JOINT AMBIENT AIR QUALITY MONITORING IN BANGALORE CITY

Central Pollution Control Board has notified the National Ambient Air Quality Standards for 12 air pollutants way back in 2009. A joint monitoring in association with KSPCB has been initiated and AAQ monitoring was carried out at seven locations in Bangalore city during the month of September and October, 2013 as a trial run.

OBJECTIVES

- To develop infrastructure to monitor all the twelve parameters in accordance with the Notified National Standards.
- To measure the concentrations of conventional air pollutants viz., Particulate Matter (PM10 and PM2.5), Sulphur dioxide, Nitrogen dioxide, Ammonia, Ozone, Carbon monoxide, Benzene, Benzo (o) Pyrene (BaP), Lead(Pb), Arsenic(As), and Nickel(Ni) for urban Bangalore.
- To verify the compliance status with the National standards.
- To supplement the data to decision makers in planning

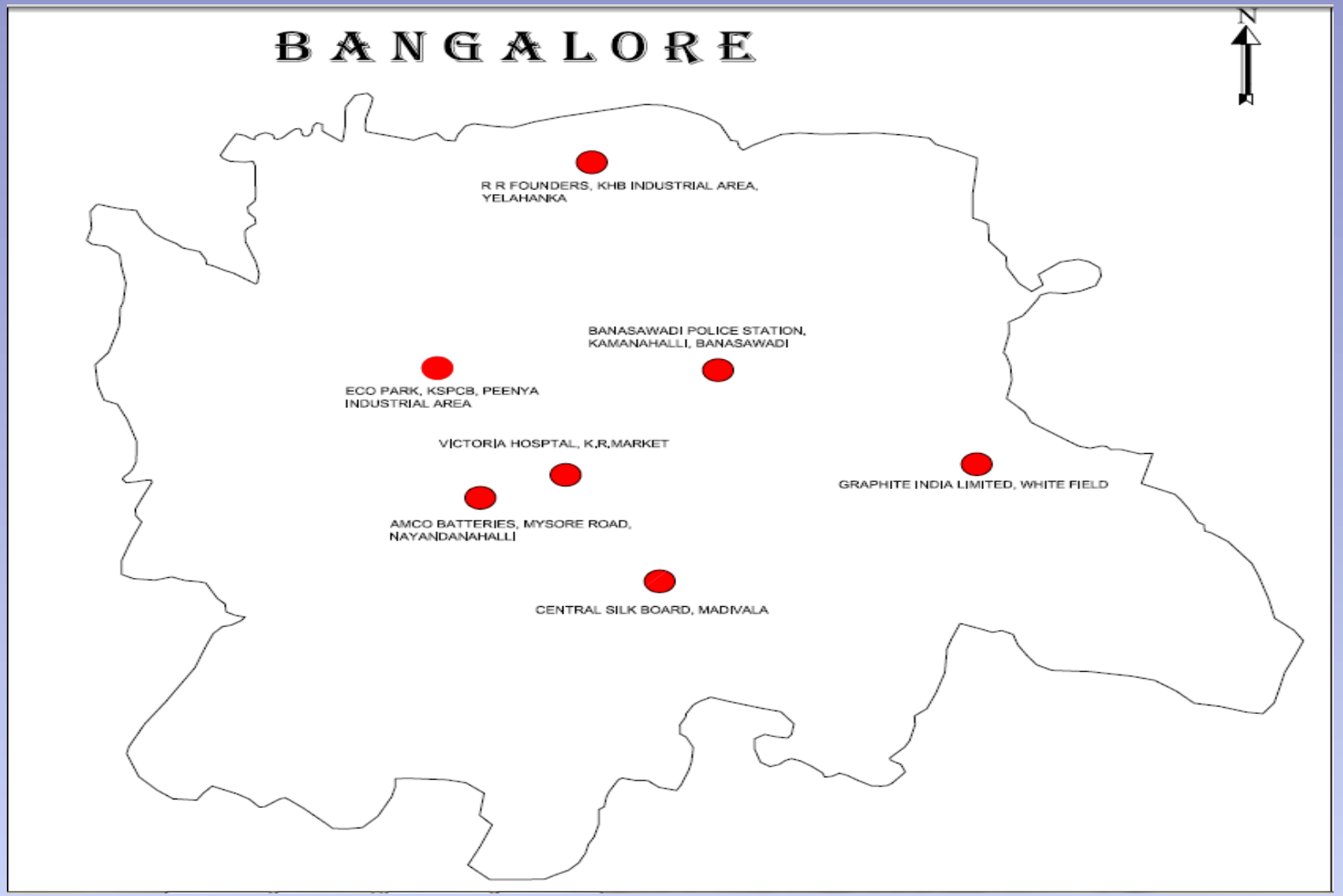
NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Time Weighted Average	Concentration in ambient air	
		Industrial, Residential, Rural & other Areas	Ecologically Sensitive Area
Sulphur dioxide (SO_2), ($\mu g/m^3$)	Annual 24 hours	*50* *80*	*20* *80*
Oxides of Nitrogen as (NO_2), ($\mu g/m^3$)	Annual 24 hours	*40* *80*	*30* *80*
Particulate matter (size < 10 µm) or PM10, ($\mu g/m^3$)	Annual 24 hours	*60* *100*	*60* *100*
Particulate matter(size < 2.5 µm) or PM2.5, ($\mu g/m^3$)	Annual 24 hours	*40* *60*	*40* *60*
Ozone (O3) ($\mu g/m^3$)	8 hours 1 hour	*100* *180*	*100* *180*
Lead (Pb) ($\mu g/m^3$)	Annual 24 hours	*0.5* *1*	*0.5* *1*
Carbon Monoxide (CO) (mg/m^3)	8 hours 1 hour	*2* *4*	*2* *4*
Ammonia (NH3) ($\mu g/m^3$)	Annual 24 hours	*100* *400*	*100* *400*
Benzene (C6H6) ($\mu g/m^3$)	Annual	*5*	*5*
Benzo (a) pyrene (BaP) particulate phase only (ng/m^3)	Annual	*1*	*1*
Arsenic (As) (ng/m^3)	Annual	*6*	*6*
Nickel (Ni) (ng/m^3)	Annual	*20*	*20*

MONITORING LOCATIONS

1. Urban Eco Park, Peenya
2. Yelahanka New Town
3. Central Silk Board, Madiwala
4. Amco Batteries, Mysore Road
5. Banaswadi Police Station
6. Graphite India Ltd., Whitefield Road
7. Victoria Hospital

LOCATION MAP



Sampling Methodology

- PM10: 24 hours on 8hrs frequency following 0600-1400, 1400-2200 and 2000 – 0600 hours time schedules.
- Used EPM 2000 filter paper instead of GF/A filter paper.
- Sampling time is calculated using Timer readings in most of the cases.

$PM_{2.5}$

- PM2.5 Sampler was used
- 24 hours sampling by following 0600 hours to 0600 hours time schedule continuously with constant flow rate.
- 47 mm PTFE filter paper was used.
- Calculation was done based on recorded value.
- KSPCB's micro analytical balance was used.

SO_2, NO_2, NH_3 and O_3

- 24 hours sampling by following 0600-1000, 1000-1400, 1400-1800, 1800-2200, 2200-0200 and 0200-0600 hours time schedule were followed.
- In case of Ozone one hour sampling was carried out at 1400 Hours and analysed first three samples i.e., 0600-1000, 1000-1400, 1400-1500 on the same day.

Sampling methodology

- CO was monitored for 5 minutes duration for six times during the day time only mostly in between 1100 to 1600 hours.
- Benzene sampling was carried out for 4 hours during day and night time in between 1100 – 1600 and 2000 2400 hours.

PM10

- **Gravimetric method**
- PRINCIPLE: Ambient air is drawn through a size selective inlet and a filter paper. Particles with aerodynamic dia less than 10microns are collected by the filter. Wt. gain of the Filter divided by volume of air gives the concentration of PM10
- **Methodology:** Sampling was carried out by following NAAM guidelines.
- **Range of the method** : 5 – 5000 µg/m^3

PM2.5

- **Gravimetric method**
- **PRINCIPLE**: Ambient air is drawn at a constant volumetric flow rate regulated by a Mass flow controller coupled to a microprocessor into specially designed inertial particle-size separator where the PM in 2.5 micron size ranges is separated for collection on a 47mm PTFE filter over a specified sampling period.
- **Range of the method** : 1 – 500 $\mu g/m^3$

SO2

- **Improved West and Gaeke method**
- **PRINCIPLE**: Ambient air is impinged into the solution of Sodium / Potassium tetracholoromecurate. The Sulphur Dioxide in the ambient air is reacts with TCM and forms a stable compound Dichlorosulphito mercurate. The complex is made to react with para rosaniline and formaldehyde to from the intensely coloured para rosaniline methylsulphonic acid. The absorbance of the solution is measured by means of a suitable spectrophotometer.
- **Methodology**: Sampling was carried out by following NAAM guidelines.
- **Range of the method** : 4 – 300 µg/m^3

NOx

- **Modified Jacob & Hochheiser Method**

- **PRINCIPLE** Ambient air is impinged into the solution of Sodium Hydroxide and Sodium Arsenite. The Nitrogen Dioxide present in Ambient Air converted into Nitrite ion. This nitrite ion so produced is determined colorimetrically by reacting it with phosphoric acid, sulfanilamide and N-(1-naphthyl)-ethylenediamine di-hydrochloride (NEDA) to form azo-dye and the absorbance of the same is measured at 540nm.
- **Methodology:** Sampling was carried out by following NAAM guidelines.
- **Range of the method** : 9 – 300 µg/m^3

AMMONIA

- **INDOPHENOL BLUE METHOD**

- **Principle of the Method**: Ammonia in the atmosphere is collected by bubbling a measured volume of air through a dilute solution of Sulfuric Acid to form ammonium sulfate. The ammonium sulfate formed in the sample is analyzed colorimetric by reaction with phenol and alkaline sodium hypochlorite to produce indophenols, a blue dye. The reaction is accelerated by the addition of sodium nitroprusside as catalyst.

- **Range of the method** : 5 – 5000 $\mu g/m^3$

OZONE

- **CHEMICAL (KI) METHOD**

- **PRINCIPLE**: Ozone is collected by bubbling air in 10ml 1% Potassium Iodide in a neutral buffer composed of Na_2HPO_4 and KH_2PO_4. The Iodine liberated in the absorbing solution is determined spectrophotometrically by measuring the tri iodide ion at 352 nm. Analysis should be carried out within 30 mins to 1 hour after sampling.

- **Range** : 20 to 20000 µg/m^3

CARBON MONOXIDE (CO)

- **Non Dispersive Infra Red (NDIR) technique**
- **Principle**: Based on Absorption spectroscopy
- **Range** : 0 – 4000 ppm with a resolution of 1 ppm

BENZENE

- **Adsorbtion and desorbtion followed by GC analysis**

- **Principle:** The ambient air is drawn through a activated charcoal using a low flow sampler in such a way that Benzene is adsorbed on the charcoal. The enriched Benzene is desorbed in carbon disulphide and analysed using GC with FID detector.

- **Range:** 0.1 – 100 µg/m^3

Benzo(a)pyrene (BaP) Particulate phase only

- **Solvent extraction followed by GC analysis.**

- **PRINCIPLE**: Half of the PM_{10} sample usually EPM 2000 FP is cut into pieces, extracted using Toluene, concentrated using rotary evaporator and analysed using GC with FID detector.

- **Range** : 1 – 100 $\mu g/m^3$

Heavy Metals

- **Sampling using EPM 2000 filter paper, digestion and followed by ICP method.**

- **PRINCIPLE:** Half of the PM_{10} sample usually EPM 2000 FP is cut into pieces, digested using HNO_3 & HCL and analysed using AAS/ICP.

- **Range** : Lead 0.001 – 10µg/m^3, Nickel & Arsenic 1 – 1000 ng/m^3

S.No	Parameter		PEENYA	YELA HANKA	CSB	Amco batteries	BANASWADI	GRAPHITE INDIA LTD	VICTORIAHOSPITAL
	Date of monitoring		16th Sep – 17th Sep	18th Sep – 19th Sep	20th Sep – 21st Sep	23rd Sep – 24th Sep	25th Sep – 26th Sep	27th Sep - 28th Sep	7th Oct - 8th Oct
1. 1.	PM10	8 Hrs. avg.	193, 156, 80	53.8, 51, 6.37	143, 200, 191	87.1, 71.9, 43.4	24.8, 28.1, 9.45	92.4, 164, 56.2	19.3, 173, 77.7
		8 hrs. max.	156	53.8	200	87.1	28.1	164	173
		24 hrs. avg.	143	37.1	178	67.4	20.8	104	90
1. 2.	PM2.5	24 hrs. avg.	59.5	18.4	83.8	73	22.2	24.6	17.1

S.No	Parameter		PEENYA	YELA HANKA	CSB	Amco batteries	BANAS WADI	GRAPHITE INDIA LTD	VICTORIA HOSPITAL
	Date of monitoring		16th Sep – 17th Sep	18th Sep – 19th Sep	20th Sep – 21st Sep	23rd Sep – 24th Sep	25th Sep – 26th Sep	27th Sep - 28th Sep	7th Oct - 8th Oct
3.	SO2	4 Hrs. avg.	5.24, BDL	BDL	BDL	BDL	BDL	BDL	BDL
		4 hrs. max.	5.24	2.0	2.0	2.0	2.0	2.0	2.0
		24 hrs. avg.	2.54	2.0	2.0	2.0	2.0	2.0	2.0
4.	NO2	4 Hrs. avg.	25.2, 19.8, 19.7, 24.7, 10.5, 13.8	21, 8.62 4.48, 2.44, 2.58, 2.27,	52.8, 51.4, 45, 70.5 38.2, 34.1	20.3, 19.9, 17.8, 22.8, 17, 22.8	6.62, 7.32, 7.51, 22.5, 16.6, 9.14	32.1, 9.7, 21.8, 52.7, 27.5, 28.8	3.59, 4.01, 6.16, 1.12, 0.61, 5.11
		4 hrs. max.	25.2	8.62	70.5	22.8	22.5	52.7	6.16
		24 hrs. avg.	20	6.91	48.7	16.8	11.6	28.8	3.43
5.	NH3	4 Hrs. avg.	9.63, 8.66, 18.3, 14.5, 3.2, 4.65	12.5, 25.8, 6.53, 42.5, 52.6, 105	14.1, 13.8, 17.4, 22.1, 10.3, 22.4	10.5, 59.1, 12.8, 32.6, 10.7, 8.51	9.16, 20.4, 8.23, 13.8, 8.69, 5.33	2.61, BDL 2.95, 9.38, 3.36, 5.6	1.59, 6.46, 2.31, 2.02, 2.46, 6.3
		4 hrs. max.	18.3	105	22.4	59.1	20.4	9.38	6.46
		24 hrs. avg.	9.82	40.9	13.4	22.4	11	3.97	3.52

S.No	Parameter		PEENYA	YELA HANKA	CSB	Amco batteries	BANASWADI	GRAPHITE INDIA LTD	VICTORIAHOSPITAL
	Date of monitoring		16th Sep – 17th Sep	18th Sep – 19th Sep	20th Sep – 21st Sep	23rd Sep – 24th Sep	25th Sep – 26th Sep	27th Sep - 28th Sep	7th Oct - 8th Oct
6.	O3	4 Hrs. avg.	4.76, 12.2, 4.97, 1.28, 5.26, 5.83	1.64, 2.27, 37.4, 6.1, 6.7, 10.5	7.42, 5.47, 4.77, 4.29, 4.6, 9.87	10.2, 2.41, 4.47, 0.66, 0.51, 0.59	20.4, 11.4, BDL, NM, NM, NM	2.16, 14.3, 2.33, 0.842, 1.06, 0.168	1.23, 4.69, 8.05, 3.96, 2.76, 2.26
		1 Hr. Avg.	17.8	10.9	11.0	BDL	BDL	21.9	13.6
		4/1 hrs. range	1.28 - 17.8	1.64 - 10.9	4.29 - 11.0	0.51 - 10.2	BDL - 20.4	0.168 - 21.9	1.23 - 13.6
		24 hrs. avg.	7.44	10.8	6.77	2.73	10.7	6.11	5.22
7.	CO	5 mins avg/max	BDL	BDL	BDL	BDL	BDL	BDL	BDL