Acta Ciencia Indica, Vol. XXXVII C, No. 4, 271 (2011)

VOLATILE ORGANIC COMPOUND IN THE RESIDENTIAL AREAS OF AGRA (INDIA)

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RECEIVED : 26 May, 2011

A sampling program was conducted to determine the ambient VOCs levels in the city Agra [India] during day time and overnight from August, 2009 to July, 2010. Sampling sites were selected at Residential areas of Agra. Samples were analyzed for Acetone and o-dichlorobenzene. The day-and-night differences and day-to-day variations in the concentrations of two selected species were investigated and the effects of several factors such as metrological parameters, sources and transport characteristics on them, were studied. A back trajectory analysis showed that relatively higher levels of VOCs were related to long-range transport of pollutants from polluted area. The vertical motions of air masses also had a large impact on the variations of the level of VOCs.

KEYWORDS : Volatile organic compounds (VOCs), Agra, air.

INTRODUCTION

The quality of indoor air is causing increasing concern in the community. Volatile organic compounds (VOCs) are major indoor air contaminants. Many have indicated that indoor air is contaminated to various degrees by a wide variety of hydrocarbons and hydrocarbon derivatives including aliphatic, aromatics, alkyl benzene, ketones, polycyclic aromatics and chlorinated hydrocarbons. Among the volatile indoor air pollutants, aromatics hydrocarbons, such as benzene, toluene, ethylbenzene and the isomeric xylenes (BTEX), are particularly abundant in the indoor environment (Krause [4], Hgen [2, 3]). The range of measured concentrations of different VOCs in indoor air is extremely wide, often two or more order of magn/tude. Also, the range of concentrations for specific VOCs can vary widely between measurements. USEPA carried out a total exposure assessment methodology (TEAM) study, which measure, personal exposure to 20-30 VOCs in air and drinking water of 650 residents of seven cities (Pelhzzari [8], Pelhzzari [5, 7], Wallace [9]). The main finding in the TEAM study was that residential indoor air concentration significantly exceeded outdoor air concentrations for all of the prevalent VOCs, *e.g.* benzene, xylene isoer, styrene, ethylbenzene, chloroform, n-decane, undecane and trichloroethylene (Harley [1]). They also monitor VOCs concentration in four commercial and publicaccess building. They found similar result as those obtained in residence Over 200 aromatics, organic halogens, ester, alcohol, phenols, ether, ketones, aldehydes, and eposides were identified, in addition to several hundred aliphatic hydrocarbons. In a mainly completed office building, the concentration of ethylebenzene, 1, 1, 1-trichloroethane and xylene declne sharply over time. The concentration

of individual VOCs ranged from 1 to 500 mg m^3 before occupancy and from 1 to 60mg m^3 after occupancy.

METHODOLOGY

Various numbers of interpretative methods can be employed for the detection of compounds depending upon the medium, means of sample and the level of sensitivity required. Detection of Acetone and o-dichlorobenzene using Ultra RAE 3000 monitor (VOC monitor) under operation condition for the identification of compounds concentration in enveloping air of semi arid zone, as parts per million (ppm), parts per billion (ppb), micrograms per cubic meter and milligrams per cubic meter quantities are often found in environment samples. The Ultra RAE 3000 is hand-held programmable equipment. A specific PID monitor is designed to provide an instantaneous exposure of a specific organic gas. It monitors a specific organic gas by utilizing a gas separation tube and the photo ionization detector (PID) with **a** 9.8 eV gas discharge lamp. It can be used to measure total Volatile Organic Compound (VOC) as a broad band monitor by utilizing the PID with a 9.8 eV, 10.6 eV or 11.7 eV lamps. The instrument also accomplishes compound-specific measurement along with the general Volatile Organic Compound (VOC) measurement. This necessitates using a RAE Sep separation tube (acetone and o-dichlorobenzene). After an event is recorded, the unit records a shorter form of the data. When transferred to a PC running ProRAE Studio, this data is arranged with a sample number, time, data, gas concentration and other related information. The technique has been used for the above programme as per the standard method. The sample size for pre concentration step will be 8 hours active sampling by using low flow pump or fortnightly for passive sampling. The sample frequency will be twice a month on all sites.

RESULTS AND DISCUSSION

Table-1. Mean concentration of acetone and o-dichlorobenzene at various sites of residential area of Agra

Residential area		Acetone	o-dichlorobenzene
Heera Bagh	Mean	1.31	0.59
	Min	1.32	0.59
	Max	0.02	0.01
	S.D.	4.67	2.10
Maharishi Puram	Mean	0.86	0.39
	Min	0.98	0.44
	Max	0.00	0.00
	S.D.	3.51	1.58
Jaipur House	Mean	1.12	0.51
	Min	0.74	0.33
	Max	1.29	0.13
	S.D.	3.27	1.47

Kamla Nagar	Mean	0.65	0.29
	Min	1.10	0.50
	Max	0.001	0.00
	S.D.	3.75	1.69

At Heera Bagh concentration of acetone varied from 1.31 to 0.59 ppm. The acetone and o-dichlorobenzene concentration near Maharishipuram was observed within the range of 0.86 to 0.39 ppm. At Jaipur House, total acetone concentration ranged from 1.12 to 0.51 ppm and Kamla Nagar range from 0.65 to 0.29 ppm. Highest concentrations are observed during winter season followed by monsoon and summer season. VOCs associated with emissions due to diesel internal combustion engines have been identified at all the four commercial locations. The highest concentration was found at Heera Bagh. The HAP component in total VOC annual averages at commercial sites of Sadar, New Agra Market, Kinari Bazaar and Raja Mandi market are 83.44%, 98.84%, 75.84% and 89.22% respectively. Mobile source air toxics component of HAPs have been found to be 87.33%, 84.33%, 79.55% and 74.23% respectively.

Table-2 Residential areas wise statistical variance of acetone and o-dichlorobenzene
ANOVA table for acetone and o-dichlorobenzene

Sources		**Acetone**	**o-Dichlorobenzene**
Between Months	SS	6.03	1.22
	df	3.00	3.00
	MS	2.01	0.41
	F	1.80	1.81
	P-Value	0.152	0.151
Errors	SS	102.43	20.74
	df	92.00	92.00
	MS	1.11	00.23
	F	–	–
	P-Value	–	–
Total	SS	108.46	21.97
	df	95.00	95.00
	MS	–	–
	F	–	–
	P-Value	–	–
ANOVA indicated no significant difference between all sampling residential areas.			

On applying the one way ANOVA test (Table-2). We found statistically significant difference ($P < 0.05$), between monthly medium concentrations. Maximum mean values found at Jaipur House (1.29 ppm), lowest mean value found at Maharishi Puram (0.00 ppm). We after plays an important role in the rate at which smog precursors are converted into aerosols. For example, the speed of the conversion of sulphur dioxide to sulfate and the formation of ozone is dependent on temperature, relative humidity and a number of chemical parameters. Conversion is faster at higher temperature, greater relative humidity and at higher OH radical

concentrations, so smog is formed faster in hot humid climates and conversion speeds will vary accordingly at a rate less than 10% per hour. That is why the presence of VOCs is higher in winter's comparison to summers.

CONCLUSION

This study characterizes the extent to which the urban atmosphere is contaminated with anthropogenic chemicals. Many of these chemicals are known to be toxic at concentration much higher than those measured in this study. The risk associated with low level but long term exposures to these chemicals are only now being evaluated and are highly uncertain. Most of the VOCs can be associated with mobile source and diesel internal combustion engines. However, as per the auto fuel policy of Govt. of India, buses, taxis and autorikshaws have switched over to CNG as fuel and benzene content in petrol has been reduced to l% (Auto Fuel Policy, Govt. of India, 2001). There is need to monitor VOCs again in changed scenario to assess the effect of actions again.

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