



Qualitative and Quantitative Analysis of PM_{2.5} using FTIR Spectroscopy

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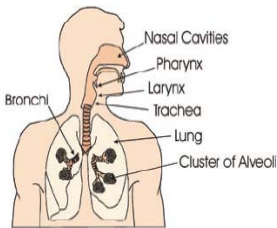
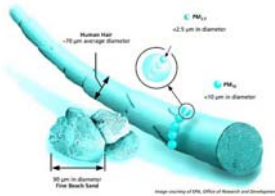


Abstract

FTIR is useful for identifying chemicals that are either organic or inorganic. It can be utilized for both qualification and quantitation of components of an unknown mixture. Infrared spectroscopy is extensively applied to various samples such as liquid, gas, and solid-state matter to identify unknown materials. The purpose of this investigation was to identify the composition of organic and inorganic species in ambient fine particulate matter using FTIR. Particles smaller than 2.5µm in diameter qualify as ambient fine particulate matter. Studying PM_{2.5} is important because due to their small size, they can penetrate the pulmonary and tracheobronchial systems, resulting in health problems ranging from coughing and sneezing to lung cancer and cardiopulmonary disease. A sampling system was assembled to collect ambient air samples in New York City, and the samples were subsequently analyzed using FTIR.

Introduction

Fine particulate matter is any solid or liquid particles found in ambient air. PM_{2.5} is particulate matter smaller than 2.5 micrometers, about 30 times smaller than the diameter of a human hair.



PM_{2.5} is particularly hazardous to public health because it can penetrate deep into the respiratory system, causing health problems ranging from coughing and wheezing to cardiopulmonary disease and death.

If the relative amounts of chemicals can be easily characterized, the sources of air pollution can be identified and controlled based upon known chemical "footprints."

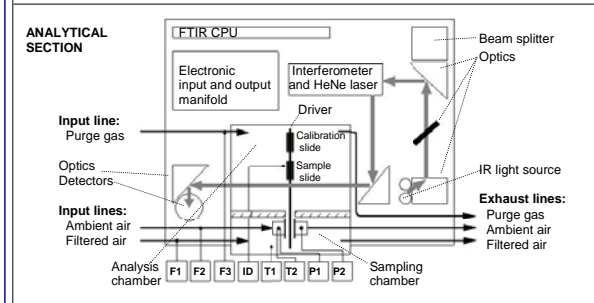
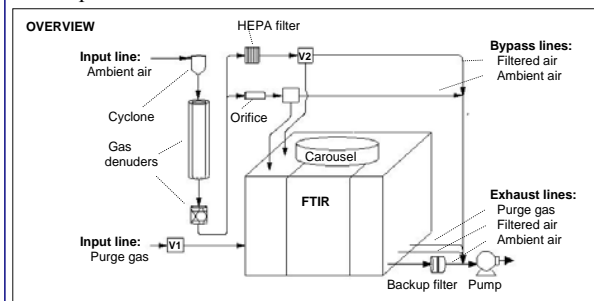


Experimental Objective

The objective of this project is to develop a method of determining the composition of fine particulate matter using a single analytical technique. This method must analyze both organic and inorganic species without destroying the sample.

Methods

➤ First, a sampling system was assembled to collect ambient air samples.



➤ Before analyzing a sample, the background spectrum was taken. Two separate methods of collecting the background were used for comparison: open-path background and using the Teflon filter as a background. In initial trials, the methods appear to give comparable results.

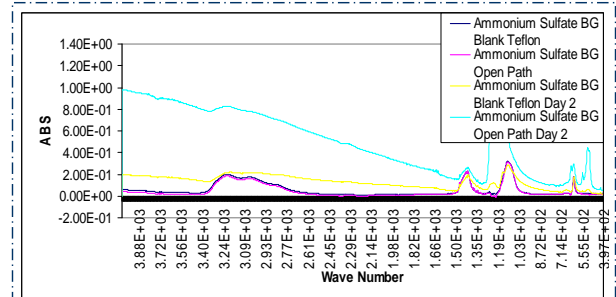
➤ When using an open-path background, the filter spectrum was taken prior to collecting the sample. The filter spectrum was subtracted from the sample + filter spectrum to produce the sample spectrum.

➤ Each band on the sample spectrum was analyzed for peak area, peak height, and wave number.

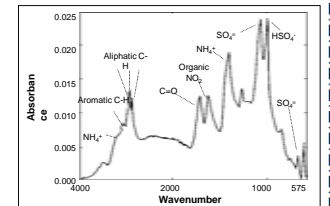
➤ After determining the functional groups, the concentrations are determined using this formula:

$$C_x = \frac{A_x \epsilon_y}{A_y \epsilon_x} C_y$$

Results



Due to the recent assembly of the sampling system, samples have not yet been analyzed. The spectrum on the right is an FTIR spectrum of PM_{2.5}. Source: Pickle, 1990



Conclusions

Although quartz filters are preferable for collecting organic samples, Teflon filters appear to interfere less with the sample spectrum than quartz filters. Therefore, as this project proceeds, Teflon filters will be used in the sampling system.

References

- Human hair image available from: <http://www.epa.gov/air/particlepollution/humanhair.html>
- Respiratory system image available from: http://www.atsdr.cdc.gov/tar/images/self-care_04.jpg
- New York City air quality photo available from: <http://www.pollutionissues.com/A-Bo/Air-Pollution.html>

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