SOURCE APPORTIONMENT OF AIR POLLUTANTS IN HYDERABAD CITY, INDIA

Dr. K.V. Ramani[1], Dasari.Prasad[1]

1Andhra Pradesh Pollution Control Board, Sanathnagar, Hyderabad – 500 015,AP

Abstract

The major cause of the increasing air pollution in Hyderabad city is attributed to the growing number of vehicles taking into consideration of the correlation between oxides of nitrogen and SPM. This has triggered certain actions by the state of Andhra Pradesh to control the vehicular pollution. Initially a slightly decreasing trend in the concentration of RSPM was observed for two years but later the concentrations of RSPM started inching upwards. This has necessitated the source apportionment and emission inventory of the pollutants to identify the major contributors and to assess whether high ambient concentrations are a result of anthropogenic activities in the city; fossil fuel use, garbage burning, re-suspended, etc.

As per the action plan submitted to Environmental Pollution (prevention & control) Authority (EPCA) for reducing the air pollution levels in Hyderabad city, it is planned to develop an air pollution inventory for Hyderabad city under which, APPCB has taken up Hyderabad Source Apportionment study training and demonstration project.

At the conclusion of the source apportionment work, a number of recommendations will be made by the APPCB and Government of Andhra Pradesh. Among the recommendations will be specific policy initiatives and measures that serve multiple purposes including the reduction of RSPM and oxides of nitrogen. In addition, it is expected that some of he measures will have other co-control benefits such as reduction of carbon dioxide, a common greenhouse gas. These measures, once implemented, will enable government of Andhra Pradesh and APPCB to meet the air quality management plan.

Keywords: *Source Apportionment, PM10, PM2.5, Emission inventory, policy initiatives, co-benefits, GHG reduction*

Introduction:

Hyderabad a 400 years old city is the state capital of Andhra Pradesh and fifth largest metropolis of India. The rapid rate of urbanisation with increased economic activity has encouraged migration to this twin city on a massive scale. The population of the city is near about 7 million with a density of 16988 person/square kilometer. The increase of public transport vehicles with respect to the growth of the population is not substantial. This has resulted in proliferation of personalised, private and Para transit modes (3 and 6 seat autos).

The 1.7 million fleet vehicles will be moving on a road length of about 365 km in the Hyderabad Urban Development Authority (HUDA). Most of the vehicles will be roaming in around 100Kms area resulting in traffic jams in high density corridors. The share of road space in Hyderabad is about 10% as against a desirable 20%. The situation is made worse as 20-30% of this available space is lost due to encroachments of foot paths and roads by hawkers, thus forcing pedestrians on to the roads. The on-street parking of the vehicles and stopping on the mid of the road (especially autos and buses) to service their passengers act as a hindrance for free flow of the traffic. The average speed in the central business districts due to aforesaid reasons in peak hours is as low as 6K.Ms/hr and the average is around 14KM/Hr.

The increasing air pollution problems have necessitated the source apportionment of air pollutants in Hyderabad city for better management of air pollution. This study is intended to identify different source contributions qualitatively and quantitatively.

Methodology:

Sampling is carried out at three locations in Hyderabad city viz., 1) Punjagutta representing highly commercial and moderately residential area

2) Chikkadpally representing moderately commercial and highly residential area and 3) Hyderabad Central University is away from the city which is predominantly a downwind site in winter and rest of the seasons it is an upwind site.

The samples were collected simultaneously for both PM2.5 and PM10 for 24 hours duration using mini volume (sampling @ of 5 liters/minute) samplers. The sampling has been planned to encompass the variations of the three principle seasons. In each season sampling has been carried out for 10 alternate days. Integrated sampling is carried by using Teflon and Quartz filters for both PM10 and PM2.5.The Teflon filters have been used for determining mass concentrations and the metals by using X-ray fluorescence and Atomic Absorption Spectrophotometer. The Quartz filters was analyzed for sulfate, nitrate and chlorides by Ion chromatography, Ammonia by automated colorimetry and Organic and Elemental carbon fractions by Thermal optical reflectance (TOR). In Hyderabad the winter period is characterised by a high degree of air pollution due to meteorological and thermodynamic conditions of the atmosphere. This paper discusses the interpretation of winter season results

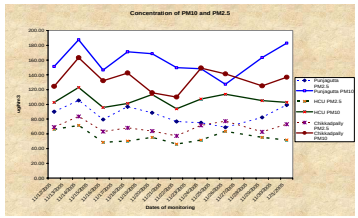
Results & Discussions:

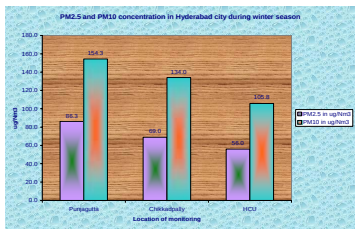
Mass Concentration: The concentration of PM10 and PM2.5 in descending order is Punjagutta, Chikkadpally and Hyderabad Central University (HCU). It is observed that the PM2.5 contributes to around 50% of PM10 concentration at all the stations. The concentration of PM10 at Punjagutta is 45% more than that of HCU and 14% higher than that of Chikkadpally. The percentage variation and the ratios of PM10 and PM2.5 are presented in tabular column in table.

Percentage ratio of PM2.5 in PM10

S. No.	Station name	PM10 in ug/Nm3	PM2.5 in ug/Nm3	% of PM2.5 in PM10
1.	Punjagutta	154.3	86.3	55.9
2.	Chikkadpaly	134	69	51.5
3.	HCU	105.8	56	52.9

The average concentrations at the three sites and the time series data for the three stations are given in graph.





The PM10 concentrations are exceeding the National Ambient Air Quality standards (NAAQS) prescribed for commercial and residential areas (100ug/Nm3) by 50% at Punjagutta and 34% at Chikkadpally. HCU is exceeding the NAAQS prescribed for sensitive places (60ug/Nm3) by 76%.

Source contribution: The composition of the particulate matter is analysed and the data is divided into three categories to correlate with the sources.

The first category consists of Elemental Carbon (EC), Organic Carbon (OC), sulfates and nitrates, which are mostly contributed by vehicles.

The second category is related to re-suspended dust lofted by natural wind and movement of vehicles from paved and unpaved road. The constituents of which depends much on the nature of the earth crust. It consists of Silicon, Aluminum, Calcium, potassium, Magnesium and Iron.

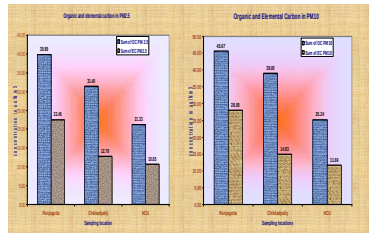
The third category consists of soluble potassium and organic carbon and is related to biomass burning.

Vehicular contribution: It is obvious that the vehicular contribution will be significant. Hyderabad is registering an annual growth of around 10% with a vehicular fleet of around 1.7 million at present. The growth was phenomenal in two wheelers and cars.

EC is mostly a by-product of diesel combustion, wear and tear of the tyres and biomass combustion. Organic Carbon (OC) is partially contributed by gasoline vehicles, diesel vehicles and biomass. The concentration of Elemental Carbon (EC) is higher in Punjagutta when compared to the other two stations. At Punjagutta the movement of density of vehicles is very high. The correlation between PM2.5 and PM10 concentration of OC and EC indicates that they contribute more to the fine particulate matter. The percentage of PM2.5 in PM10 for EC at Punjagutta is 80%, Chikkadpally is 85.6% and HCU is 91.3%.

Thus most of the Elemental carbon is contributed to the finer fraction of particulate matter. The percentage is lesser in Punjagutta as the contribution of EC from tyres to coarser fraction is more. HCU has relatively higher percentage, as it falls downwind side of the city. The concentration of EC and OC is depicted in the graph-2. The ratio of OC to EC is given in table.

Organic and elemental carbon in PM2.5 and PM10

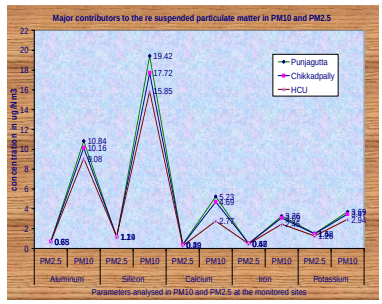


Station	PM 2.5			PM10		
	OC	EC	Ratio of OC/EC	OC	EC	Ratio of OC/EC
P.Gutta	39.9	22.4	1.78	45.7	28.1	1.63
C.Pally	31.4	12.8	2.46	39.0	14.9	2.61
HCU	21.3	10.6	2.00	25.2	11.6	2.16

The ratio of elemental carbon to that of organic carbon in Punjagutta is around 1.7 indicating the contribution mostly from diesel vehicles (Watson et al., 2001). Chikkadpally has a ratio of 2.6, which is higher than Punjagutta. This is due to the restaurants and industrial chimneys using biomass fuel and with moderate vehicular contribution. HCU has a ratio of 2.0 i.e., it is between to that of Punjagutta and Chikkadpally. The site is relatively far from any local emissions the higher concentration of EC may be attributed to the upwind activities contribution on the site.

High OC levels may be a result of gasoline-fuelled vehicles especially by the two stroke vehicles (Autos and scooters), diesel vehicles, cooking, open garbage burning and Secondary Organic Aerosol formation. In Hyderabad 90% of the vehicle fleet uses petrol as fuel. The evaporation losses at the time of dispensing the gasoline will also contribute to the elevated levels of organic carbon. In the absence of or scant presence of other sources (biomass combustion) for EC and OC in the city, vehicular sources for major contributors for the above.

Re suspended/Re-entrained particles: Silicon and aluminum are the major contributors for the re-suspended dust. The re-suspended dust contribution to the PM10 is more than that of PM2.5. The crustal elements lofted by vehicular movement, natural winds contribute to the coarser part of the particulate matter. The concentrations of the Aluminum, Silicon, Calcium, Iron and potassium at the monitored three sites are presented in the graph.

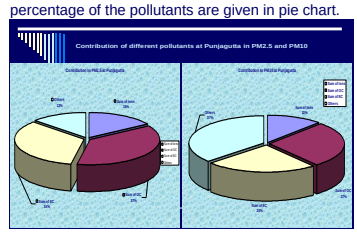


Vegetative/ Biomass burning: Biomass burning is characterized by high OC, EC, and K (Watson and Chow, 2001). Water-soluble K is about one tenth of the total K abundance in most fugitive dusts, if this exceeds it indicates that other sources are responsible for water-soluble K in atmospheric samples (*Jeffrey Brook et al)*. Various types of biomass are used in Hyderabad.

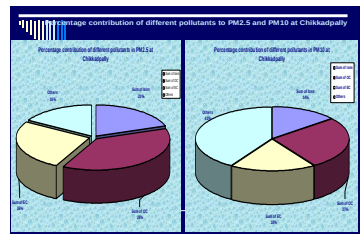
Station	PM2.5			PM10		
	Solubl e K	K	Ratio	Solub le K	K	Ratio
P.Gutta	1.24	1.50	0.82	1.34	3.69	0.36
C.Pally	1.23	1.48	0.83	1.47	3.47	0.42
HCU	1.02	1.26	0.81	1.18	2.94	0.4

CONCLUSIONS:

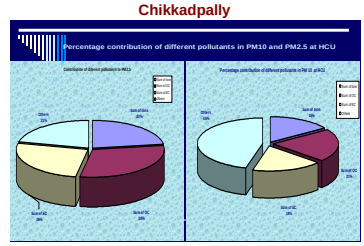
The residents of Hyderabad are exposed to different air pollutants at higher levels making them susceptible for various respiratory disorders and there-by morbidity. The concentration of particulate matter of size fractions PM10 and PM2.5 are exceeding the standards for healthy living. The total carbon content is more than 50% in Hyderabad. The ultimate effect is economic losses on account of the morbidity caused due to pollution, thus affecting the production. This necessitates initiating various measures to reduce the concentration of the air pollutants. The percentage of the pollutants are given in pie chart.



Punjagutta



Chikkadpally



Hyderabad Central University

Measures taken to reduce the vehicular pollution: The construction of flyovers is taken up to relieve pressure at traffic junctions. The traffic flow is managed in a better way by removing the number of intercepts and widening of the roads. Intelligent Vehicle Parking system is Smart Card based prepaid card system wherein the vehicle owner does not have to pay parking fee on the spot. There are 115 intelligent parking lots in operation. Multi Modal Transport System (MMTS) services were introduced in the year 2003 in one route and in 2004 in another route. Mass Rapid Transit System (MRTS) is proposed in three high density corridors. An outer ring road is being laid, which will serve as a by-pass for heavy vehicles. To meet the Bharat stage-III norms, government has introduced fuel with reduced sulfur content in diesel (350PPM) and in Petrol (150PPM). Similarly petrol with low Benzene (0.56%) has also been introduced. The fuel dispensing stations in HUDA area have been directed to pre-mix 2T oil to prevent the adulteration of loose 2T oil. Alternative fuels like Liquefied petroleum gas (LPG), Compressed Natural Gas (CNG) and Bio-diesel are introduced in the city to reduce the pollution in the city. The vehicles which are 15-years old, are phased-out, as they cause not only pollution because of poor combustion, but also cause traffic jams due to frequent failures and low speed. Computerised Inspection and Maintenance (I&M) centers are established with linkage to registration databases to catch hold of the polluting vehicles. The Government of AP has come up with a Green tax to discourage the usage of old vehicles. To strengthen the public transport, the taxes on public transport (APSRTC buses) are reduced.