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Assessment of air quality in Shivamoga City, Karnataka (India)

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Abstract. Assessment of the ambient air quality status in the selected location of Shivamoga city Karnataka State India was carried out for four years (2005 - 2009). Four stations (industrial, commercial, institutional and residential) of Shivamoga city were selected purposively to spotlight an overview of the total air quality of this region. The air quality was assessed based on measuring three air pollutants namely Suspended Particulate Matter (SPM), Oxides of Nitrogen (NOx) and Oxides of Sulphur (SOx). The average concentration of SPM in Amir Ahmed circle was the highest at 969.43 μg/m^3 and was lowest at the Sahayadri college Campus (65.59 μg/m^3). Vinobha nagar with an average of 803.46 μg/m^3 is in the medium range as well as industrial area (269.00 μg/m^3). The study shows that the average NO_2 concentration was highest in Amir Ahmed circle (6.79 μg/m^3), followed by Vinobha nagar (6.06 μg/m^3), industrial area (2.97 μg/m^3) and Sahayadri college Campus (1.97 μg/m^3). The average SO_2 concentration except Vinobha Nagr station (6.59 μg/m^3) in all the other locations was below the detection level, i.e. 4 μg/m^3. Amir Ahmed circle had the second highest value (2.89 μg/m^3) followed by industrial area (1.49 μg/m^3) and Sahayadri college campus (1.22 μg/m^3). According to the air quality standards given by NAAQS and WHO standards, the SPM concentrations is high in Amir Ahmed circle and Industrial Area locations and SO_2 and NOx pollutants values obtained are all within the standard level. Uncontrolled emission of pollutants by motorized traffic with heavy traffic jam is the main source of pollution in the urban area mainly.
Key words: air quality, Karnataka, India, 2005-2009.

Introduction. Air pollution is a topic among many others, has been at the forefront of social concern for the past several years. Conservation, protection and preservation of environment have been the cornerstone of the Indian ethos, culture and traditions. Urban air pollution is probably the most well known problem created by rapid industrialization. Air pollution around major factories, thermal power plants, open mines and quarries has attracted a lot of attention.

Air pollution can cause death, impair health, reduce visibility, bring about vast economic losses and contribute to the general deterioration of both our cities and countryside. It can causes intangible losses to historical monuments. It is therefore, a matter of great importance that engineers of all disciplines consciously incorporate in their design, sufficient constraints and safe measures, to ensure that they do not contribute to atmospheric pollution.

Shivamoga District is an administrative district of Karnataka state in southern India. The city of Shivamoga is located on NH17 (National Highway 17) at a distance of about 280 km from the state capital of Bangalore. Became of Shivamoga geographically it is located at

75.34 E longitude and 13.56 N latitude. The city of Shivamoga is the district headquarters. It has a population of 1.639.595 of which 30.32% is urban as of 1996. Shivamoga District lies in the Maidan region on the Deccan plateau. The prominent cities/towns in this district are Tirthalli, Sagar, Bhadravathi, Shikaripur, Hosanagar. Neighbouring districts are Davangere District, Haveri District and Chikamaglur District.

Materials and Methods

A study of air pollution was carried out in city of Shivamoga Karnataka State India during 2005–2009. The study sites selected and their station types are given in Table 1. The objectives of study were to estimate suspended particulate matter (SPM), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2). The ambient air quality at four different stations was monitored over a period of 4 years from 2005 to 2009. Analysis was done once every week and the sample monitored for 8 hours. The absorbing reagents and filter paper were kept a day before analysis. APM-415 suspended particulate matter samplers (SPM) with provision for gaseous sampling APM-415 (Envirotech, New Delhi) was used for measuring the concentrations of SPM, NO_2 and SO_2 in the ambient air. The sampling inlet was placed 1-3 meter above the ground level, depending upon the site available for the RDS. The APM-415 RSPM Sampler has been provided with a cyclone. Atmospheric air was drawn for ~24 hours through the cyclone and 20 X 25 cm glass fiber filter (GFF) sheet at a flow rate of 0.8 to 1.2 m^3/min^{-1} and finally the average flow rate was calculated.

For gaseous (SO_2 and NO_2) sampling the impingers was exposed for 24 hour at an impingement rate of 1 L min^{-1} to get one sample in a day. SO_2 and NOx were analyzed by the (Elico SL159) spectrophotometer at wavelength of 560 nm and at wavelength of 540 nm respectively (Central Pollution Control Board, National Ambient Air Monitoring Programme Manual, Mizoram Pollution Control Board, Report 2005).

Site details

Vinobha Nagar: This is a commercial and residential area having large number of shops and this area is also congested area with the movement of automobile traffic, which consists of two and three wheelers, buses, trucks etc.

Industrial Area: This is a residential area. It is situated on National Highway-17 (NH17). This site is a growing industrial belt which includes traffic auto a large number of shops, many restaurants and schools are situated here.

Amir Ahmed Circle: This is a commercial area having large number of shops and offices and is situated in the heart of the city. This is one of the busiest parts of the city. Although traffic is fast but due to traffic stops, there is very frequent buildup of pollutants. Main polluting vehicles are two wheelers and three wheelers besides cars, buses, jeeps, etc.

Sahayadri college Campus: This is institutional area. The traffic is low and there is no industry in the vicinity. Some crop fields are also located nearby. There is less pollution buildup.

Results and Discussions. The present study shows that the concentration of SPM, NO_2 and SO_2 varies greatly from one station to another. The study was done based on the National Ambient Air Quality Standards given by the Central Pollution Control Board (Mizoram Pollution Control Board, Report 2005). The average concentration of the estimated

particulate matter and gases is given in Table 2. The average concentration of SPM in Amir Ahmed Circle was the highest at 969.43 µg/m^3 and was lowest at the Sahayadri college Campus (65.59 µg/m^3). Vinobha Nagar with an average of 803.46 µg/m^3 is in the medium range as well as industrial area (269.00 µg/m^3). Also, from the data obtained, SPM analyzed in 2009 was comparatively higher compared to 2005 (Mizoram Pollution Control Board, Report), which could be due to the slash and burn method of agriculture practiced widely in the surrounding area of the Shivamoga city. Various activities like use of used tyres as fuel in puffed rice industry, demolition, agriculture and stone quarrying generate SPM (Alam et al 2000). Automobile exhaust has been found to contain 40–50 µg L^{-1} SPM thus some areas with high vehicle density like Amir Ahmed Circle have the highest SPM. Comparatively less movement of traffic in the institutional zone (Sahayadri college campus) than the other zone may be the main reason for the lowest concentration of all the parameter here. Figure 1, 2 and 3 depicts the monthly average variation on concentrations of SPM, SOx and NOx in four different station of the study area respectively.

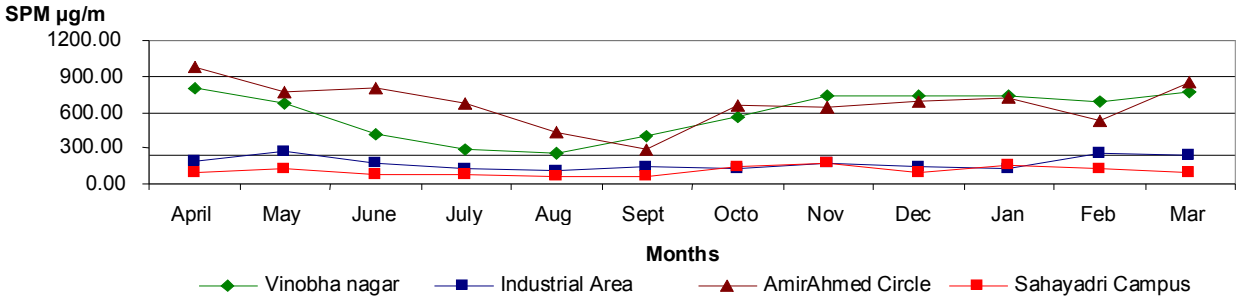

Figure 1. Monthly Average Variations of SPM Concentrations (2005-2009).

Table 1

Study sites and their station type

Stations	I	II	III	IV
Sampling location	Vinobha Nagar	Industrial Area	Amir Ahmed Circle	Sahayadri college Campus
Station type	Residential and commercial area	Residential area	Commercial area	Institutional area

Table 2

Average ambient air quality (2005 – 2009)

Sampling location	Station type	Over all Mean concentration (µg/m^3)		
		SPM	NO_2	SO_2
Vinobha Nagar	Residential and commercial area	586.85	4.59	5.30
Industrial Area	Residential area	173.080	2.17	1.07
Amir Ahmed circle	Commercial area	665.75	4.19	2.26
Sahayadri college Campus	Institutional area	110.18	1.40	0.62

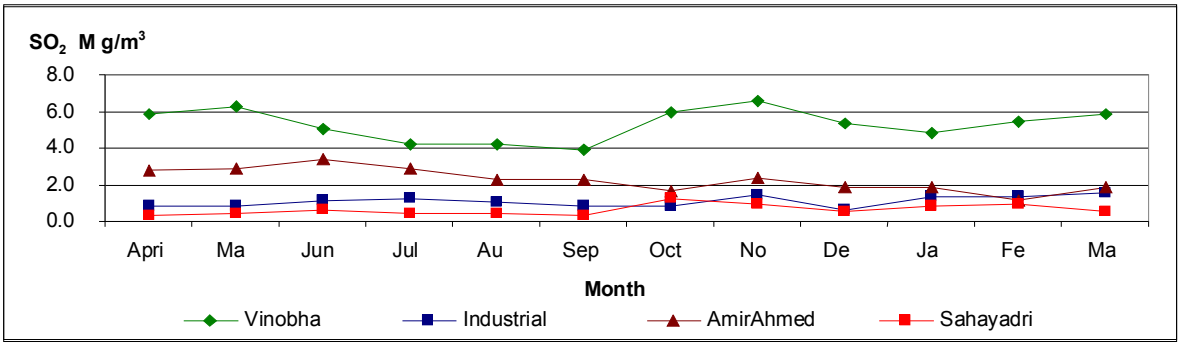

Figure 2. Monthly Average Variations of SO_2.

The study shows that the average NO_2 concentration was highest in Amir Ahmed circle (6.79 µg/m^3), followed by Vinobha Nagar (6.06 µg/m^3), industrial area (2.97 µg/m^3) and Sahayadri college Campus (1.97 µg/m^3). The average SO_2 concentration except Vinobha Nagar station (6.59 µg/m^3) in all the other locations was below the detection level, i.e. 4 µg/m^3. Amir Ahmed circle had the second highest value (2.89 µg/m^3) followed by industrial area (1.49 µg/m^3) and Sahayadri college campus (1.22 µg/m^3). The reason for the lowest level at the Sahayadri college campus is because it is an institutional area with less traffic, low population and less social activities. From the data, it can be concluded that the residential and commercial areas have a higher SPM, NO_2 and SO_2 compared to the only residential and institutional areas. According to the air quality standards given by NAAQS (G.O.B., 1998) and WHO standards, the SPM concentrations are high in Amir Ahmed circle and Industrial area. Still for these locations SO_2 and NOx pollutants values obtained are all within the standard level. As far as air pollution is concerned, in station Vinobha Nagar, where the puffed rice manufacturing units are established is the main causes for the pollution in Shivamoga, though the enormous increase in the number of vehicles with the associated problems of traffic congestion is a major contributor among the various sources of air pollution (Miller 2002).

People must participate in the environmental quality improvement programmes (Kumar 1999). Also, Shivamoga city is not well-planned and also lack spaces and greenery. So, there is a possibility that the green leaves that trap CO_2 emitted by the vehicles are not sufficient and thus pollution gradually increases. A more scientific outlook is needed to fight air pollution. These efforts will benefit the well being of humans, the environment and our natural resources.

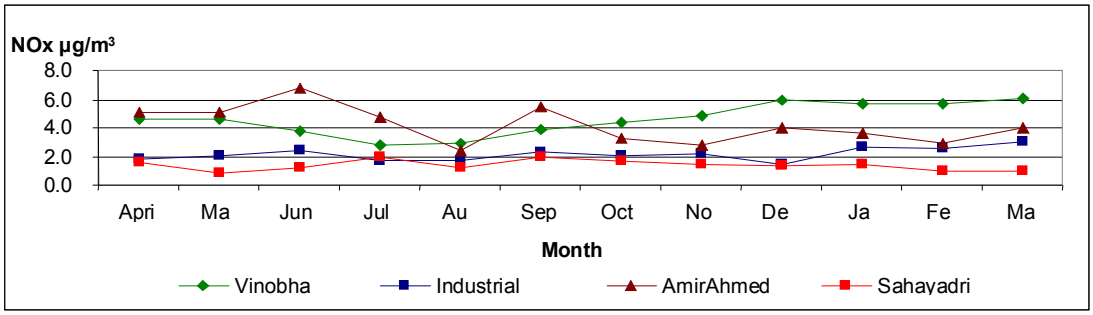

Figure 3. Monthly Average Variations of NOx Concentrations (2005-2009).

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