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# Detection of the vapor benzene composition formed inside the car cabin

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## ABSTRACT

The detection of benzene vapor composition formed inside the cars cabin has been investigated. Benzene is an organic chemical compound. The sample of benzene vapor composition is taken from a cars cabin and then the samples are analyzed by the gas chromatography-mass spectrometer (GCMS). The data is recorded and plotted by using the 4000 GCMS version 6's software. Finally, the results show that there are different gases compositions inside the cars cabin. Beside of the gas (Z)-1-(Ethoxycarbonyl-1-Fluoro-2-(Methoxycarbonyl)-1, 3-Butadiene, that found inside the cars cabin, there are other gases as - (3-Oxo-3H-Benzo [F] Chromen-2-Yl)-2, 4(1H,3H) - Quinolinedione, Ethane-D6, Ethylene-D4, Heptacosafuoro-Tributylamine, Nonanal, Decanal, Tetradecanoic Acid, 11-Dodecen-1-Al, benzeneethanamine, 3-fluoro-a, 5-dihydroxy-N-methyl-, 2-Pyridinepropanoic Acid, a-Methyl-a-Oxo-Ethyl Ester, Silane Methyl-, Hexadecanoic Acid.

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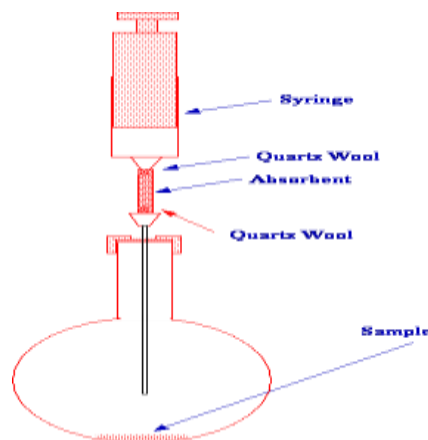
## Introduction

Benzene ( $C_6H_6$ ) is an organic chemical compound sometimes known as benzol. It has a particularly sweet smell and is a colorless and flammable liquid. Benzene is a major industrial solvent and is used in the production process of plastic, oil, synthetic rubber, and many dyes [1]. Benzene's dangerous properties are masked by its pleasant and sweet smell. It is colorless liquid with a sweet odor that evaporates into the air quickly and dissolves slightly in water [2].

A Canadian company is introducing a new handled sensor technology that detect levels of benzene gas, a human carcinogen common in industrial settings as well as service stations and other consumer environments. Benzene detection is not a simple task, and only recently with increased public awareness including some high profile class action lawsuits have significant steps which have been taken to regulate and effectively limit benzene exposure. Benzene is considered a human carcinogen by the International Agency for Research on Cancer (IARC), and the National Institute of Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration have limited occupational exposure to benzene. Workers in the petrochemical industry, mechanics, firefighters, and others can be severely affected [3].

The purpose of this study is mainly focused to detect the vapor of benzene compositions that formed inside the car cabin and find out whether the vapor of benzene compositions formed is related to the temperature or not. Today, most benzene comes from the petrochemical industry, with only a small fraction being produced from coal. Four chemical processes contribute to industrial benzene production are catalytic reforming, toluene hydrodealkylation, toluene disproportionation, and steam cracking.

This research was conducted in Schools of Physics and Chemistry's MUPA laboratory, University Sains Malaysia. The sample of the compositions formed inside the car cabin was taken from two different car models. Then, the sample is analyzed by using the Gas chromatography-mass spectrometry (GCMS).



The experimental setup

## Benzene effects on health:

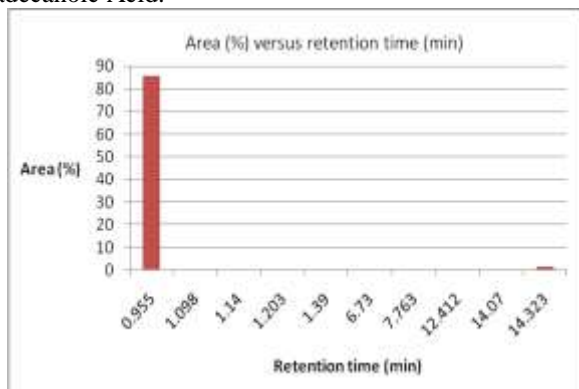
Benzene can cause malfunction of bone marrow to produce enough red blood cells, which can lead to anemia. Also, it can damage the immune system by changing blood levels of antibodies and causing the loss of white blood cells. The amount, route, and length of exposure time of benzene seriously poisoned, as well as the age and preexisting medical condition of the exposed person [4]. Benzene is known as a reason of cancer, based on evidence of previous studies. The link between benzene and cancer has intensively focused on leukemia and blood cells. Rates of leukemia have been found to be higher among the workers in chemical, shoemaking, and oil refining industries who are exposed to high levels of benzene.

Benzene has been shown to cause chromosome changes in bone marrow cells. Such changes are commonly found in human leukemia cells. Benzene is a potentially dangerous chemical. High levels of exposure can cause both short-term and long-term health effects. Inhalation or swallowing very high levels of benzene probably caused death. Exposure to benzene liquid or vapor may irritate the skin, eyes, and throat. The US Environmental Protection Agency (EPA) limited the percentage of benzene allowed in gasoline to be at average of 1% - 5% in

1990 and then reduced to be at average of 0.62% - 1.3% in 2011. The EPA limits concentrations of benzene in drinking water at 5 ppb (parts per billion). The US Food and Drug Administration (FDA) limited the concentration of benzene in bottled water at 5 ppb [5-9].

#### Results:

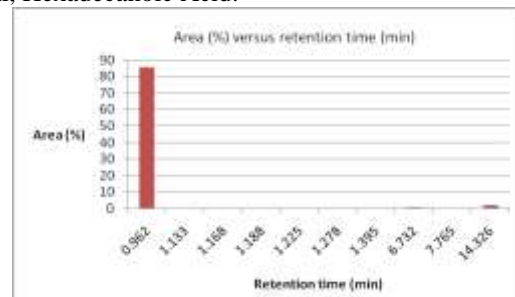
Figure 1 showed the vapor benzene in car1. The most gas exist in the sample gas is (Z)-1-(Ethoxycarbonyl-1-Fluoro-2-(Methoxycarbonyl)-1, 3-Butadiene which the height of the peak is 3894550016, the area is 89641,816.0 and the percentage of area is 85.628%. In addition, the retention time is at 0.955 minute. Meanwhile, the least gas exist in the sample is Carbonic Dihydrazide with the height of the peak is 3777,670, area of 65774.9 and the percentage of area is 0.063% which is the smallest percentage of area. The retention time is at 1.140 minute, as shown in Table 1. Retention time is defined as the amount of time that a compound is retained in the GC column. The molecules take different amount of time to come out of (elute from) the gas chromatography and this allows the mass spectrometer downstream to capture, ionize, accelerates, deflects and detects the ionized molecules separately. The mass spectrometer breaks each molecule into ionized fragments and detecting these fragments using their mass to charge ratio [10]. There are other gases that exist in the gas samples. They are - (3-Oxo-3H-Benzo [F] Chromen-2-Yl)-2, 4(1H,3H) - Quinolinedione, Ethane-D6, Heptacosafuoro- Tributylamine, Nonanal, Decanal, Tetradecanoic Acid, 11-Dodecen-1-Al, Hexadecanoic Acid.



**Figure 1: Vapor benzene level in car 1.**

Figure 2 showed the vapor benzene in car 2. The most gas exist in the sample gas is (Z)-1-(Ethoxycarbonyl-1-Fluoro-2-(Methoxycarbonyl)-1, 3-Butadiene which the height of the peak is 5,087,960,064, the area is 108,128,192.0 and the percentage of area is 88.108%. In addition, the retention time is at 0.962 minute. Meanwhile, the least gas exist in the sample is air with the height of the peak is 2,273,646, area of 70,286.9 and the percentage of area is 0.057% which is the smallest percentage of area. The retention time is at 1.278 minute, as shown in Table 2. Retention time is defined as the amount of time that a compound is retained in the GC column. The molecules take different amount of time to come out of (elute from) the gas chromatography and this allows the mass spectrometer downstream to capture, ionize, accelerates, deflects and detects the ionized molecules separately. The mass spectrometer does this by breaking each molecule into ionized fragments and detecting these fragments using their mass to charge ratio. There are other gases that exist in the gas samples. They are benzeneethanamine, 3-fluoro-a, 5-dihydroxy-N-methyl-, Ethylene-D4, 2-Pyridinepropanoic Acid, a-Methyl-a-Oxo-Ethyl

Ester, Silane Methyl-, Heptacosafuoro-Tributylamine, Nonanal, Decanal, Hexadecanoic Acid.



**Figure 2: Vapor benzene level in car 2.**

#### Conclusion:

It can conclude that different gases composition has been detected inside the cars, which are benzeneethanamine, 3-fluoro-a, 5-dihydroxy-N-methyl-, Ethylene-D4, 2 Pyridinepropanoic Acid, a-Methyl-a-Oxo-Ethyl Ester, Silane Methyl-, Heptacosafuoro-Tributylamine, Nonanal, Decanal, Hexadecanoic Acid, 11-Dodecen-1-Al, 3H-Benzo[F]Chromen-2-Yl)-2, 4(1H,3H) Quinolinedione, Ethane-D6, Heptacosafuoro-Tributylamine. All of the mentioned gases are considered as health hazard and needed to whether reduced its emission inside the car cabin by using green materials or proposed a good ventilation system for all the cars during under sun parking because all the new cars manufacturing used the petrochemicals products in their dashboards, seats covers, stirring, roof and most of other parts inside the cabin.

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during the use of biomass fuels in cooking time. *Journal of chromatography*, 2005, 1065, 315-319.

**Table1: Vapor benzene in car 1 at 11AM**

#	RT	HEIGHT	AREA	AREA %
1	0.955	3,894,550,016	89,641,816.0	85.628
2	1.098	5,952,292	154,913.3	0.148
3	1.140	3,777,670	65,774.9	0.063
4	1.203	2,715,700	73,916.0	0.071
5	1.390	6,832,297	87,907.3	0.084
6	6.730	9,473,740	157,407.5	0.150
7	7.763	5,990,286	100,466.8	0.096
8	12.412	15,190,185	348,784.6	0.333
9	14.070	6,408,278	273,755.4	0.261
10	14.323	44,828,484	1,729,993.8	1.653

**Table 2: Vapor benzene in car 2 at 11 AM**

#	RT	HEIGHT	AREA	AREA %
1	0.962	5,087,960,064	108,128,192.0	88.108
2	1.133	5,802,896	147,443.5	0.120
3	1.168	4,936,522	89,089.1	0.073
4	1.188	4,675,740	94,902.8	0.077
5	1.225	3,323,910	75,342.5	0.061
6	1.278	2,273,646	70,286.9	0.057
7	1.395	9,513,037	109,112.3	0.089
8	6.732	13,584,113	207,070.1	0.169
9	7.765	5,315,942	93,077.5	0.076
10	14.326	30,687,898	1,200,012.5	0.978