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Detection and Concentration of Gasoline and Diesel 1 Hazardous Air Pollutants in Some Typical Refining Products

Tye Spillum

ABSTRACT

Air pollution is well-known to today's society, and Hazardous Air Pollutants are large contributors to this problem. Using gasoline and diesel 1 samples from the NCRA Refinery in McPherson, Kansas I have tested the gasoline and diesel 1 samples for the presence and concentration of three major aromatic Hazardous Air Pollutants. These Hazardous Air Pollutants include benzene, toluene, and naphthalene. Using a mass spectrometer at Kansas State University, I found benzene, toluene, and naphthalene to be present in gasoline. Benzene was in the largest quantity with 116.23 mg./10cc followed by toluene with 80.68 mg /10cc. Naphthalene was present in the smallest amount with 28.76 mg /10cc. I was unable to detect any presence of benzene, toluene, or naphthalene in the diesel 1 sample. Testing was accurate, based upon a sensitive threshold setting of the mass spectrometer.

INTRODUCTION

Air pollution is a major problem in industry today. Regulation helps restrict the amount of pollutants distributed. Hazardous Air Pollutants or HAP's are one of the major contributors to today's air pollution. The EPA produces reports and new regulations addressing Hazardous Air Pollutants every year. In these volumes of regulations, there consists a list of new pollutants to be both monitored and regulated by industry on an annual basis. From this list of new chemicals is where my research will be centered. Samples were provided by NCRA's refinery in McPherson which consist of gasoline, and diesel1. From these samples I determined if any of the new restricted chemicals exist and if so in what concentration. The instrument used was a Hewlett-Packard 5989 A mass spectrometer capable of detecting the chemicals present and determining the concentration in parts per million (PPM). Results provided the refinery with some of the information it needs to determine if it is within its EPA guidelines. Only three aromatic molecules were tested based on the limitations of time and availability on the instrumentation.

MATERIALS AND METHODS

The materials needed did include a mass spectrometer and the samples. The mass spectrometer was used to analyze nine total samples. A standard and the two sources were each individually analyzed to provide accurate and precise results. The standard had the following components diluted in 10cc of pentane: 41.2 mg of naphthalene, 455.7 mg of toluene, and 476.9 mg of benzene. The stock solution or internal standard consisted of naphthalene d8- 49.1 mg and toluene d8- 444.4 mg. The stock solution was diluted 2cc of stock plus 8cc pentane or a 2:10 ratio. All samples and the standard were diluted to a 2:10 ratio with pentane and a 1:1 ratio mix of internal standard and sample was injected into the mass spectrometer (Message, 1984). The data collected did produce evidence that determined the concentration of specific chemicals (HAP's) in the samples (McLafferty and Stauffer, 1989).

The mass spectrometer used in this experiment was KSU's Hewlett-Packard 5989A model. This is an electron impact instrument with a 200 degree source (Mann, et al., 1974). The analyzer was set at 150 degrees Celsius and the gas chromotagraph injector along with the transfer line was at 300 degrees Celsius. Helium was used as the carrier gas. The column used was a Restek Rtx-1 which is thirty meters in length (30 m x 0.25 mnid x 1.0 u). The sample injected is 1 ul and the heat program is as follows:

10 degrees for 1 minute
10 degrees-115 degrees @ 50 degrees/ minute
115 degrees-150 degrees @ 5 degrees/ minute
130 degrees-320 degrees, hold @ 320 degrees for 10 minutes.

RESULTS

Using the mass spectrometer I was able to determine detection and concentrations of these samples. The computer analyzed the data given from the mass spectrometer and printed it out in the form of spectral information (McLafferty, 1989). I used the computer to calculate the area (numerical value) under the spikes. This value was then transformed into a concentration based on the internal standard. The internal standard is the scale by which these tests are measured. In the gasoline sample I found the concentration of benzene to be a 116.23 mg/ 10cc. I found the concentration of toluene to be 80.68 mg/ 10cc. I found the concentration of naphthalene to be 28.76 mg/ 10cc. In diesel benzene, toluene, and naphthalene were not detected in any concentration (if the threshold were lower they may have been detected in very small concentrations). All these conditions were evaluated under a threshold of ten.

DISCUSSION

The results are reasonably consistent with previous commercial lab evaluations. The possibility of benzene, toluene, and naphthalene being found in gasoline was very high and this is consistent with my results. The possibility of toluene and naphthalene being found in diesel 1 was high, however, neither were found to be present in diesel 1. The concentrations of the three molecules in gasoline can provide the refinery with an idea of approximately how much hazardous air pollutant is dispersed in the combustion of each gallon of commercial gas. This information can be used as a guideline to give approximate amounts of HAP's produced by McPherson's NCRA's refinery on an annual basis.

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