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ASSESSMENT OF BTEX IN AMBIENT AIR OF AGRA

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ABSTRACT

Volatile organic compounds (VOCs), which are habitually found in both indoor and outdoor environments, may represents a significant health risks. In this context, we assess the BTEX in ambient air of Agra. The objective of this study is to present the levels of BTEX from five locations of Agra. BTEX sampling was carried out by using the Respo Rae Ultra VOCs Monitor for four hours at each sampling sites for five times in a month. The BTEX levels were higher in industrial location as well as refueling pump stations. The annual mean levels of BTEX at five locations were ranged from 7.5 µg/m^3 – 17.2 µg/m^3, 11.2 µg/m^3 – 39.7 µg/m^3, 3.4 µg/m^3 – 8.7 µg/m^3, and 2.3 µg/m^3 – 5.8 µg/m^3 respectively. We found that, in comparison with other studies, our levels of BTEX were quite low. Still, due to the small sample size of the present study, further studies are needed to be carried out in this regard to prepare the strategic plan to control the BTEX levels not only in Agra but also other cities of India and abroad.

Keywords :- Correction factor, dermal, Environmental tobacco smoke, t-test, ubiquitous, VOCs.

I. INTRODUCTION

Agra, India suffers from high ambient concentrations of atmospheric pollutants, including BTEX, particulates, carbon monoxide, oxides of nitrogen, ozone and sulphur dioxide. Amongst them, volatile organic compounds mainly benzene, toluene, ethylbenzene and xylene, collectively called BTEX, play an important key role in tropospheric chemistry. Industrial processes, combustion of fossil fuels, vehicular exhaust, domestic heating and electricity generation, fuel distribution, solvent use, landfills, waste treatment plants, environmental tobacco smoke, fuel combustion, building materials, furnishing, furniture and carpet adhesives, paints and solvents, cleaning agents, air freshners and cosmetics are the various sources of BTEX in ambient air[1]. In recent years, the number of days with ozone hourly concentration exceeding the National ambient air quality standard. Ozone is not emitted directly into air, it is formed in the troposphere as a result of complex photochemical reactions that involve VOCs and NO_x as its precursors. VOCs have a wide range of variation in reactivity with respect to ozone formation [2].

Organic solvents such as benzene, toluene, ethylbenzene, and xylene (BTEX), are a heterogeneous group of pollutants, known as hazardous air pollutants (HAPs). These are emitted from several sources. Human exposure to BTEX can result from inhalation., ingestion and dermal absorption. Benzene is one of the most prevalent HAPs in urban areas [3] and is of particular interest because it has been associated with several adverse health outcomes including pediatric cancer and intrauterine growth restriction [4,5]. In addition, IARC classify benzene as known human carcinogens and ethylbenzene, toluene and xylene as possibly carcinogenic to humans [6]. Exposures to BTEX is ubiquitous and can results in a wide range of acute and chronic health effects such as

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sensory irritation, nervous system impairment, asthma and cancer [7]. Therefore, there is an international recognition of the potential health risks associated with exposure to BTEX and of need for action to assess the ambient concentrations of BTEX as well as their exposures in the general population and to minimize their risks.

Several researchers attempted to assess the exposures of BTEX to humans and its ambient levels. Maternal exposure to ambient levels of benzene and neural tube defects among offspring studied and reported that, mothers living in census tracts with the highest benzene levels were more likely to have offspring with spina – biofida than were women living in census tracts with lowest benzene levels [8]. Indoor and outdoor BTEX exposures in children living in a petrochemical area in Spain was investigated and found that, industrial emissions contribute exposure on children [9]. Patterns of VOCs and BTEX concentration in ambient air around industrial sources in Daegu, Korea were determined and significant difference observed between the ratios for the residential and commercial areas implies that the two areas have different emission sources [10]. The main aim of the present study to assess the ambient levels of BTEX in ambient air of Agra and to identify their sources.

II. METHODOLOGY

In this study, ambient air samples were collected during the period of November 2008 to October 2009 at five locations, in Agra, Uttar Pradesh, India. The selected five locations were, Vibhab Nagar (Residential), Raja Ki Mandi (Commercial), Nunhai (Industrial), Rambagh Crossing (Traffic Intersection), and New Agra (Refueling pump station). A real time measurements of benzene, toluene, ethylbenzene and xylene, collectively regard as BTEX, concentration levels were performed by using Respo Rae 3000 Ultra VOCs Monitor, which is a programmable compound specific photo-ionization detector (PID) and monitor BTEX by utilizing a gas separation tube with 9.8 eV gas discharge lamp. However, correction factor (CF) have been determined the quantity of BTEX gases in ambient air. Prior to start sampling of BTEX gases in ambient air, first we calibrate the monitor with isobutylene gas by input an equivalent corrected span gas concentration when prompted for the value of BTEX gases.

The sample size for pre-concentration step was four hours for using the Respo Rae 3000 Ultra VOCs Monitor. Samples were collected for five times in a month, during peak hours at all the selected five locations in Agra. The collected data has been analysed under SPSS 15 software and performed one- sample t-test.

III. RESULTS AND DISCUSSIONS

In this study, concentrations of BTEX were measured in ambient air at the five selected locations in Agra, during November 2008 to October 2009. Table 1. Summarizes the levels of BTEX measured in ambient air of Agra at all the selected locations viz. residential, commercial, industrial, traffic intersections and refueling pump station respectively.

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TABLE 1. Min. Max. and Mean Concentrations of BTEX at all the selected locations in Agra during Nov. 2008 to Oct. 2009 (μg/m^3)

NAME OF SITE	Conc (μg/m^3)	Benzene	Toluene	Et.benzene	Xylene
1.Vibhab Nagar[Residential]	Min.	4.0	10.8	1.7	1.2
	Max.	12.9	37.4	5.8	3.9
	Mean	7.5	21.4	3.4	2.3
2.RajaKi Mandi[Commercial]	Min.	4.9	5.6	3.0	1.5
	Max.	19.4	22.7	8.7	5.8
	Mean	9.6	11.2	4.6	2.9
3. Rambagh Crossing [Traffic Intersection]	Min.	7.8	8.9	3.6	2.3
	Max.	16.7	19.7	7.5	4.7
	Mean	10.4	12.2	5.0	3.1
4. Nunhai [Industrial]	Min.	10.3	23.7	6.3	3.6
	Max.	25.2	55.4	11.8	7.8
	Mean	17.2	39.7	8.7	5.8
5. New Agra [Refueling Pump Station]	Min.	8.4	10.7	3.9	2.6
	Max.	18.1	21.7	8.1	5.2
	Mean	11.3	14.2	5.4	3.7

From the Table 1, it was evident that the concentrations of benzene ranged from 4.0μg/m^3 – 25.2 μg/m^3. The minimum concentration of benzene was observed at Vibhab Nagar residential location and the maximum concentration of benzene was observed at Nunhai industrial location. The concentrations of toluene, ethylbenzene and xylene ranged from 5.6 μg/m^3 – 55.4 μg/m^3, 1.7 μg/m^3 – 11.8 μg/m^3, 1.2 μg/m^3 – 7.8 μg/m^3 respectively. In this study, the levels of BTEX were much lower than those observed in other studies performed in different cities of India [11] and different countries of the world. When compared to the other mega- cities of India, the BTEX levels in Agra were much lower than those observed in Mumbai [12], Delhi [13] and Kolkata [14] and different countries like Taiwan [15], Northern Germany [16] and Mexico [17] etc. Figure 1 to 4, shows

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the annual mean concentrations of BTEX in selected locations of Agra, during the study periods. Figure 1. Shown that the annual mean concentration of benzene was highest at industrial site due to industrial activities as well as human activities. The levels of benzene follow the given trend :

Industrial > Refueling Pump Station > Traffic Intersection > Commercial > Residential

Figure-1. Annual mean concentrations of benzene [µg/m^3] at different locations.

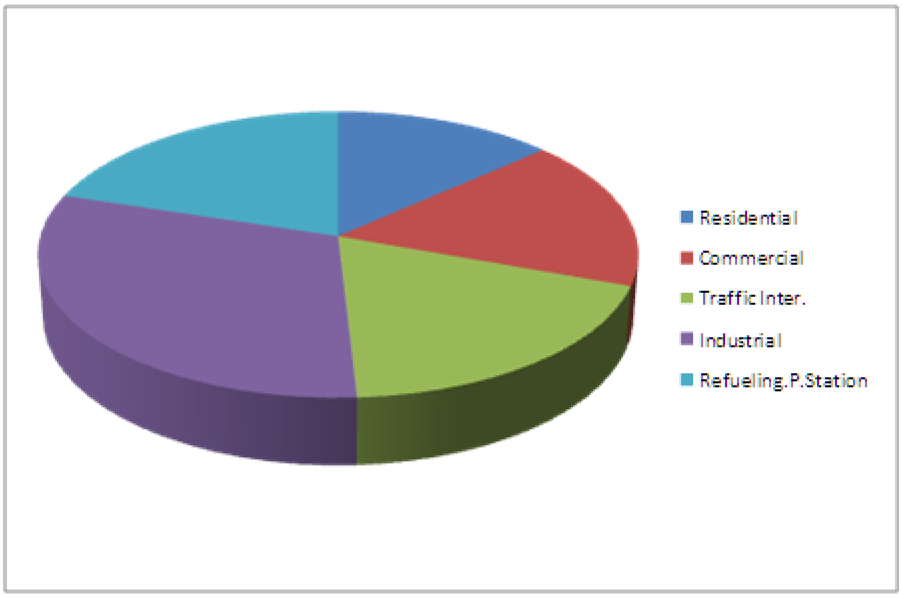

Figure-2. Annual mean concentrations of toluene [µg/m^3] at different locations.

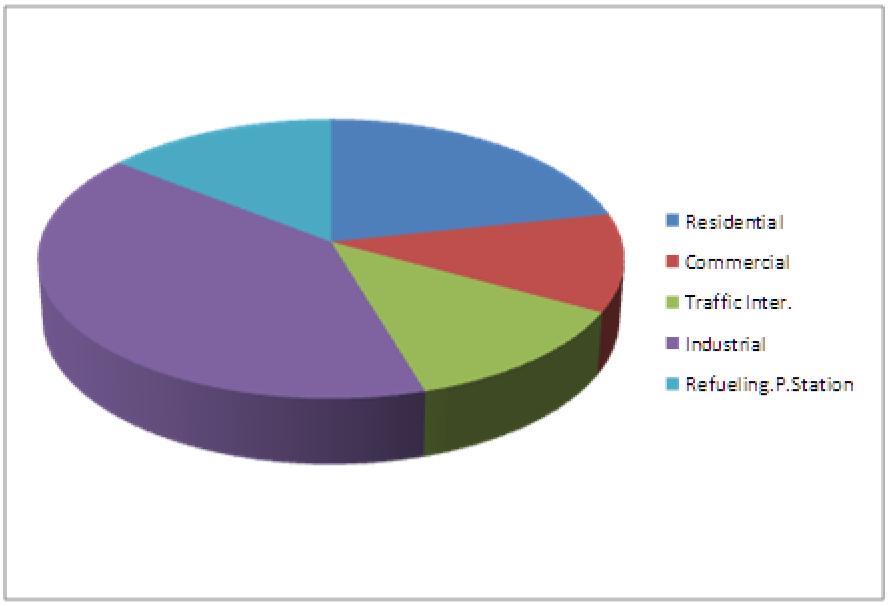

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Figure-3. Annual mean concentrations of ethylbenzene [µg/m^3] at different locations.

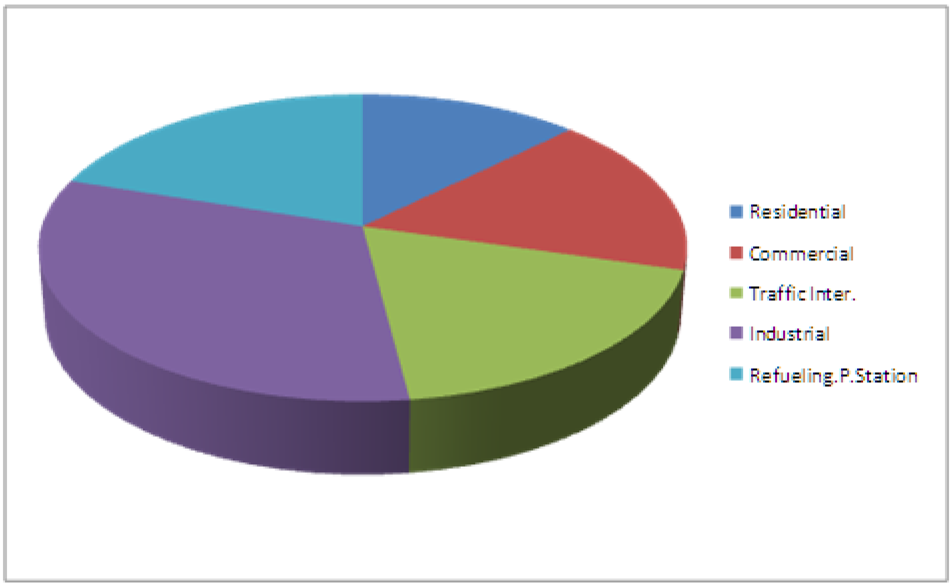

Figure-4. Annual mean concentrations of xylene [µg/m^3] at different locations.

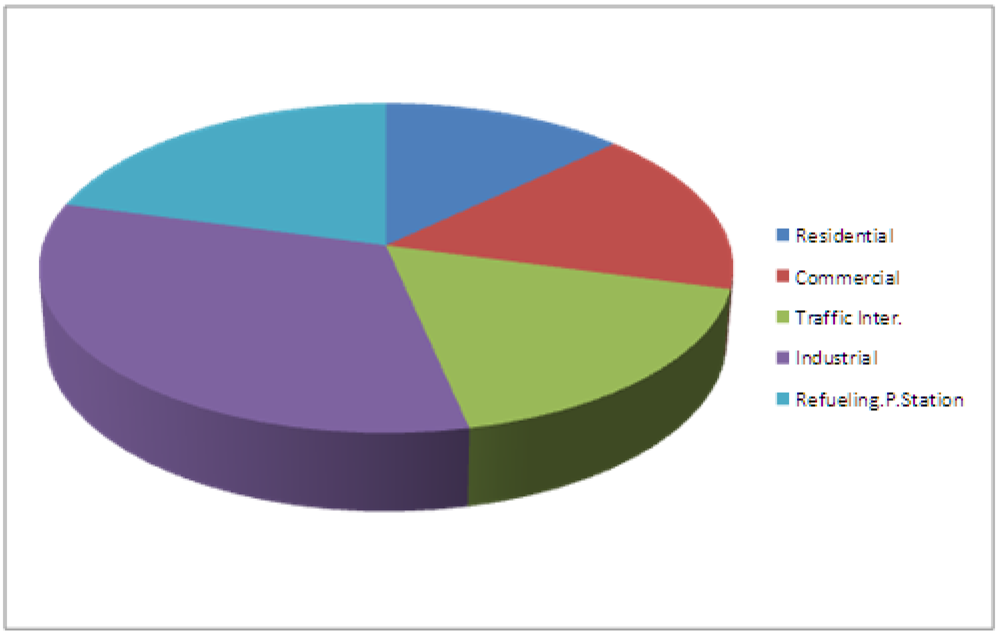

Figure 2, shown that the annual mean concentration of toluene was highest at industrial location and lowest at commercial location. Toluene followed the given trend :

Industrial > **Residential** > **Refueling Pump Station** > **Traffic Intersection** > **Commercial**

.Ethylbenzene and xylene were followed the given trend :

Industrial > **Refueling Pump Station** > **Traffic Intersection** > **Commercial** > **Residential**

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The higher levels of BTEX represent at the industrial location because the decisive source of atmospheric emissions of BTEX is exhaust gases from petrol driven automobiles. The other sources include evaporative emissions produced during petrol handling, storage, distribution and solvent usage. The lower values of BTEX concentrations represent at the residential site because use of petrol, diesel driven vehicles only observed.

IV. CONCLUSIONS

We have determined the ambient levels of BTEX in Agra, Uttar Pradesh, India, by using Respo Rae Ultra VOCs Monitor at five locations. In Agra, the mean ambient levels of BTEX were quite low and comparable to studies done in mega- cities of India and other countries of the world, due to use of petrol and automobiles at busy roads. Other sources and anthropogenic activities, also contributes to an extent to BTEX levels in ambient air. The variations of BTEX ambient air levels were found at five locations. The levels of BTEX in ambient air were found to be dependent on the season. Sampling sites also were found to be influenced the BTEX levels in ambient air of Agra. Thus, we have to need to prepare the strategic plan to control the BTEX levels in ambient air of Agra.

V. ACKNOWLEDGEMENT

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REFERENCES

[1.] J. M. D. Sabarit, N. J. Aquilina, C. Meddings, S. Baker and R. M. Harrison, Relationship of personal exposure to volatile organic compounds to home, work and fixed site outdoor concentrations, ***Science of The Total Environment, 409, 2011, 478-488.***

[2.] M. Y. Hwa, C. C. Hsieh, T. C. Wu and L. F. W. Chang, Real world vehicle emissions and VOCs profile in the Taipei tunnel located at Taiwan Taipei area, ***Atmospheric Environment, 36, 2002, 1933-2002.***

[3.] M. F. Mohamed, D. Kang and V. P. Aneja, Volatile organic compounds in some urban locations in United States, ***Chemosphere, 47, 2002, 863-882.***

[4.] K. W. Whitworth, E. Syamanski and A. L. Colter, Childhood lymphohematopoletic cancer incidence and hazardous air pollutants in Southeast of Texas, 1995-2004, ***Environmental Health Perspectives, 116, 2008, 1576-1580.***

[5.] S. N. Yin, R-B. Hayes, M. S. Linet, G. L. Li, M. Dosemeci and L. B. Travis, An expanded cohort study of cancer among benzene- exposed workers in China, ***Environmental Health Perspectives, 104, 1996, 1339-1341.***

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

[6.] IARC, IARC monographs on the evaluation of carcinogenic risks to humans, complete list of agents evaluated and their classification, ***IARC, 2006.***

[7.] L. Caprino and G. Tonga, Potential health effects of gasoline and its constituents : A review of current literature on toxicological data, ***Environmental Health Perspectives, 106, 1998, 115-125.***

[8.] J.L. Philip, Maternal exposure to ambient levels of benzene and neural tube defects among offspring : Texas, 1999 – 2004, ***Environmental Health Perspective, 119, 2011, 397-402.***

[9.] B. A. Gonzalez, M. B. Rodriguez, A. Daponte and M. Lacasana, Indoor and outdoor BTEX exposure in children living in a petrochemical area in Spain, ***Epidemiology, 19[6], 2008, 12-16.***

[10.] S. W. Choi, S. W. Park, C. S. Lee, H. J. Kim, S. Bae and H. I. Inyang, Patterns of VOCs and BTEX concentrations in ambient air around industrial sources in Daegu, Korea, ***Journal of Environmental Science and Health, 44[1], 2009, 99-107.***

[11.] H. Hallen, J. Kukkonen, M. Kauhaniemi, H. Hakola, T. Laurila and H. Pietarila, Evaluation of atmosphereic benzene concentrations in the Helsinki Metropolitan Area in 2002-2003 using diffusive sampling and atmospheric dispersion modeling, ***Atmospheric Environment, 39, 2005, 4003.***

[12.] M. Rao, A. M. Pandit, G. C. Sain, P. Sharma, S. Krishnamoorthy, T.M. Nambi and K. S. V. Nambi, Non-methane hydrocarbons in industrial locations of Bombay, ***Atmospheric Environment, 31, 1996, 1077.***

[13.] A. Srivastava, A. E. Joseph, A. More and S. Patil, Emissions of VOCs at urban petrol retail distributions centres in India [Delhi and Mumbai], ***Environmental Monitoring and Assessment, 109[1], 2005, 22.***

[14.] C. Dutta, D. Som, A. Chatterjie, A. K. Mukharjee, T. K. Jana and S.Sen, Mixing ratios of carbonyls and BTEX in ambient air of Kolkata, India and their associated risks, ***Environmental Monitoring and Assessment, 148, 2009, 97.***

[15.] C.H. Lai, and K. S. Chan, Characteristics of C2-C15 hydrocarbons in the air of urban Kaohsiung, Taiwan, ***Atmospheric Environment, 38, 2004, 1997.***

[16.] E. Ilgen, N. Karfich, N. K. Levsen and J. Angerer, Aromatic hydrocarbons in the atmospheric environment : Part I. Indoor versus outdoor sources, the influence of traffic, ***Atmospheric Environment, 35, 2001, 1235.***

[17.] H. Bravo, R. Sosa, P. Sanchez, E. Bueno and L. Gonzalez, Concentrations of benzene and toluene in the atmosphere of the southwestern area at the Mexico city Metropolitan one, ***Atmospheric Environment, 36, 2002, 3843.***