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STUDY OF MTBE IN TEHRAN'S ATMOSPHERE

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ABSTRACT

Around 3-million motor vehicle in Tehran burn above 20-million of litters gasoline daily. This is the first time that MTBE (Methyl tert-butyl ether) levels in Tehran have been extensively characterized.
In order to evaluate the levels of MTBE pollutant in the Tehran, ambient air samples were collected in sorbents tubes and analyzed with a gas chromatograph according to procedures described in the NIOSH method.
The aim of this study was determination of MTBE concentration and its role on Tehran pollution. For each collected sample, MTBE were analyzed by using a GC with a flame ionization detector (FID). Quality assurance was performed collecting duplicate samples which were analyzed in replicate to quantify the precision of air quality measurements.
The established calibration curves for the MTBE samples were found with R^2-value > 0.995. Mean values of MTBE concentrations in Tehran atmosphere were 0.1- 0.55 ppm.

Key Words: MTBE, Urban air quality, Vehicular emission, Tehran pollution

1.INTRODUCTION

MTBE (Methyl tert-butyl ether) is important organic air contaminants emitted into the atmosphere by automobile exhaust, fuel evaporation, storage, transfer and handling of fuel (Donati, 1995). The greatest health risk from exposure to MTBE is carcinogenic and neurotoxic (Jo and Choi, 1996).

Its poisoning effect may occur due to inhalation , ingestion or fast absorption through the skin (Cocheo, 1998). The main symptoms are : headache , confusion , and loss of the muscle control , irritation of the airways (Wallac, 1996).

Traffic - induced emissions are a major source of urban air pollution (Rogak et al., 1997). As a result of increased emissions and inadequate ventilation , the concentration of these pollutants in confined spaces can result in deleterious impacts on health and the well being of exposed population (Swati, 1999).

Pollutants in urban atmosphere arise from traffic and in particular, are emitted from automotive exhaust or fuel evaporation from tanks, vehicle carburetors, and gasoline stations during the refilling operations (Faiz et al., 1996). To date, the traffic density

of the transportation system has increased dramatically during the recent years in many developing and developed countries (Meek, 2000 and Sonawance et al., 2000). Tehran is amongst a few capitals of the world, which mountains surround the city from the North and East. The total area of the city is 800 km ^{2}. There are four accurate seasons, with the annual mean rainfall at about 230 mm .The basin's topographical situation does not allow, the major part of the time, the free circulation of winds and good ventilations. A major focus of this study is the contribution of vehicular emissions to air pollution in Tehran. Vehicular traffic can be classified into three categories: gasoline fueled (cars), diesel fueled (buses, trucks) and motorcycles (2-stroke and 4- stroke). In recent years due to consumption gasoline content of MTBE (instead gasoline leaded) in Tehran, evaluation of MTBE in atmosphere were necessary.

It is estimated that 80 – 85 % of MTBE in the atmosphere comes from the automobile depend on traffic flow and street geometries (Rama, 2004).
MTBE is the most widely used fuel oxygenate and is added to gasoline at 5-15 % in gasoline. MTBE has accumulated sufficient evidence as a human carcinogen (Johnson et al., 2000 and Squillace et al., 1996).

Evaporative emissions from vehicle systems are generally grouped into three categories namely (Meek, 2000) :

- diurnal emissions
- hot - soak emissions
- running losses

2.EXPERIMENTAL METHOD

The method presently adopted for air sampling is based on adsorption on a activated sorbent tube and desorption methods followed by gas chromatography analyses. The choice of the sampling points in the monitoring campaign followed two basic criteria. First a representative ness of the area, in areas with high population density or intense traffic. Second, in the surroundings of the main sources.

The sampling height was about 1.6 m above the ground. The preparation and pre-conditioning of the instruments performed prior to sampling. MTBE (99.5 %) used were of analytical grade (MERCK CO.)for standard solutions. A calibration curve was prepared from known concentrations of MTBE. Carbon disulfide (analytical grade) used for making all solutions the method 1615 which was suggested by the US National Institute for Occupational Safety and Health (NIOSH) was adopted. In this sampling, sampling system consisted of a sorbet tube (SKC charcoal tube, 100 mg/50 mg) and low-flow sampling pumps (model 224-44EX, SKC Inc.). Air was pumped (2lit/min) through absorption tubes, which contained two sections.

The charcoal sampling tube should always be vertical during sampling to prevent channeling of the charcoal.Generally, the loss of the MTBE has to be minimized during sampling, samples were stored in the dark at 4 $^{\circ}$C before analysis no longer

than 24 – 48 hr later. After sampling, the charcoal tube is removed from the sample holder and both ends capped with plastic caps provided. During the sampling procedure one charcoal tube is opened at the sample site and the ends capped .No air is drawn through this tube which serves as a blank.

Desorption of the collected samples from the charcoal tube have been accomplished by CS_2. The analyze of samples were carried out using a gas chromatograph (GC - Perkin Elmer - Sigma 3B) with FID detector. The established calibration curves were found with R^2- Value > 0.95. The monitoring was performed in twenty stations in strategic with in the municipal district.

3.RESULTS AND DISCUSSION

Organic compound in Tehran atmosphere originating in automobile engine emissions are among the most significant sources of air pollution in the congested and poorly ventilated streets of the city. It is important to note that the Iran vehicle fleet differs significantly from fleets in other developed countries due to the fact that most of those vehicles have no evaporative emission control devices, even in many of the new vehicle models. Fuel in Iran has been supplied at one of the cheapest prices. The availability of low cost fuel has increased private vehicle ownership. Around 3 million motor vehicle burn above 15-20 million of liters gasoline daily.

In recent years due to consumption gasoline content of MTBE (instead gasoline leaded) in Tehran, evaluation of MTBE in atmosphere were necessary. Table 1 shows the mean concentration of MTBE obtained in the Tehran's atmosphere of the sampling sites.

The finding shows that the mean concentration of MTBE is 337 ppb with a maximum of 1000 ppb.

Table 1-Average concentration of MTBE (ppb)

Sampling sites	MTBE	Sampling sites	MTBE
Azadi seq.	230	Shoosh seq.	200
Enghelab seq.	350	Khorasan seq.	150
Ferdouci seq.	200	Bazar	450
Emam hossein seq.	220	Peroozi str.	1000
Damavand str.	520	Khavaran str.	350
Kauj seq.	10	Nemat-abad str.	150
Vanak seq.	330	Shahr- Ray	300
Azadi str.	200	Elghadeer str.	500
Naser Bridge	200	Shaheed Beheshty str.	700
Tajreesh seq.	350	Rah- Ahan seq.	N.D.

In Iran, air-quality standards have not yet been set for organic pollutants. It is accepted that MTBE is genotoxic carcinogen and therefore no absolutely safe exposure level can be defined.

There is evidence that humans (specially children) who live near heavily traveled streets and squares that has showed in the table may be at an elevated risk of cancer, including leukemia (U.S. EPA, 1986 and U.S. EPA, 1996).
It is known that the fleet age significantly affect the exhaust of toxic contents from a vehicle. Figure 1 shows daily concentration of MTBE in Tehran.

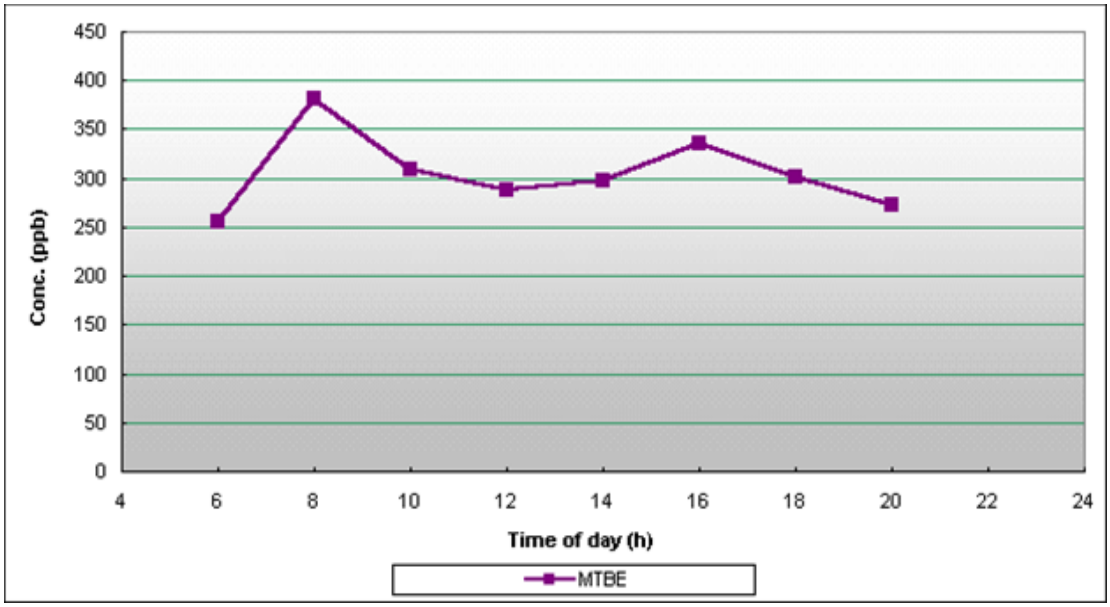

Figure 1 : Fluctuation of daily concentration of MTBE

In addition the area of two gas station and surrounding have been selected for sampling MTBE (Table 2-3). These stations are infeluenced directly by MTBE.

Table 2- Contents of average of MTBE in the different distance of Khavarun Gas station during the summer and winter seasons.

Compound / Sampling site	Jun. and Jul. (ppm)	Dec. and Jan. (ppm)
Gas Station area	5.85	5.4
8m from Gas station	1.1	1.1
25m from Gas station	0.45	0.25
50m from Gas station	0.13	0.18
100m from Gas station	0.45	0.12

Because MTBE is highly volatile because of its high vapor pressure (245 - 276 mm Hg at 25 ºC) therefore the concentration of this compound is become more in the summer time (IAOF, 1997).

Table 3 - Contents of average of MTBE in the different distance of Beheshtee Gas station during the summer and winter seasons.

Compound / Sampling site	Jun. And Jul. (ppm)	Dec. and Jan. (ppm)
Gas Station area	3.4	3.1
8m from Gas station	1.1	2.6
25m from Gas station	0.68	1.5
50m from Gas station	0.55	0.35
100m from Gas station	0.48	0.22

Environmental exposure to MTBE can be largely lowered by adopting preventive measures including traffic restrictions, equipped of new cars with catalytic converters and reformulation of gasoline and devices to recover vapors from gasoline pumps.
There is evidence that humans (specially children) who live near heavily traveled streets and squares that has showed in the table may be at an elevated risk of cancer, including leukemia. Benzene is a mutagen and human teratogen.

No safe guide lines for airborne MTBE can be recommended as they are carcinogenic to humans and there are no known safe threshold level.
Legislation should also be introduced and enforced to promote the use of reformulated gasoline with low MTBE content.

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