IJASRM

International Journal of Advanced Scientific Research and Management, Vol. 1 Issue 1, January 2016.

www.ijasrm.com

Concentration of Benzene and Toluene in ambient air influenced by External Factors at a diesel and petrol refueling pump station in Firozabad, India

Sandhya Chaudhary [1]

[1] Department of Chemistry, N.R.E.C. College,
Khurja, Bulandshahr, U.P. – 203131, India

Abstract

Mostly public transport systems in Firozabad, India, release vehicular emission on a large scale of diesel-powered buses, auto-rickshaw etc. These all types of vehicles are fuel economical and durable. However, refueling pump station attendants, vehicle drivers and the public are exposed to the diesel and petrol fuel and fumes associated with them. Fuel attendants are exposed to diesel and petrol exhaust fumes, as well as emissions from fuel pumps on a daily basis, and are at risk to adverse health effects associated with inhalation of volatile organic compounds (VOCs) released. The VOCs released include benzene and toluene, (BT), which have a high level of toxicity. Studies relating to the concentrations of BT at diesel and petrol stations are limited, as most petrol refueling stations. Thus, analyses of benzene and toluene concentration are significant for developing countries whose transport systems rely on diesel-powered vehicles, and where public health measures are often less rigorously enforced.

A larger study relating to the health impact of Benzene and Toluene on fuel attendants at a diesel and petrol-refueling bay, an initial study was undertaken to analyze the two main external factors that are influential on fluctuations of ambient concentrations. The mean concentration of benzene and toluene 18.42-41.01 µg/m3, 26.12-44.12µg/m3 and 27.12-33.71 µg/m3, 28.36-37.49µg/m3 were found to be higher at Hindustan petrol pump (at Jain mandir) and Bharat petrol pump (at Jaleshar road) respectively. Thus, an analysis of total volume dispensed, and ambient temperature at the station, both affecting the concentrations of Benzene and Toluene released, was conducted.

Keywords: *Benzene, Toluene, VOCs and BTEX*

1. Introduction

The regular impact on air quality world-wide was created by the rapid urbanization and industrialization over the past decades. Risks on human health can be posed by the ambient air pollutants such as suspended particulate matters and volatile organic compounds that originate from automobile exhaust, combustion exhaust, industry processes and domestic activities.1

Today we know the technological up gradation and scientific know how has reduced the pollution level, especially of the gaseous pollutants, but increase in number of vehicles causes more emission of pollutants and also changes the composition ratio of the pollutants especially the particulate matter (Zanini et al., 2006), 2 which includes the fine and ultrafine particles. Vehicular exhaust is one of the most important source of fine particles. The major sources of air pollutants which are secondary sulphates, wood combustion, diesel and gasoline powered exhaust and road dust are responsible for the higher level of air pollutants in urban area. Besides that, various types of vehicles and their different operating modes such as idling, stop and start, accelerating and decelerating, combined with a high density of vehicles leads to a pollution source problem (Kumar et al., 2001). 3 Many trace metals are present in leaded and unleaded petrol, diesel oil, anti-wear substances which are added to lubricants, brake pads and tyres and are emitted by

vehicles via their exhaust pipe (Monacci and Bargagli, 1997). 4

On the daily bases diesel exhaust fumes, released from motor vehicles, buses, locomotives and other motorized machinery, has three major groups of sources (i.e. mobile sources, stationary sources and stationary point sources). In addition, vapours are released from diesel fuel at refueling bays and filling-garages. However, many studies have focused on specific VOCs, namely the Benzene and Toluene which are released by petrol and diesel fuels. The amount of Benzene and Toluene concentrations released from the fuel can vary according to the composition and additives in the fuel, as some additives may increase benzene concentrations. In addition, the ways in which the diesel fuel is used at specific sites, such as parking or refueling bays, can affect the concentrations, as well as ambient climatic conditions. Hein et al. 5 stated that exposure to fuel vapours can be markedly influenced not only by total volume of fuel dispensed by the attendants during each shift, or length of each shift, but also by changes in atmospheric temperature, ventilation and/or concentration of benzene in the fuel. However, very little literature is available on the effects of temperature and pressure, and/or total volume of fuel dispensed linked to fluctuations in concentrations of Benzene and Toluene, specifically in diesel fuel. Thus, the main aim of this study was to investigate whether daily Benzene and Toluene concentrations in diesel varied according to fuel dispensed in one refueling bay, in Firozabad, India

Exposure to benzene can result in haematotoxicity, immunotoxicity and carcinogenicity in humans and animals. Haematotoxicity resulting from chronic benzene exposure can present as anemia, aplastic anaemia, leukopaenia, lymphocytopaenia, thrombocytopaenia, or pancytopenia (Aksoy, 1989). 6 Toluene is rapidly absorbed into the bloodstream from the lungs following inhalation exposure. Once absorbed, it is rapidly distributed to vascular and fatty tissues. Performance deficits in neuro behavioral tests have been observed in studies with human volunteers exposed to short-term controlled toluene concentrations of more than 188 mg m-3 (50 ppm).

In the present study, the ambient concentration of Benzene and Toluene in Firozabad, India, have been measured during six months at two sites refueling pump station (Hindustan Petroleum - Jain Mandir and Bharat Petroleum - Jalesar Road) from September 2012 to February 2013.

2. Materials and Methods

This section assesses the various air monitoring methodologies to measure Benzene and Toluene in ambient air, and describes their advantages and disadvantages. Air monitoring is used to determine the concentrations of chemical species in the atmosphere. For any single chemical species, there are typically several methods that can be used, with varying detection levels, sampling periods/frequencies and operational levels-of-effort, the Benzene and Toluene concentrations in the ambient air across the Firozabad city were completed. The sampling points were chosen because ambient Benzene and Toluene concentration levels were expected to be different at the selected two sites of refueling pump stations (Hindustan Petroleum - Jain Mandir and Bharat Petroleum - Jalesar Road) from September 2012 to February 2013.

Study site: This study was carried out in pre, mid and end winter 2012-13 (during September 2012 to February 2013) at two refueling pump stations, Firozabad, India. The selected refueling pump stations were two high sale stations. Benzene and Toluene sampling was conducted in the working place. Samples were collected for two times (in a month) during eight hours of normal working period time for in September 2012 to February 2013. The two selected sites used in this study represent refueling pump stations (Hindustan Petroleum - Jain Mandir and Bharat Petroleum - Jalesar Road).

Benzene and Toluene measurement: In this research, real-time measurements of Benzene and toluene concentrations were performed using the specific Photo Ionization Detector (PID) designed to provide instantaneous exposure monitoring of a specific organic gas. It monitors a specific gas by utilizing a gas separation tube and the photo-ionization detector (PID) with a 9.8 eV gas discharge lamp (range- 50 ppb to 200 ppb).

Statistical analysis: Collected data has been analyzed under SPSS 17 software and using One-sample t-test to compare concentration environmental and personal sampling air Benzene and Toluene by the threshold level recommended (TLV) by the American Conference of Governmental Industrial Hygienists (ACGIH).

3. Results and Discussion

The results of Benzene and Toluene were measured in ambient air from the selected site in Firozabad for 24 hours duration in table 1. The mean concentration of

benzene (in morning) at the Hindustan Petrol Pump – Jain Mandir (ranging from 18.42 µg/m3 to 40.11 µg/m3), the mean concentration of benzene (in evening) at the Hindustan Petrol Pump – Jain Mandir (ranging from 18.82 µg/m3 to 41.01 µg/m3), and the mean concentration of toluene (in morning) at the Hindustan Petrol Pump – Jain Mandir (ranging from 26.12 µg/m3 to 43.21 µg/m3), the mean concentration of toluene (in evening) at the Hindustan Petrol Pump – Jain Mandir (ranging from 27.02 µg/m3 to 44.12 µg/m3), respectively.

SITE	SITE SEC.	Time	Months	Benzene	Toluene
RPS	HP J M	Morning	Sep-12	18.42	26.12
			Oct-12	23.06	29.43
			Nov-12	26.34	31.49
			Dec-12	30.12	42.02
			Jan-12	40.11	43.21
			Feb-12	38.02	42.22
		Evening	Sep-12	18.82	27.02
			Oct-12	23.46	30.21
			Nov-12	27.03	31.99
			Dec-12	31.33	42.78
			Jan-12	41.01	44.12
			Feb-12	38.46	42.54
			Sep-12	18.82	27.02
			Oct-12	23.46	30.21

Table 1: Concentration of benzene and toluene at Hindustan Petrol Pump - Jain Mandir

SITE	SITE SEC.	Time	Months	Benzene	Toluene
RPS	B.P.P. J.R.	Morning	Sep-12	27.12	28.36
			Oct-12	29.12	31.22
			Nov-12	29.89	32.27
			Dec-12	31.48	36.79
			Jan-12	33.46	37.12
			Feb-12	32.06	34.71
		Evening	Sep-12	27.36	28.78
			Oct-12	29.84	31.46
			Nov-12	29.96	32.89
			Dec-12	31.63	37.06
			Jan-12	33.71	37.49
			Feb-12	32.79	34.12

Table 2: Concentration of benzene and toluene at Bharat Petrol Pump – Jaleshar Road

From table 2, the mean concentration of Benzene at the selected sites ranged (in morning) 27.12 - 33.46 µg/m3 (at the Barat Petrol Pump – Jalesar Road) and (in evening) ranged 27.36 – 33.71 µg/m3(at the Barat Petrol Pump – Jalesar Road) and the mean concentration of Toluene at the selected sites ranged (in morning) 28.36 – 37.12 µg/m3 (at the Barat Petrol Pump – Jalesar Road) and (in evening) ranged 28.78 – 37.49 µg/m3(at the Barat Petrol Pump – Jalesar Road), respectively . Some studies have been reported on the indoor and outdoor concentration levels of carbonyl compounds and BTEX the studies in Finland 7, 8 reported that the pump-island concentration of MTBE (97-1,790 µg/m3) and benzene (5-17 µg/m3). In Brazil and Korea, the levels of MTBE and BTEX in traffic area were about 56.3, 30.3, 104, 9.5, and 53.1 µg/m3, respectively. 9, 10

The concentration of Benzene and Toluene at the selected site Hindustan Petrol Pump – Jain Mandir, shows higher emission because the decisive source of atmospheric emissions of Benzene and Toluene is exhaust gases from petrol driven automobiles and this refueling pump station situated in near about traffic point and the centre in the Firozabad city. The other sources include evaporative emissions produced during petrol handling, storage, distribution and solvent usage. At the Barat Petrol Pump – Jalesar Road shows slightly lower emission of Benzene and Toluene because this site situated in outer area of the Firozabad city. The six month variation indicates a higher concentration of Benzene and Toluene during winter season. Benzene and Toluene level in winter season was higher because pollutants were more homogeneously distributed in winter. The concentration of the Benzene and Toluene were found to be quite high in the present study in winter season and their level could be threat to the health of the Firozabad city.11

4. Conclusions

Ambient concentration of Benzene and Toluene, have been found to be appreciably high in Firozabad city. The mean concentration of benzene and toluene 18.42-41.01 µg/m3, 26.12-44.12µg/m3 and 27.12-33.71 µg/m3, 28.36-37.49µg/m3 were found to be higher at Hindustan petrol pump (at Jain mandir) and Bharat petrol pump (at Jaleshar road) respectively were observed. The probability of additional source of Benzene and Toluene indicates adulteration of the fuels which used in vehicles and released exhaust in an ambient air. Modifying certain fuel parameters, like reducing Benzene and Toluene content in petrol will reduce Benzene and Toluene content in ambient air29. The prevailing level of BTEX, may pose both cancer risk and non-cancer hazards for the health of general population as estimated at both two sites.

References

[1] Martins E M, Arbilla G, Bauerfeldt G F, de Paula M. Atmospheric levels of aldehydes and BTEX and their relationship with vehicular fleet changes in Rio de Janeiro urban area. Chemosphere, 67, 2096–2103, (2007).

[2] Zanini G, Berico M, Monforti F, Vitali L, Zambonelli S, Chiavarini S, Georgiadis T and Nardino M. Concentration measurement in a road tunnel as a method to assess “real-wor ld” vehicles exhaust emissions. Atmos. Environ., 40, 1242-1254,(2006).

[3] Kumar AV, Patil RS and Nambi KSV. Source apportionment of suspended particulate matter at two traffic junction in Mumbai, India. Atmos. Environ., 35, 4245-4251,(2001).

[4] Monacci F and Bargali R. B and other metals as indicator of vehicle emissions. Water Air Soil Pollut.,100, 89-98 (1997).

[5] Hein R, Aung BT, Lwin O and Zaidi, SH, Assessment of occupational benzene exposure in petrol filling stations at Rangoon. Annalsof Occupational Hygiene, 33(1), 133-136,(1989).

[6] Martinez JS, Sala JJG and Vea AM, Renal tubular acidosis with an elevated anion gap in a ‘glue sniffer’: Letter to editor. Human Toxicol, 8, 139-140,(1989).

[7] Vainiotalo S, Peltonen Y and Pfafeli P. Atmospheric Environment, 1998,32(20), 3503-3509 (1998).

[8] Vainiotalo S, Peltonen Y, Ruonakangas A and Pfafeli P. Environmental Health Perspectives, 107(2), 133-140,(1999).

[9] Grosjean E, Rasmussen R A, and Grosjean D. Atmospheric Environment,32(20), 3371-3379,(1998).

[10] Jo W K and Choi S J. Journal of the Air and Waste Management Association, 46, 749-754,(1996).

[11] Majumdar D , Mukherjeea A K and Sen S, BTEX in Ambient Air of a Metropolitan City. Journal of Environmental Protection, 2, 11-20 (2011).