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Assessment of Ambient Air Quality and Air Quality Index (AQI) in Dahej Area, Gujarat, India

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ABSTRACT

Clean air is a basic requirement of living organisms. But now-a-days, due to the unplanned growth, development and vehicular boom, the air has become polluted. Pollutants of major public health concern includes, particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide, which can pose a serious threat to human health. In the present study, prime air pollutants (PM_{10}, $PM_{2.5}$, SO_2 and NO_2) were estimated at seven stations of Dahej area. The projected value of PM_{10}, $PM_{2.5}$, SO_2 and NO_2 at all the 7 stations were ranging from 67.39 to 98.75, 29.57 to 45.79, 17.76 to 22.29 and 28.29 to 32.42 µg/m^3, respectively. PM_{10} level at all stations and $PM_{2.5}$ level at 3 stations find a little higher level than CPCB recommended limit while SO_2 and NO_2 levels were found under permissible limit. AQI values in the study area were calculated and they were in the range from 76.50 to 97.75, which are categorized as satisfactory level by CPCB.

INTRODUCTION

In addition to land and water, air is the prime resource for sustenance of life. For better human health and wellbeing of the humanity, clean air is one of the main basic requirements. Clean air becomes polluted by a variety of sources, out of them household combustion devices, motor vehicles, industrial facilities and forest fires are common sources of air pollution that change the composition of atmosphere and affect the biotic environment. The concentration of air pollutants depend not only on the quantities that are emitted from air pollution sources, but also on the ability of the atmosphere to either absorb or disperse these emissions.

The unplanned growth, development and vehicular boom have deteriorated the ambient air quality. Pollutants of major public health concern include, particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide, and these can pose a serious threat to human health if they exceed the permissible limit (WHO 2000, USEPA 2008). More than two million premature deaths per year can be attributed to the effects of urban (outdoor/indoor) air pollution that is mainly caused by burning of solid fuels (WHO 2005). More than half of the air pollution driven disease burden is borne by the population of developing countries (WHO 2005). The relationships between the occurrence of respiratory and cardiovascular diseases and cardiopulmonary mortality with exposure to air pollutants are well documented in the literature (Dockery et al. 1994, Koken et al. 2003).

The major source responsible for higher levels of SPM, RSPM, SO_2, NO_X and other organic and inorganic pollutants in the environment, was motor vehicle emission (Sharma et al. 2006, Barman et al. 2010) and 60 to 70% of the pollution found in the urban environment is also due to that (Panday et al. 1988, Singh et al. 1995).

The public health implications due to the emission of CO, O_3, SO_2, NO_2 and particulates are very well known (Yadav et al. 2012). Among air pollutants, particulate matter (PM) is a ubiquitous and it is especially a major problem due to its adverse health effects, visibility reduction and soiling of buildings (Horaginamani & Ravichandran 2010, Chaurasia et al. 2013).

The Central Pollution Control Board initiated the National Ambient Air Quality Monitoring (NAAQM) programme in the year 1984 with 7 stations at Agra and Anpara. Subsequently, in 1998-99 the programme was renamed as National Air Monitoring Programme (NAMP). The number of monitoring stations under NAMP had increased, steadily to 295 by 2000-01 covering 98 cities/ towns in 29 States and 3 Union Territories of the country. Under NAMP, four air pollutants viz., sulphur dioxide (SO_2), oxides of nitrogen as NO_2, particulate matter ($PM_{2.5}$) and respirable suspended particulate matter (RSPM/PM_{10}), have been identified for regular monitoring at all the locations.

Air pollution has emerged in the past few decades and pose a critical health problem to the mankind. So, that large number of studies in this regard have been undertaken in all over the world and also in India (Katsouyanni et al. 2001, Afroz et al. 2003, Yang et al. 2004, Samoli et al. 2005, Analitis et al. 2006, Kaushik et al. 2006, Barman et al. 2010, Yadav et al. 2012, Mukhopadhyay & Mukherjee 2013, Rai et al. 2013, Barman et al. 2015). The aim of the study is to assess the ambient air quality with respect to $PM_{10,}$ $PM_{2.5}$, SO_2 and NO_2 in Dahej area because it is a fast growing industrial area of District Bharuch, Gujarat.

MATERIALS AND METHODS

Study area: Dahej (21° 42' N and 72° 38 'E) is a cargo port situated on the south-west coast of Gujarat, India. It is about 45 km from Bharuch.

Study sites: The study sites were chosen after proper investigation, based on the basic site selection criteria and reduced interference of the local public with the devices used for the experiment. Seven monitoring stations were chosen in and around the Dahej area to measure the concentration of sulphur dioxide, nitrogen dioxide, $PM_{2.5}$ and PM_{10} in the surrounding environment. The monitoring stations were named as Station-1 (Project Site of Rallis India Ltd.), Station-2 (Jolwa village), Station-3 (Lakigam village), Station-4 (Rahiyad village), Station-5 (Jageshwar village), Station-6 (Suva village) and Station-7 (Ambetha village) with station code A 1, A 2, A 3, A 4, A 5, A 6 and A 7, respectively.

Ambient air quality monitoring: The sample was taken by the help of combo instrument for PM10 and PM2.5 with air flow rate of 2.3 m^3/hr and 1.0 m^3/hr respectively, while gaseous pollutant sampler instrument was used for sampling of sulphur dioxide and nitrogen dioxide with specific absorbing solution (sodium hydroxide and sodium arsenite for NO_2 and potassium tetrachloromercuate for SO_2). The analysis was carried out in the months of December, 2014 to February, 2015 with a frequency of once a week. The apparatus was kept at a height of 5 m from the surface of the ground. Once the sampling was over, the samples were brought to the laboratory and concentration of different pollutants was determined.

The concentration of gases SO_2 and NO2 were measured by modified West and Gaeke method and modified Jacob Hochheiser method respectively, while the particulate pollutants $PM_{2.5}$ and PM_{10} were measured by gravimetric method as per prescribed in the Guidelines for Manual Sampling and Analyses, Central Pollution Control Board (CPCB 2013, Jacob & Hochheiser 1958, West & Gaeke 1956).

The quality of air in the study area can be estimated from the air quality index. There are several methods and equations used for determining the AQI. However, here the below mentioned equation (Zlauddin & Siddiqui 2006, Joshi & Semwal 2011) has been used for computation of AQI value.

$$AQI = \frac{1}{4} \times (IPM_{10}/SPM_{10} + IPM_{2.5}/SPM_{2.5} + ISO_2/SSO_2 + INO_2/SNO_2) \times 100$$

Where, SPM_{10}, $SPM_{2.5}$, SSO_2 and SNO_2 represent the new ambient air quality standards as prescribed by the Central Pollution Control Board of India and IPM10, IPM2.5, ISO_2 and SNO_2 represent the actual values of pollutants obtained on sampling.

RESULTS AND DISCUSSION

The estimated value of air pollutants (PM_{10}, $PM_{2.5}$, SO_2 and NO_2) of seven stations is presented in Table 1. The projected value of PM_{10}, $PM_{2.5}$, SO_2 and NO_2 at all the 7 stations were in the range from 67.39 to 98.75, 29.57 to 45.79, 17.76 to 22.29 and 28.29 to 32.42 µg/m^3, respectively.

In the present study, values of PM_{10} ranged from 67.39 to 98.75 µg/m^3, which were higher than recommended limit (60 µg/m^3) for residential area as well as industrial area by CPCB at all the seven stations. The standard limit prescribed by Central Pollution Board of India for $PM_{2.5}$ for residential area and industrial area is 40 µg/m^3, but the study demonstrated a little higher levels in A1, A6 and A7 areas, while the concentration of SO_2 and NO_2 was still under the pre-

Table 1: Estimated value of air pollutants (PM_{10}, $PM_{2.5}$, SO_2 and NO_2) at seven stations of Dahej area.

Station Code	PM_{10} µg/m^3 (8h)	$PM_{2.5}$ µg/m^3 (8h)	SO_2 µg/m^3 µg/m^3 (8h)	NO_2 µg/m^3 µg/m^3(8h)
A 1	98.75	40.45	22.29	32.42
A 2	76.28	30.48	20.84	30.88
A 3	83.82	36.67	18.73	29.17
A 4	67.39	29.57	19.80	32.33
A 5	78.56	33.64	17.89	31.04
A 6	86.70	45.79	21.59	28.79
A 7	97.44	42.5	17.76	30.18

Table 2: Air quality category based on AQI of seven station of Dahej area (CPCB).

Station Code	AQI	AQI Category
A 1	97.75	Satisfactory
A 2	82.50	Satisfactory
A 3	85.25	Satisfactory
A 4	76.50	Satisfactory
A 5	82.25	Satisfactory
A 6	93.75	Satisfactory
A 7	94.75	Satisfactory

scribed limits (50 µg/m^3 for SO_2 and 40 µg/m^3 for NO_2).

The air quality index (AQI) may act as a valuable tool and also act as proxy of ambient air quality status. AQI values in this study were calculated by using the concentration of PM_{10}, $PM_{2.5}$, SO_2 and NO_2. The AQI value ranged from 76.50 to 97.75 (Table 2) at seven stations of Dahej area, which are categorized as satisfactory level (50 to 100µg/m^3) by CPCB. This may cause minor breathing discomfort to sensitive people.

Air pollution in Dahej area was under control. Level of PM_{10} at all the stations and level of $PM_{2.5}$ at some locations were found beyond the permissible limit but SO_2 and NO_2 were below the permissible limit at all the stations. Based on the AQI, the Dahej area was categorized as satisfactory, which can cause minor breathing discomfort to sensitive people. So, the overall air quality of Dahej area was in good condition and it should be maintained for long years. For that, the periodic estimation should be carried out to check the level of air pollutants in the area.

REFERENCES

Afroz, R., Hassan, M.N. and Ibrahim, N.A. 2003. Review of air pollution and health impacts in Malaysia. Environ. Res., 92: 71-77.

Analitis, A., Katsouyanni, K., Dimakopoulou, K., Samoli, E., Nikoloulopoulos, A.K. and Petasakis, Y. 2006. Short-term effects of ambient particles on cardiovascular and respiratory mortality. Epidemiology, 17(2): 230-233.

Barman, S.C., Kisku, G.C and Khan, A.H. 2015. Report on assessment of ambient air quality of Lucknow city during pre-monsoon, 2015. Environmental Monitoring Division CSIR- Indian Institute of Toxicology Research, M.G. Marg, Lucknow.

Barman, S.C., Kumar, N. and Singh, R. 2010. Assessment of urban air pollution and its probable health impact. J. Env. Biol., 31(6): 913-920.

Central Pollution Control Board (CPCB) 2013. Guidelines for Manual Sampling and Analyses. National Ambient Air Quality Series: NAAQMS/36/2012-13

Chaurasia, S., Singh, S. and Gupta, A.D. 2013. Study on air quality of SKS Ispat and Power Ltd. Raipur (CG), India. Asian JST, 4(4): 48-50.

Dockery, D.W. and Pope, C.A. 1994. Acute respiratory effects of particulate air pollution. Annu. Rev. Public Health, 15: 107-132.

Horaginamani, S.M. and Ravichandran, M. 2010. Ambient air quality in an urban area and its effects on plants and human beings: a case study of Tiruchirappalli, India. Kathmandu. Uni. J. Sc. Eng. and Tech., 6(2): 13-19.

Jacob, M.B. and Hochheiser, S. 1958. Continuous sampling and ultramicro determination of nitrogen oxide in air analyst. Chem., 30: 426-428.

Joshi, P.C. and Semwal, M. 2011. Distribution of air pollutants in ambient air of district Haridwar (Uttarakhad), India: a case study after establishment of state industrial development corporation. Int. J. Environ. Sci., 2(1): 237-243.

Katsouyanni, K., Touloumi. G., Samoli, E., Gryparis, A., Le, T.A. and Monopolis, Y. 2001. Confounding and effect modification in the short-term effects of ambient particles on total mortality: results from 29 European cities within the APHEA2 project. Epidemiology, 12: 521-531.

Kaushik, C.P., Ravindra, K. and Yadav, K. 2006. Assessment of ambient air quality in urban centres of Haryana (India) in relation to different anthropogenic activities and health risk. Environ. Monit. Assess., 122(1-3): 27-40.

Koken, P.J., Piver, W.T., Ye, F., Elixhauser, A., Olsen, L.M. and Portier, C.J. 2003. Temperature, air pollution and hospitalization for cardiovascular diseases among elderly people in Denver. Environ. Health Perspect., 111: 1312-1317.

Mukhopadhyay, S. and Mukherjee, R. 2013. Assessment of ambient air quality of Purulia town, Purulia district, West Bengal, India. Biolife, 1(4): 189-94.

Panday, P.K., Patel, K.S. and Subart, P. 1988. Trace element composition of atmospheric composition of atmospheric particulate at Bhilai in central east India. Sci. Total Environ., 21: 123-134.

Rai, P., Panda, L.L., Chutia, B.M. and Singh, M.M. 2013. Comparative assessment of air pollution tolerance index (APTI) in the industrial (Rourkela) and non-industrial area (Aizawl) of India: an eco-management approach. Afr. J. Environ. Sci. Technol., 7(10): 944-48

Samoli, E., Analitis, A., Touloumi, G., Schwartz, J., Anderson, H.R. and Sunyer, J. 2005. Estimating the exposure-response relationships between particulate matter and mortality within the APHEA multicity project. Environ. Health Perspect., 113: 88-95.

Sharma, K., Singh, R., Barman, S.C., Mishra, D., Kumar, R., Negi, M.P.S., Mandal, S.K., Kisku, G.C., Khan, A.H., Kidwai, M.M. and Bhargava, S.K. 2006. Comparison of trace metals concentration in PM10 of different location of Lucknow city. Bull. Environ. Contam. Toxicol., 77: 419-426

Singh, N., Yonus, M., Srivastav, K., Singh, S.M. and Panday, V. 1995. Monitoring of auto exhaust pollution by road side plant. Environ. Monitor. Ass., 34: 1325.

US Environmental Protection Agency (USEPA) 2008. Air quality index: a guide to air quality and your health. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park.

West, P.W. and Gaeke, G.C. 1956. Fixation of sulphur dioxide as sulfitomercurate (11) and subsequent colorimetric determination. Anal. Chem., 28: 1916-1819.

World Health Organization (WHO) 2000. Air Quality Guidelines for Europe. 2nd ed., Reg. Publ. Eur. Ser., 91: 288.

World Health Organization (WHO) 2005. Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide. Global update, Summary of risk assessment, WHO/SDE/PHE/OEH/06.02, 2005.

Yadav, S.K., Kumar, V. and Singh, M.M. 2012. Assessment of ambient air quality status in urban residential areas of Jhansi city and rural residential areas of adjoining villages of Jhansi city. I.J.A.E.T., 3(1): 280-285

Yang, C.Y., Chang, C.C., Chuang, H.Y., Tsai, S.S., Wu, T.N. and Ho, C.K. 2004. Relationship between air pollution and daily mortality in a subtropical city: Taipei Taiwan. Environ. Int., 30(4): 519-523.

Zlauddin, A. and Siddique N.A. 2006. Air quality index (AQI)- a tool to determine ambient air quality. Pollution Research, 25: 885-887.