



## Determination of Benzene and Benzo (a) Pyrene levels in Ambient Air Quality of in and around Tirupati, Chittoor District, and Andhra Pradesh, India

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### ABSTRACT

Benzene and Benzo (a) Pyrene (BAP) are carcinogenic pollutants which will be emitted in the Atmospheric air through vehicular emission and burning of petroleum products. In this study we made an attempt to study the Benzene and BAP concentration levels in AAQ(Ambient air Quality) in Tirupati. For this study we were identified 5 sampling locations in Tirupati surrounding areas. Sampling was carried out 24 hourly and twice a week for in the month of February 2012. Totally 15 air samples were collected. The samples are subjected to analysis for Benzene and BAP using GC-MS based on USEPA Compendium method TO 3 for Benzene and TO 13A for BAP. By using GC-MS we can able to determine the Benzene levels in Ambient air minimum  $0.01\mu\text{g}/\text{m}^3$  and by using GC we can able to determine the BAP levels of Ambient Air Particulate phase minimum  $0.01\text{ng}/\text{m}^3$ . The concentration levels of Benzene and BAP in different areas of Tirupati are summarized in results and discussion. The levels of Benzene and BAP levels were compared with NAAQS(National Ambient air Quality Standard) amended by MoEF(Ministry of Environment and Forests), Govt. of India. The observed results of Benzene and BAP were found lesser than NAAQS.

**Keywords:** Benzene –BAP-AAQ-Tirupati.

### INTRODUCTION

Benzene is a Volatile Organic Compound which will be emitted into the Ambient Air through vehicular emissions and also from burning of fossil fuels. Same way Benzo (a) Pyrene most carcinogenic pollutant, which belongs to polynuclear Aromatic Hydrocarbons group. Owing to the industrialization and urbanization there may be chances to increase these pollutant levels in Ambient Air Quality. Trace levels of these benzene and BAP in ambient air quality will act as carcinogens to human health. Even in trace levels of these pollutant levels in Ambient air will act as a carcinogenic.

Owing to carcinogenic nature of Benzene and BAP, Central Pollution Control Board (CPCB) and MoEF are set limits for these parameters in NAAQS amended on 16<sup>th</sup> November 2009. As per NAAQS maximum permissible limit of Benzene in gaseous phase of Ambient Air is  $5.0\mu\text{g}/\text{m}^3$  and Maximum Permissible Limit for BAP in particulate phase of ambient air quality is  $0.1\text{ng}/\text{m}^3$ .

The Atmospheric Air can be polluted in many ways and most of the sources are man-made. Rapidly growing vehicular population as well as pollutants emitted by them generate harmful that have marked effects on pedestrians as well as near-by residents.

Atmospheric particles are generated through a variety of physical and chemical mechanisms, and are emitted into the atmosphere from numerous sources, by combustion, industrial and natural processes. They are involved in many

atmospheric processes, and play an important role in reducing visibility, acid deposition, and the balance of radiation in the atmosphere, both directly and indirectly through cloud formation.

The effects of atmospheric particulate matters on environment and human health have been of great global concern. Atmospheric aerosol found in urban areas represent a mixture of primary particles emitted from various sources and secondary particles from aerosols formed by chemical reactions. The morphology and composition of these particles may change through several processes, including vapour condensation, evaporation and coagulation. The final 'products' usually vary according to origin, chemical composition and physical properties, leading to particular deposition patterns in the human respiratory system.

### Present Study

Since the World famous Lard Venkateswara temple is present in Tirupati, it has become a most popular pilgrim city in Andhra Pradesh, India. Lakhs of pilgrims will visit and therefore rapidly growing vehicular population pollutant levels may also increases. In view of the air pollution effects on human health, we made an attempt to study the levels of trace levels of Benzene and Benzo (a) Pyrene in ambient air quality of Tirupati.

The prime objective of the air monitoring is to evaluate the existing air quality of the Tirupati area with respect to the Benzene and BAP levels. For this study we selected five sampling locations which are having more vehicle moment. Ambient air quality monitoring has been carried out with a frequency of alternative days in week at each location. At each of these locations, sampling stations were operated for 24 hours. We collected fifteen RSPM (Respirable Suspended Particulate Meter) (PM<sub>10</sub>) samples in five selected locations. These samples are collected both working days and holiday's period in the month of February 2012.

Gaseous phase samples are collected for Benzene in charcoal sorbent tubes and particulate phase sampling for Benzo (a) Pyrene on 8'x10' cellulose membrane filters exposed for 24 hours using Repairable Dust Samplers (Envirotech), at the average flow rate of 1.2 m<sup>3</sup> /min for particulate phase and 0.5 LPM (Liters per minute) for gaseous phase sampling. The samples are collected at the following locations in and around the Tirupati area:

- S.V.University Main Gate
- Gandhi Road
- Near RTC Bus stand
- K.T.Road
- Alipiri Bypass road

The details of sampling locations with date and time and total volume of air collected is given in the below table.

TABLE-1 DETAILS OF AMBIENT AIR QUALITY MONITORING LOCATIONS

Sample Code	Location	Date and Time of Sampling Started	Date and Time of Sampling Started	Volume of Air Sampled for BAP	Volume of Air Sampled for Benzene
AAQ1	S.V.U Main Gate	02-02-2012 & 6:30 a.m	03-02-2012 & 7:20 a.m	1624	0.72
AAQ2	S.V.U Main Gate	04-02-2012 & 6:10 a.m	05-02-2012 & 6:50 a.m	1682	0.72
AAQ3	S.V.U Main Gate	06-02-2012 & 6:45 a.m	07-02-2012 & 7:15 a.m	1596	0.72
AAQ4	Gandhi Road	02-02-2012 & 7:30 a.m	03-02-2012 & 8:15 a.m	1684	0.72
AAQ5	Gandhi Road	04-02-2012 & 6:45 a.m	05-02-2012 & 7:20 a.m	1632	0.72
AAQ6	Gandhi Road	06-02-2012 & 7:12 a.m	07-02-2012 & 7:35 a.m	1588	0.72
AAQ7	Near RTC Bus stand	02-02-2012 & 8:10 a.m	03-02-2012 & 9:04 a.m	1627	0.72
AAQ8	Near RTC Bus stand	04-02-2012 & 7:12 a.m	05-02-2012 & 7:45 a.m	1646	0.72
AAQ9	Near RTC Bus stand	06-02-2012 & 7:35 a.m	07-02-2012 & 7:55 a.m	1602	0.72
AAQ10	K.T.Road	02-02-2012 & 8:55 a.m	03-02-2012 & 9:50 a.m	1672	0.72
AAQ11	K.T.Road	04-02-2012 & 7:40 a.m	05-02-2012 & 8:10 a.m	1613	0.72
AAQ12	K.T.Road	06-02-2012 & 7:58 a.m	07-02-2012 & 8:30 a.m	1583	0.72
AAQ13	Alipiri Bypass road	02-02-2012 & 9:40 a.m	03-02-2012 & 10:35 a.m	1628	0.72
AAQ14	Alipiri Bypass road	04-02-2012 & 8:05 a.m	05-02-2012 & 8:30 a.m	1672	0.72
AAQ15	Alipiri Bypass road	06-02-2012 & 8:25 a.m	07-02-2012 & 8:55 a.m	1601	0.72

Note:- Volume of Air is expressed in m<sup>3</sup>

TABLE-2 TECHNIQUES USED FOR AMBIENT AIR QUALITY MONITORING

Sr. No.	Parameter	Technique	Technical Protocol	Minimum Detectable Limit
1	Benzene	GC-MS	USEPA COMPENDIUM METHOD TO – 3.0	0.01 $\mu\text{g}/\text{m}^3$
2	Benzo (a) Pyrene	GC-MS	USEPA COMPENDIUM METHOD TO – 17	0.01 $\text{ng}/\text{m}^3$

**SAMPLING METHODOLOGY:****Sampling of Benzene:**

- Prepare a gas sampling tube filled with an activated charcoal.
- Open a tube at two ends and connect it to a sample pump and pulling air through the tube with the pump. Thus airborne chemicals will be trapped onto the surface of the sorbent.
- The sampling is carried out using low flow sampler by keeping the tubes in vertical position to prevent the possibility of channeling that can lead to under sampling
- The sampling flow rate was maintained 0.2 LPM ( $\pm 2\%$ ) for ambient air
- Discard sample if breakthrough exceeds 10 Percent. The tube is then sealed with push-on caps and sent to a laboratory for analysis.

Store the tubes properly wrapped in aluminum foil in a silica gel multi tube storage container in a clean environment

**Sampling of Benzo (a) Pyrene:**

Ambient air samples are collected for Benzo (a) Pyrene in cellulose 8'x10' membrane filters exposed for 24 hours using Repairable Dust Samplers (Envirotech), at the average flow rate of 1.2  $\text{m}^3/\text{min}$  for particulate phase. These particulate samples are used for Benzo (a) Pyrene analysis.

**ANALYTICAL METHODOLOGY****Analysis of Benzene:**

Benzene is analyzed by using Gas Chromatography coupled with Mass Spectrometer and the samples are quantified by using High standards.

**Analysis of Benzo (a) Pyrene**

Particulate Phase filter papers are extracted and analyzed by using GC-MS and the samples are quantified by using high standards.

**RESULTS AND DISCUSSION**

GC-MS is very sensitive technique for the determination of volatile and semi volatile organic compounds. By using the GC-MS technique we can able to determine benzene in air gaseous phase minimum of 0.01 $\mu\text{g}/\text{m}^3$ . By using GC-MS technique we can able to determine BAP levels minimum of 0.01 $\text{ng}/\text{m}^3$ .

The results of Benzene and Benzo (a) Pyrene levels during the study period is summarized in TABLE – 3.

TABLE -3 CONCENTRATIONS OF BENZENE AND BENZO (A) PYRENE IN DIFFERENT AAQ LOCATIONS SAMPLED IN DIFFERENT WEEK DAYS

Sample Code	Location	Date and Time of Sampling Started	Benzene ( $\mu\text{g}/\text{m}^3$ )	Benzo (a) Pyrene ( $\text{ng}/\text{m}^3$ )
AAQ1	S.V.U Main Gate	02-02-2012 & 6:30 a.m	3.4	0.05
AAQ2	S.V.U Main Gate	04-02-2012 & 6:10 a.m	3.6	0.02
AAQ3	S.V.U Main Gate	06-02-2012 & 6:45 a.m	2.9	0.04
AAQ4	Gandhi Road	02-02-2012 & 7:30 a.m	3.2	<0.01
AAQ5	Gandhi Road	04-02-2012 & 6:45 a.m	2.7	<0.01
AAQ6	Gandhi Road	06-02-2012 & 7:12 a.m	2.9	<0.01
AAQ7	Near RTC Bus stand	02-02-2012 & 8:10 a.m	3.9	0.04
AAQ8	Near RTC Bus stand	04-02-2012 & 7:12 a.m	3.3	0.02
AAQ9	Near RTC Bus stand	06-02-2012 & 7:35 a.m	3.7	0.06
AAQ10	K.T.Road	02-02-2012 & 8:55 a.m	2.4	0.02
AAQ11	K.T.Road	04-02-2012 & 7:40 a.m	2.8	<0.01
AAQ12	K.T.Road	06-02-2012 & 7:58 a.m	2.1	0.01
AAQ13	Alipiri Bypass road	02-02-2012 & 9:40 a.m	2.3	<0.01
AAQ14	Alipiri Bypass road	04-02-2012 & 8:05 a.m	1.9	<0.01
AAQ15	Alipiri Bypass road	06-02-2012 & 8:25 a.m	2.2	<0.01

This study shows that the observed concentration levels of Benzene and Benzo (a) Pyrene in Ambient Air Quality of Tirupati area is less than that of NAAQS amended on 16<sup>th</sup> November 2009, published by Ministry of Environment and Forestry, Govt.of India.

#### CONCLUSION

The authors selected tirupati for this research purpose with an impression that since tirupati since tirupati is one of the important pilgrim center and expected more benzene and BAP in AAQ of tirupati due to more vehicles pollution. But the concentration limits of benzene and BAP came to know that they are with in the limits of NAAQS, MUEF, the reason may be the more greenery in and around the sampling locations and the regular check – up of vehicle by the RTA authority.

This study has given an awareness of concentration levels of Benzene and Benzo (a) Pyrene in Ambient air Quality of Tirupati.

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