

Ambient Air Quality Analysis Using Air Quality Index – A Case Study of Bangalore City

Krishna Reddy K.S¹, Dr. N.T. Manjunath²

Research Scholar, Dept. of Studies in Civil Engg., University BDT College of Engg., Davangere, Karnataka, India.

Professor & Director, Centre of Env. Sci. Engg. & Tech, University BDT College of Engg., Davangere, Karnataka, India.

ABSTRACT: Analysis of the ambient air in Bangalore city, capital of Karnataka, employing Air Quality Index (AQI) has been presented in this paper. For simplified public information and data interpretation, air quality is presented in the form of AQI, for the year 2014, at three different locations covering Industrial, Commercial and Residential area. The 24 – hourly average concentrations of three pollutants have been considered for development of AQI. The pollutants considered are namely Particulate Matter (PM₁₀), Sulphur dioxide (SO₂) and Nitrogen dioxide (NO₂): The AQIS were calculated using IND-AQI procedure. It has been observed that AQI values fall under moderately polluted at industrial site, good to satisfactory at commercial and residential sites. Further it is inferred that particulate matter is the critical pollutant responsible for air pollution in the study area.

KEYWORDS: Air Quality Index, SO₂ NO₂, PM₁₀, Bangalore, Ambient Air Quality.

I. INTRODUCTION

In most of the metropolitan cities air pollution is a wide spread problem and is due to urbanisation, industrialisation, poor maintenance of motor vehicles and road conditions. The pollutants in the atmosphere not only can act synergistically, exacerbating health problems but can also contribute to regional and global atmospheric pollution. The pollutants viz. particulate matters, sulphur oxides and nitrogen oxides are having the significant role and increasing impact on urban air quality. In this paper an attempt has been made to present the air quality status at three selected locations of Bangalore City using AQI. Various researchers across the globe have discussed and published the importance of AQI in communicating air quality and decision making.

II. RELATED WORK

Researchers across the globe have carried out investigations to assess the ambient air quality of Metropolis and thereby to develop AQI. Goutam and Anjali [5] based on their studies carried out at four junctions of Vapi, reported that, the overall AQI was found to fall under the category moderately polluted owing to PM₁₀. Studies carried out at twelve industrial areas of Bangalore city (India) revealed that most of the predicted pollutants viz, SPM, SO₂ and NO₂ are violating the permissible values [6]. The analysis of the ambient air in Delhi employing air quality index has been carried out by Prakash Mamata and Basin [9]. The authors reported that SPM is a critical pollutant at the study sites considered for study in Delhi. Similarly, the studies have been carried out by various researchers to take stock of ambient air quality [7,10,11,13].

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016

III. STUDY AREA

Urban and rural parts of Bangalore are situated in the south eastern quadrant of Karnataka State between 12°58' North latitude and 77°35' East longitude. The city is at an altitude of 921 meters above the mean sea level. The climate of the study area is seasonally dry tropical savannah. The three pockets viz. KHB industrial area, Yelahanka AMCO Batteries – Mysore Road (Commercial area) and TERI office – Domlur (Residential) were considered for study.

IV. MATERIALS AND METHOD

The significant parameters considered for the study include particulate matter, sulphur dioxide and oxides of Nitrogen as NO₂. Sampling at three selected pockets/stations was carried out using High Volume Sampler. The care was taken to place the sampler in free atmosphere without interferences from stagnant spaces or large buildings and at a height of about 2.0 m. As prescribed in NAAQM standard methods of sampling and analysis, the sampling and analysis of the samples was done. A known amount of air was drawn through a pre weighed glass fibre filter paper at a flow rate of 0.8 to 1.3 m³/min on 8 hourly basis for 24 hours and thereby particulate matter was determined by gravimetric method. Gaseous pollutants namely SO₂ and NO₂ were collected using absorbing solution on four hourly basis for 24 hours by drawing air at a flow rate of 1 LPM and were analysed by West and Greak and Jacob and Hochheiser method respectively. The concentrations of pollutants were expressed in µg/m³.

V. AQI CALCULATION

In the present study IND-AQI was used for the calculation on AQI, which has been developed on the dose – response relationship of various pollutants (Prakash Mamatha and Basin : 2010). The method involves formation of subindices for each pollutant and aggregation of subindices. The linear segmented relationship for sub index values and the corresponding pollutant concentrations that are calibrated to Indian conditions are shown in Table 1. Further IND-AQI has 6 categories namely Good (0-50), Satisfactory (51-100), Moderately polluted (101-200), Poor (201-300), Very poor (301-400) and Severe (401-500).

**Table – 1 : Break Points of Various Pollutants
(National Air Quality Index. CPCB. October 2014) (Units: µg/m³)**

AQI Category Range	PM ₁₀ (24hr)	PM _{2.5} (24hr)	SO ₂ (24hr)	NO ₂ (24hr)
Good (0-50)	00-50	0-30	0-40	0-40
Satisfactory (51-100)	51-100	31-60	41-80	41-80
Moderately polluted (101-200)	101-200	61-90	81-380	81-180
Poor (201-300)	251-350	91-120	381-800	181-280
Very poor (301-400)	351-400	121-250	801-1600	281-400
Severe (401-500)	>430	>250	>1600	>400

The mathematical equations for calculating sub-indices is as follows

$$I_p = \left(\frac{I_{HI} - I_{LO}}{B_{PHI} - B_{PLO}} \times (C_p - b_{PLO}) \right) + I_{LO}$$

- Where I_p is AQI for pollutant “P” (Rounded to the nearest integer).
- C_p the actual ambient concentration of pollutant “P”.
- B_{PHI} the upper end break point concentration that is greater than equal to C_p.
- B_{PLO} the lower end break point concentration that is less than or equal to C_p.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016

- I_{LO} the sub index or AQI value corresponding to B_{PLO} .
- I_{HI} the sub index or AQI value corresponding to B_{PHI} .

VI. RESULTS AND DISCUSSIONS

After analysing ambient air quality data, for the study period 2014 for 3 pockets considered for study, daily average concentrations and AQI values were calculated. For more clarity and to enable fruitful discussions the results obtained are graphically represented. Variations of PM_{10} , SO_2 and NO_2 are respectively shown in figure 1, 2 and 3. AQI values are represented by bar chart (fig.4).

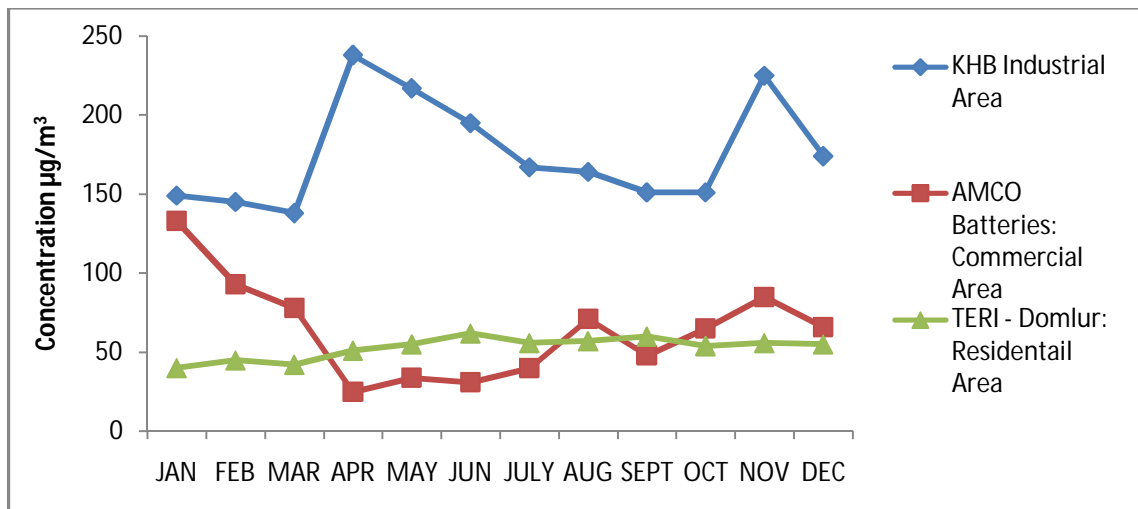


Fig.1 : Variation of PM_{10} During Study Period at Study Locations

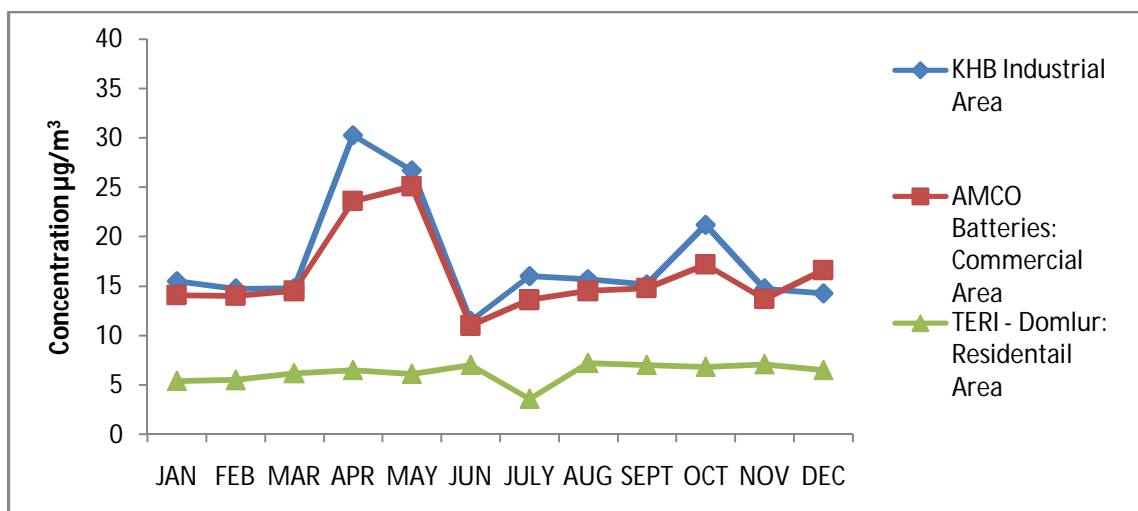


Fig.2 : Variation of SO_2 During Study Period at Study Locations

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016

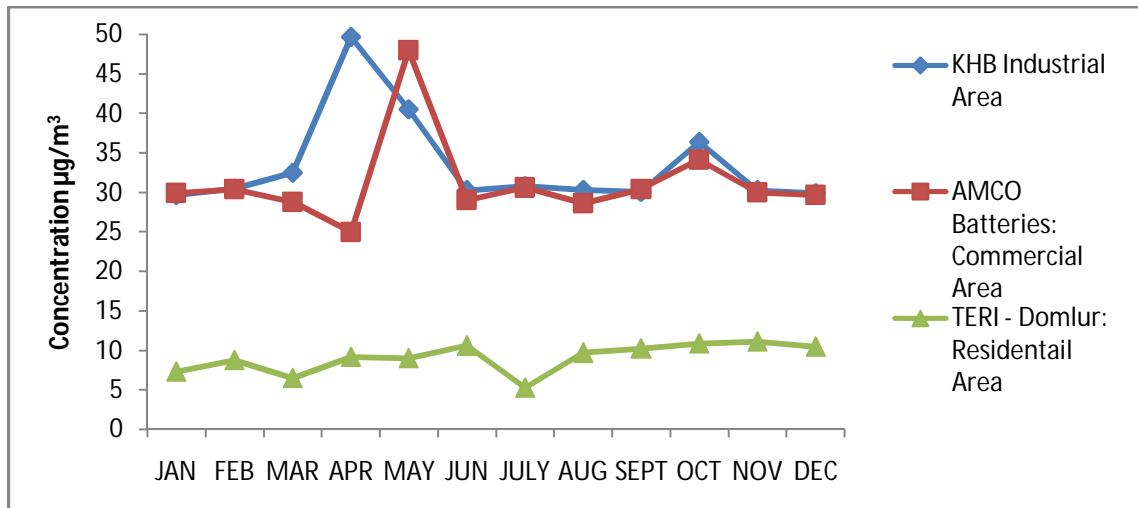


Fig.3 : Variation of NO_x During Study Period at Study Locations

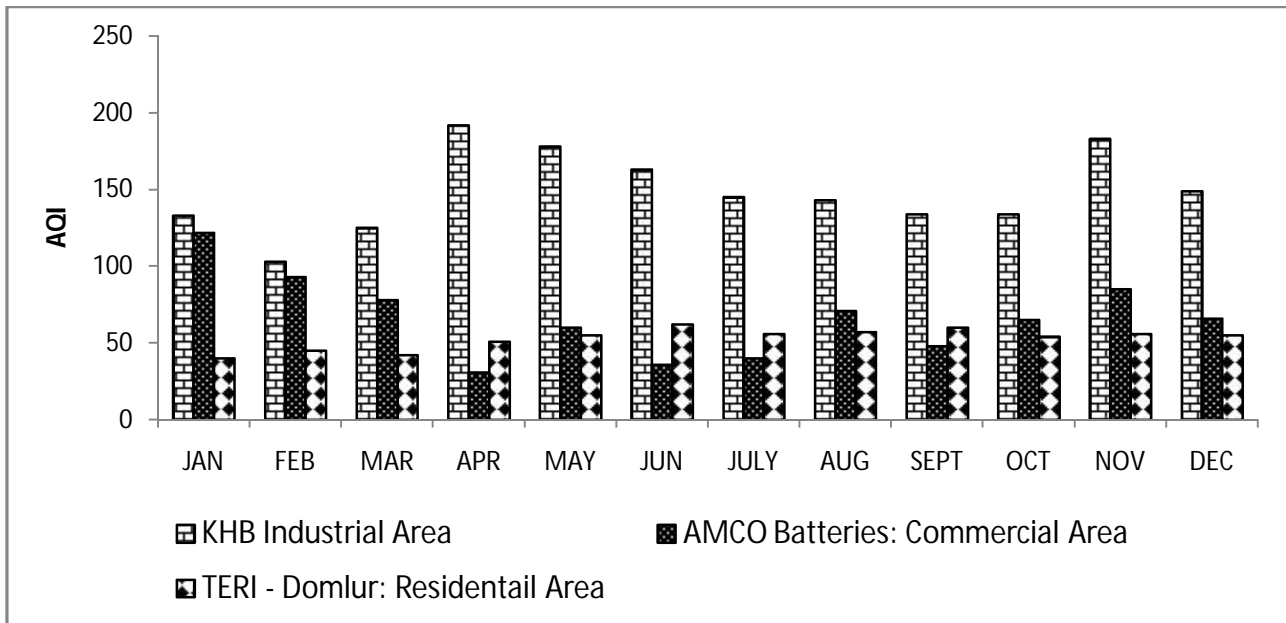


Fig.4 : Variation of AQI During Study Period at Study Locations

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016

The results represented graphically show that average concentration of PM_{10} in all the three sites ranged between 151 to 238 $\mu\text{g}/\text{m}^3$ at industrial, 25 to 133 $\mu\text{g}/\text{m}^3$ at commercial and 40 to 62 $\mu\text{g}/\text{m}^3$ at residential sites respectively. Further the maximum at minimum concentration of gaseous pollutants SO_2 and NO_2 at all the sites ranged between 11.5 to 30.3 $\mu\text{g}/\text{m}^3$ and 29.7 to 49.7 $\mu\text{g}/\text{m}^3$ (Industrial), 11 to 25.1 $\mu\text{g}/\text{m}^3$ and 25 to 48 $\mu\text{g}/\text{m}^3$ (Commercial), and 5.4 to 7.2 $\mu\text{g}/\text{m}^3$ and 5.3 to 11.1 $\mu\text{g}/\text{m}^3$ (Residential) : The results clearly indicated that, the pollutants in the ambient air followed the sequence of Residential < Commercial < Industrial sites.

The AQI values calculated for 24 hourly average concentration of pollutants considered for study are categorised as moderately polluted at industrial site good to satisfactory at commercial site (except in the month of January : Winter) and at residential site. Further it is noticed that particulate matter is the major air pollutants in the study area.

VII. CONCLUSIONS

According to Indian air quality index (IND-AQI), the AQIs were calculated to assess the ambient air quality at three different sites in Bangalore city during the year 2014. From the AQI values it is concluded that, industrial area is moderately polluted, while ambient air quality at commercial and residential areas are good to satisfactory. It is inferred that the industrial activities and transportation activities are mainly responsible for the pollution of ambient air in the study area. Therefore it is suggested that, only public awareness can play a major role in solving air pollution problems.

REFERENCES

- [1] Agarwal M, Singh S.K, Singh J and Rao D.N "Biomonitoring of Air Pollution around Urban and Industrial Sites, JEB 12, 211, 1991.
- [2] Air Quality Index and Emission Inventory for Delhi. Centre for Science and Environment(CSE), New Delhi, 2000.
- [3] APHA, Standard methods of air Sampling and Analysis, 2nd Edn, Washington DC 1997.
- [4] CPCB, Air Quality Status and Trends in India. 2000.
- [5] Gowtham Sarella and Anjali K. Khambete, "Ambient Air Quality Analysis using Air Quality Index – A case study of VAPI IJIRST", 1(1), 68-71, 2015
- [6] Harinath S. and Usha N. Murthy, "Air Quality Index in Industrial Areas of Bangalore City – A case study, India", JIPC, 26(2), 235-237, 2010
- [7] Mahendra and Krishnamurthy, "Assessment of Carbon Monoxide Levels at selected Traffic Intersections in Urban Area of Bangalore", JEEM, 14(2):101-104, 2004
- [8] Mahendra S.P and Krishnamurthy, " Air Quality Detereoration due to Pollution from Road Traffic in Bangalore City", JEEM, 14(1), 9-14,2014.
- [9] Prakash Mamta and Bassin J.K., "Analysis of Ambient Air Quality using Air Quality Index – A case study", IJAET,1(11), 106-114, 2010
- [10] Sastry M.S., Suneela M., Shashidhar Kumar N.P. and Hussain S.K. "Air Quality status at selected location sin Hyderabad city", JESE, 46(2), 86-9, 2004
- [11] Senthilnathan T., "Urban Air Quality in Chennai city based on Exceeding Factor Criteria During 1999-2003", IJEP,27(7), 638-644, 2007
- [12] Sharma M., Maheshwari M., Sengupta B. and Shukla B.P., "Design of website for dissemination of an air quality Index in India, Env Mod & Software", 18, 405-411, 2003
- [13] Srivastava R.K and Rajasree Sarkar "Pollution Detection in High Traffic Zones of Jabalpur City by Means of Air Quality Index", JIPC, 26 (2), 193-198, 2010.