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APCBEE Procedia 10 (2014) 37 – 41

Procedia APCBEE

www.elsevier.com/locate/procedia

ICESD 2014: February 19-21, Singapore

Temporal variation of BTEX at the area of petrol station in Bangkok, Thailand

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Abstract

This work aims to find changing amount of BTEX in period of time and theirs concentration at difference positions surrounding the petrol station located at the boundary of Bangkok and Nonthaburi, Thailand. A carbon charcoal glass tube connected to a personal air pump was used to collect BTEX during 16 hrs (6 a.m. - 10 p.m.) divided into 4 periods. After sampling, BTEX was extracted from charcoal tubes and analyzed by GC/FID. The center of petrol station which is considered as the main point source has the highest BTEX average concentration: benzene 589.91±107.26 μg/m^3, toluene 1,694.92±212.27 μg/m^3, ethylbenzene 96.74±17.34 μg/m^3, m,p-xylene 409.79±59.91 μg/m^3, and o-xylene 123.96±16.01 μg/m^3. Total BTEX at the center point are 12.8 and 22.9 times higher than those at roadside and the backside of petrol station, respectively. Temperature and humidity are possible meteorological variables which affect BTEX concentrations.

Selection and peer review under responsibility of Asia-Pacific Chemical, Biological & Environmental Engineering Society

Keywords: BTEX, petrol station, temporal, variation

1. Introduction

Nowadays, public and personal transportation becomes essential especially in urban area like Bangkok city.

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Selection and peer review under responsibility of Asia-Pacific Chemical, Biological & Environmental Engineering Society
doi:10.1016/j.apcbee.2014.10.011

Thailand has many petrol stations to support gasoline demand, especially in Bangkok and perimeter. In first ten months of 2012, new 4-wheeled cars has been registered about 1,536 cars/day which is 39.6% increased from the year before. Large amount of gasoline consumption can cause enormous emission of some volatile organic compounds or VOCs. The prominent VOCs from gasoline are BTEX which are the major compounds which affect to human health [1]. International Agency of Research on Cancer and World Health Organization found that benzene is a group 1 carcinogens which can lead to leukemia, and ethylbenzene is a group 2B carcinogens [2].

The unburned benzene can be directly released from incomplete combustion of gasoline in old vehicles and vaporization of gasoline from fuel tanks and filling stations. The results from study in Greece show a clear influence on the measured benzene concentrations, depending on the activity of the petrol station, the leaks of the fuel tanks and the meteorological conditions [3]. The another study in Thailand demonstrated that gas service station workers were exposed to higher VOCs levels than workers who were not direct contact with VOCs and extrapolated that brand of station might had an effect on level of lifetime cancer risk [4].

Most of researches in Thailand determine 8-hour VOCs concentration; although, workers in petrol station did not work in 8-hour work shift. Diurnal profile of VOCs in petrol station and possibly variables which would affect to VOCs concentration should be examined in order to decrease exposure. This study aims to investigate the concentration of BTEX and their temporal profile in ambient air at the petrol station and the roadside along with observation of meteorological data which would affect variation of BTEX concentration.

2. Experimental

2.1. Sampling Method

This study was held in a petrol station located on Cheangwattana road in the boundary of Bangkok and Nonthaburi province. This station is in an urban area and far from major intersection 700 meters. BTEX was collected by using a charcoal glass tube connected to a personal air pump, and the sampling equipment was approximately set at the height of 2 meters from the ground, and placed at three sampling points: front of station which represents roadside BTEX, center of the station which represents BTEX from filling nozzle, and back of station which represents ambient air in the petrol station.

The sampling was conducted 3 days a week (Tuesday, Friday, and Sunday), and taken for 2 weeks consecutively. The sampling started from 6 a.m. to 10 p.m. and divided into 4 periods per day. Each sample had been taken for 4 hours; morning (6 a.m. to 10 a.m.), noon (10 a.m. to 2 p.m.), evening (2 p.m. to 6 p.m.), and night (6 p.m. to 10 p.m.). After finish each sampling, the charcoal glass tube was sealed and stored at cold condition until transferred to 4 ^{o}C refrigerator at the laboratory.

The meteorological data was measured on-site during sampling using Automet^{TM} by Met One Instruments. The measured atmospheric variables were barometric pressure (mHg), percentage of relative humidity, solar radiation (W/m^2), temperature (^{o}C), wind direction (degree), and wind speed (m/s). Each variable was measured and recorded 5 minutes interval, and was calculated as 1 hour average.

2.2. Analytical Method

After sampling from the site, the charcoal sample in the front and back section was separately extracted following the US EPA Compendium Method 1501. 4-bromofluorobenzene and carbon disulfide were used as internal standard and extracted solution, respectively. The extracted solution was analyzed by Gas Chromatography (GC) with flame ionization detector (FID), and Helium (He) was used as carrier gas. The standard calibration curves of benzene, toluene, ethylbenzene, m,p-xylene, and o-xylene were prepared which