Habitation of volatile organic compounds (VOCs) in the aura of Agra the city of Taj Mahal

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ABSTRACT

When speaking about harm to the human body in the term of pollution, indoor pollution is equally harmful as the outdoor pollution. Volatile Organic Compounds contribute to the toxic oxidants which are harmful to the ecosystem, human health and atmosphere. Volatile organic compounds (VOCs) are major group of air pollutants which play critical role in atmospheric chemistry. It contributes to toxic oxidants which are harmful to ecosystem human health and atmosphere. A sampling program was conducted to determine volatile organic compounds (VOCs) levels in the aura of the Agra (India) during day time and overnight between mid-September and mid-October 2010. Sampling sites were selected at residential area and industrial area in Agra. Samples were analyzed for benzene, toluene, ethylenebenzene and o-xylene. The day-and-night differences and day-to-day variations in the concentrations of four 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.

Key words: Volatile organic compounds (VOCs), ambient air.

INTRODUCTION

Volatile Organic Compounds (VOCs) have grasped much attention over the last two decades because of their contribution in the formation of oxidants like ozone and PAN in the troposphere besides their health implications to human beings (Haagen³). The toxicological profiles of these compounds provide ample proof that humans are easily prone to the hazardous influence since they are diffused in the ambient air through source like motor vehicle exhaust, manufacturing and cigarette smoke (Wallcare⁹). Their mutual reactions with each other may produce new hazardous combinations too (Khillare⁵ and co-worker, Joseph⁴). In spite of the well known toxic effects of VOCs, data available on VOC levels in India is very limited. Moreover, there is no legislation for VOC in ambient air of India (Sengupta B7). Few studies have reported VOC level in Indian Metro – cities (Srivastava⁸ *et al.*,). Since the city is a developing hub of industrial activity and is progressing rapidly towards acquiring a metropolitan status a study of VOCs here is highly significant and relevant (Wan-Kuen¹⁰). It can be utilized to trace the relative potential of various sources of emission, engineering methods to check this kind of pollution and thus preventing human health and natural environment from these hazards.

Sampling and Analytical 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 compounds using Ultra RAE 3000 monitor (VOC monitor) under operation condition for the identification of compounds concentration in ambient air 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 sample sizes for pre concentration step were 8 hours active sampling by using low flow pump or fortnightly for passive sampling. Two central sites had been selected for the studies on diurnal variation. The samples were collected at each central site 8 hours sampling over 24 hours. The sampling period was between mid August and mid September 2010.

RESULTS AND DISCUSSION

Statistical Analysis : Residential Area

Concentrations of compounds at different sampling sites in residential area are given in table -1. Maximum average concentration of VOCs (1.01ppm) was found at site New Agra while minimum at site Kamla Nagar (0.24 ppm).high level

Site		benzene	toulene	ethylenebenzene	o-xylene
Kamla Nagar	Avg.	0.26	0.25	0.24	0.26
0	Min	0.12	0.12	0.11	0.12
	Max	0.56	0.55	0.53	0.57
	S.D.	0.05	0.05	0.04	0.05
Sadar	Avg.	0.57	0.56	0.54	0.58
	Min	0.14	0.14	0.13	0.14
	Max	2.24	2.19	2.11	2.28
	S.D.	0.08	0.08	0.06	0.08
New Agra	Avg.	0.99	0.98	0.94	1.01
	Min	0.06	0.06	0.06	0.06
	Max	5.15	5.06	4.87	5.24
	S.D.	0.07	0.08	0.07	0.07

Table 1: VOCs concentration (ppm) at residential area

Table 2: VOCs concentration (ppm) at Industrial area

Site		Benzene	Toulene	Ethylenebenzene	O-xylene
Nunihai	Avg.	0.91	0.10	0.86	0.93
	Min	2.09	2.05	1.98	2.13
	Max	8.89	8.73	8.41	9.06
	S.D.	0.09	0.09	0.09	0.09
Sikandra	Avg.	3.62	3.55	3.42	3.68
	Min	1.84	1.80	1.74	1.87
	Max	8.02	7.87	7.58	8.16
	S.D.	0.37	0.37	0.35	.38
Ram Bagh	Avg.	2.79	2.74	2.64	2.84
	Min	1.35	1.32	1.28	1.37
	Max	7.84	7.70	7.42	7.99
	S.D.	1.71	0.16	0.16	0.17

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of VOCs at New Agra could be attributed to very high automobile traffic density, slow movement of the traffic and more frequent idling of the vehicles as during the sampling period.

Concentration of compounds at different sampling sites in Industrial Areas is given in table-2. Maximum average concentration of VOCs (3.68ppm) was found at site Sikandra while minimum at site Nunihai (0.10ppm). The industrial area in these locations is non-chemical. However, degreasing activity was observed in considerable scale as most of these are engineering unit. Open defecation in slums has been found around the industrial area, contributes to emissions, which are classically considered to originate from sewage sludge. Large scale use of generators result in VOCs associated with diesel internal combustion engine (CarterWPL¹).

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 exposure to these chemicals are only now being evaluated and are highly uncertain. (Mao Ting6). Most of the VOCs can be associated with mobile source and diesel internal combustion engines (chang²). 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 1% (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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