through a solution of sodium hydroxide and sodium arsenite. The concentration of nitrite ion produced during sampling were determined calorimetrically by reacting the nitrite ion with phosphoric acid, sulphanilamide and N-(1-naphthyl)-ethylenediamine di-hydrochloride (NEDA) and measuring the absorbance of the highly coloured azo-dye[18] at 540 nm (Jacob and Hochheiser, 1958; IS 5182 (Part 6):2006; CPCB, 2011).

Result and Discussion

The maximum permissible limit of Gaseous pollutant and particulate matter (Chavanet.al., 2010) is given in Table 1.

Table 1. National Ambient for Quality Standards

Sr. No	Pollutant	Time weighted average	Concentration in ambient air	
			Industrial, Residential, Rural and Other area	Ecological sensitive area (notified central government)
1.	Sulphur Dioxide (SO_2) (µg/m^3)	AA24 Hrs	50 mg/$m^2$80 mg/m^2	20 mg/$m^2$80 mg/m^2
2.	Oxides of Nitrogen (µg/m^3)	AA24 Hrs	40 mg/$m^2$80mg/m^2	30 mg/$m^2$80mg/m^2
3.	Suspended particulate matter (µg/m^3)	AA24 Hrs	60 mg/$m^2$100 mg/m^2	60 mg/$m^2$100 mg/m^2

Gaseous Pollutants: Due to improper decomposition of vegetable waste oxides of nitrogen may be one of the cause. It is established fact that the source of sulphate and phosphate in water is n the domestic waste containing detergents and soap hence they may get decomposed in waterand may released oxides of sulphates though it very slow process but the content of other pollutants may accelerate it hence this possibility cannot be ruled out. The other sources of NO_X and SOx may be due to small scale industries located within the residential area which includes hotel industries, food processing industries and waste from the gold-smith shops. The monthly mean concentrations of SO_2 and NOx monitored at residential area (S.P. Office) has been presented in Table 2.

Sulphur dioxide (SO_2): The monthly mean concentration of SO_2 at residential area (S. P. Office) at Jalna was varied between 7.58-12.38 µg/m3 (Table 2). The highest max.concentration of SO_2 (12.38 µg/ m3) at residential area (S.P. Office) was recorded in the month of January 2014 whereas the lowest max. concentration of SO2 (7.58 µg/m3) was observed in the month of October 2014. The biannual mean max. concentration of SO_2 at residential area (S.P. Office) was recorded 10.55 µg/m3 which is well below the National Ambient Air Quality Standards (NAAQS) stipulated by Central Pollution Control Board[7]. Automobiles and industries are the major contributors of sulphur dioxide (SO_2) and oxides of nitrogen (NOx) to ambient air[2,25]. The diurnal and seasonal concentration pattern of air pollutants is driven by emission characteristics of the dominant sources and the meteorological conditions[12]. Similar results were reported by [3,6,20,25].

Oxides of Nitrogen (NOx): The monthly mean max. concentrations of oxides of nitrogen (NOx) at residential area (S.P. Office) at Jalna were varied from 27.19 - 37.03 µg/m3 (Table 2). The highest monthly mean max.concentration was reported inDecember 2014 (37.03 µg/m3). The biannual mean max. concentration of NOx at residential area (S.P. Office) was recorded 30.38 µg/m3 which was found below the NAAQS[7].

Kerosene combustion produce more NOx than the other traditional fuels[26] (Rajajoseph *et.al.*, 2014). The majority of the NOx (NO2 + NO) emitted to the atmosphere comes from fossil fuel combustion sources of NOx include gasoline and diesel vehicles. The industrial power sources include power plants, industrial boilers and municipal incineration and home heating[10]. The contribution of this pollutant from using kerosene as fuel is also high because of domestic use as well as illegal use of kerosene in the vehicles particularly in auto-rickshaws.

Particulate Pollutants: The monthly mean concentrations of RSPM and SPM monitored at residential site (S. P. Office) at Jalna has been presented Table 2.

Table 2: Monthly mean concentrations of SO_2, NOx, RSPM and SPM Residential site [S. P. Office, Jalna] (µg/m^3)

Month	N	SO_2			NOx			RSPM			SPM			
		A M	S.D	Max	A M	S.D	Max	G M	S.D	Max	A M	G M	S.D	Max
Jan – 2013	9	11.36	0.6	12.23	31.85	0.72	33.03	128.5	35.96	189.500	316.44	314.27	37.81	362.00
Feb – 2013	8	10.85	0.83	12.26	30.75	0.98	32.01	119.26	65.13	253.00	284.09	273.39	83.88	400.00
Mar – 2013	9	10.78	0.58	11.58	31.16	1.22	32.34	94.97	26.97	151.00	266.67	262.66	48.13	318.00
Apr – 2013	8	9.71	0.77	11.01	29.88	0.76	31.08	111.31	17.57	134.00	323.00	321.59	31.78	362.00
May – 2013	10	9.48	0.86	11.30	29.43	0.80	30.33	105.06	15.17	127.00	352.7	350.25	43.67	418.00
Jun – 2013	6	8.62	0.5	9.35	29.59	1.03	30.04	76.41	16.59	104.00	228.33	223.95	49.62	304.00
Jul – 2013	8	10.84	0.85	12.27	30.76	0.97	32.03	119.27	65.16	253.00	284.2	273.39	83.86	400.00
Aug – 2013	7	10.35	0.5	11.14	30.81	0.91	31.65	89.83	28.28	115.00	273.14	269.47	51.33	378.00
Sep – 2013	8	10.63	0.51	11.43	31.01	0.66	32.02	82.29	28.24	140.00	249.75	246.43	43.98	318.00
Oct – 2013	9	8.36	0.58	9.23	28.78	0.82	30.53	69.81	22.06	122.00	190.11	182.83	59.37	319.00
Nov – 2013	9	9.29	0.77	10.30	29.60	0.71	30.54	99.44	43.79	188.00	262.89	255.79	65.35	376.00
Dec – 2013	8	10.78	0.9	12.03	30.77	0.94	32.44	104.71	32.24	145.00	310.91	325.27	61.11	375.00
Jan – 2014	10	10.99	0.91	12.38	30.81	0.89	32.29	111.63	33.21	201.00	269.6	266.8	43.91	378.00
Feb – 2014	8	8.70	0.80	10.29	31.87	1.31	33.62	106.83	16.23	122.00	239.00	237.00	29.08	271.00
Mar – 2014	8	8.89	2.23	11.21	30.08	2.18	32.91	109.14	19.49	132.00	244.00	252.14	33.47	295.00
Apr – 2014	8	9.72	0.78	11.02	29.89	0.79	31.09	111.32	17.56	134.00	323.2	321.60	31.79	362.00
May – 2014	10	9.49	0.85	11.32	29.45	0.83	30.36	105.04	15.16	127.00	352.6	350.26	43.66	416.00
Jun – 2014	8	8.69	0.711	9.67	29.82	0.65	30.59	91.12	12.22	110.00	163.00	161.43	24.00	199.00
Jul – 2014	9	6.77	0.71	7.87	27.69	2.57	30.24	60.92	22.40	103.00	108.00	97.00	46.00	169.00
Aug – 2014	9	7.56	0.802	8.72	26.03	1.96	31.01	42.17	25.42	92.00	76.00	72.00	25.27	110.00
Sep – 2014	8	6.69	1.13	7.95	25.04	1.99	27.19	51.56	24.00	84.00	118.00	111.00	42.00	179.00
Oct – 2014	10	7.05	0.386	7.58	28.18	3.82	35.91	85.5	18.16	114.00	189.00	182.00	56.47	293.00
Nov – 2014	8	8.32	3.99	10.14	29.15	1.34	31.01	97.00	10.80	113.00	140.00	205.82	62.64	323.00
Dec – 2014	8	9.41	0.925	11.13	30.34	1.12	37.03	30.22	21.8	130.00	225.00	321.17	59.00	332.00

Respirable Suspended Particulate Matter (RSPM): The annual mean max. concentration of RSPM at residential site (S. P. Office) at Jalna was observed 140.97 µg/m3 which is above the maximum permissible limits of NAAQS, India (Table 2). The highest monthly mean max. Concentration 253.00 µg/m3 was recorded in the month of July 2013 while lowest reported during the month September 2014 with 84.00 µg/m3.

Suspended particulate matter (SPM): The monthly mean concentration of SPM was ranged between 110 - 418 µg/m3 and biannual mean max. Concentrations were recorded 319.12 µg/m3 at residential site (S. P. Office) at Jalna respectively (Table.2).

The major sources of particulate pollutants in ambient air are automobiles processes[15,30]. The pattern of RSPM and SPM concentration can be seen from the monthly as presented in (Table.2) at residential site (S. P. Office). Excessive use of personal vehicles may cause generation of particulate pollutants. The particulate matter in the environment is generally of two types as organic and Inorganic. Therefore for the present study organic particulate matter may have source in residential garbage waste whereas inorganic particulate matter may be due to small scale industries in residential area. Secondly the particulate matter may be due to high road transportation.

Conclusion

Analysis of ambient air i.e. Air quality index (AQI) of residential area (S.P.Office) of Jalna city (MS), India based on monthly and biannual concentration of SO_2, NOx, RSPM and SPM. The biannual mean concentration of gaseous pollutants and particulate matter were found within the permissible limits of Indian National Ambient Air Quality Standards (NAAQS).

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