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System Designed to Measure BTEXs Pollutants in Exhaust Gas Output of Domestic and Foreign Cars in Tehran

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INTRODUCTION

Incomplete combustion of gasoline in the combustion chamber of a motor vehicle results in the removal of unburned or semi-burned hydrocarbons from the vehicle exhaust. Due to the presence of BTEXs in gasoline, these compounds may enter the environment from vehicle exhaust. The amount of BTEXs from the exhaust depends on many factors, such as how the engine performs, the quality of the gasoline consumed, the additives added to the fuel, and the catalysts used in the vehicles [1-4]

Due to the importance of releasing aromatic compounds from the exhaust of vehicles and for the initial evaluation of Iranian cars, in this study, the measurement of aromatic compounds (BTEXs) in the exhaust gas of gasoline cars was performed for the first time in Iran.

The investigated vehicles included Pride, Peugeot 405, Thunder L 90, Peugeot 206, Samand without Catalyst, Samand with Catalyst, Tiba, and Mazda 3.

EXPERIMENTAL PROCEDURE

The car was first called after the gasoline light was switched on and 30 liters of gasoline (supplied from a specific gas station in one day) was transported to the car's fuel tank, and the fuel tank was sealed.

The car was then delivered to the owner until it consumed half of the fuel injected. This is to ensure the replacement of the fuel injected with the previous fuel in the car's refueling system.

After these steps, the car was transferred to the Research Institute of Petroleum Industry, and the

car was initially kept on for 15 minutes, until the car's engine reached relative stability. Then the sampling system is installed on the exhaust of the car, and the sampling starts from the vehicle. After the end of the sampling, both tubes containing the adsorbent were closed and stored at -10 °C until analysis.

In order to extract BTEXs from the active carbon adsorbent surface, carbon disulfide solvent was used. All relevant measurements and calculations were performed according to NIOSH1501, BS-6069, ASTM D3686, ASTM 3687 and Internal Environment Standard 001-1. All measurements were performed by calculating the area under the chromatogram peak outputs of the GC-FID device and drawing calibration curves for each of the BTEXs. Finally, GC-MS was used to identify the adsorbed compounds on the adsorbent surface.

RESULTS AND DISCUSSION

• BTEXs pollutants are found in the exhaust gas of the vehicles, especially domestic cars. It indicates that a high engine temperature is not sufficient to completely remove these components. To minimize their exhaust emissions, we will need to install additional equipment such as special catalysts.

• In all cars, the amount of benzene and then toluene in the exhaust gas is higher than other BTEXs. Because of its high stability, benzene has a lower burning rate than other hydrocarbon compounds such as normal linear hydrocarbons. In addition, this causes the aromatic compounds in the structure of the gas ring to be destroyed and burned during the combustion process.

• The results of measurements on catalysts with and without catalysts show that the amount of these compounds, especially benzene and toluene, is 3 to 8 times higher in catalyzed exhaust gas than in non-catalyst Samand. By facilitating the oxidation process, catalysts convert all unburned, semi-combustible or oxidizable combustion products resulting from the repetitive processes or malfunction of the combustion engine to less harmful compounds such as carbon dioxide.

• With a relatively high percentage, Thunder is one of the most efficient cars in the country, with a relatively low concentration of BTEXs. In addition, Samand Group considered catalysts (provided the catalyst function was maintained over time) as the vehicle with the lowest emission of these pollutants. Also, due to the high concentration of emission of benzene and toluene in the two Pride and Peugeot 405 vehicles in general, it can be concluded that the highest percentage of these two car groups are the worst car groups in terms of emissions.

• By making a comparison between domestic and foreign cars, it is obvious that domestic cars emit much higher levels of pollutants than foreign cars, the Mazda 3.

CONCLUSIONS

The results, while proving the presence of the BTEXs in the exhaust of all cars, clearly indicate that domestic cars emit far more volumes of these pollutants than foreign cars, indicating poor performance. Among the domestic cars, Pride and Peugeot 405 cars, the highest and the Thunder and Samand Catalyst cars have the lowest emissions.

The amount of emission of these pollutants by a foreign car was very low so that the highest concentration measured in a foreign car was lower than the lowest concentration of a

domestic car (Samand Catalyst).

Since the main share of active cars is for domestic cars, concentrations of these compounds are high in the cities of Iran, especially Tehran. Therefore, the need for specific standards for hazardous compounds such as BTEX as well as modification of domestic vehicles is strongly recommended to reduce the emission of these compounds. Finally, complementary studies under different driving conditions (other than the static mode in this study) can help to estimate the emission rate more accurately.

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