

FTIR ANALYSIS ON ATMOSPHERIC DUST PARTICLES IN CHEYYAR TOWN, TAMILNADU, INDIA

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Abstract:

The atmosphere is often loaded with dust particles due to various activities such as wind, exhaust from industries, vehicular emission, uplift of Earth surface sediments on the move of vehicles, etc.

The dust sediments in the atmosphere contain various minerals. Among the various minerals some of them impose hazardous health effects to human beings. Each and every one on the Earth surface is continuously subjected to the atmospheric dust particles inhaled and sometimes ingested through water and food.

The main objective of this study is to characterize the atmospheric dust particles of Cheyyar town, near Kancheepuram, Tamilnadu, India, for their mineral contents using Fourier Transformed Infrared Spectroscopic technique (FTIR). Totally 10 dust sediments were collected around Cheyyar town and analysed for their mineral composition through FTIR technique.

Using FTIR spectra it is observed that the air suspended dust particles collected in and around Cheyyar town contain the minerals like Kaolinite, Calcite, Asbestos, Hematite, Orthoclase Feldspar and Montmorillonite. Among the identified minerals few of the minerals like Asbestos may bring adverse and harmful effects to the mankind.

Key words: Minerals; dust sediments; Cheyyar; FTIR

I. INTRODUCTION

The Earth atmosphere is frequently loaded with dust particles due to various activities such as exhaust from industries, wind, vehicular emission,

uplift of Earth surface sediments on the move of vehicles, etc.

The sediments on the Earth surface is the weathered product of rocks and they contain various minerals and metals. Among the various minerals some of them like asbestos impose hazardous health effects to human beings. Each and every one on the Earth surface is continuously exposed to the atmospheric dust particles which they inhale and sometimes ingest through water and food.

Earlier works have been carried out by many researchers to characterize the dust particles in atmosphere. Ramasamy¹ analysed the dust particles in different areas in Coimbatore using FTIR technique for their mineral content and health effects. Alahmr² studied the compositions of dust fall around semi-urban areas in Malaysia. Zhao³ analysed the dust storms of central and south west china, Begum⁴ studied the long-range transport of soil dust and smoke pollution in the South Asian region.

II. SCOPE OF THE STUDY

The main objective of this study is to analyze the air suspended dust particles in Cheyyar town for their mineralogical composition using Fourier Transform Infrared Spectroscopic technique (FTIR).

III MATERIALS AND METHODS

A. Study Area

Cheyyar is a town in the Tiruvannamalai District near Kanchipuram in the Tamil Nadu state of South India. It gets its name from the Cheyyar River. The town is situated at 30 km from Kanchipuram, 60 km from Vellore and 105 km from Chennai. Cheyyar is located at 12.6580°N 79.5424°E on the banks of Cheyyar River in the north eastern corner of Thiruvannamalai district of Tamil Nadu.

The air suspended sediment samples were collected from 10 different location of Cheyyar town.

The sampling locations are labeled from 1 to 10 and are given in the table I.

B. Sample Collection

The dust sediment samples were collected using tissue papers. The tissue papers were fixed on mountings in the sampling locations at a height of 15 feet. After four weeks of time the papers were removed and washed in distilled water.

Table I Sampling locations in Cheyyar town

All the dust settled at the bottom of the beaker is collected. The collected samples were then dried in hot oven until its moisture disappears. These tissue papers are washed in distilled water. The settled dust particles at the bottom of container are then dried at

| Site No | Sampling Location |
|---------|-------------------------------------|
| S1 | Govt. Arts and Science College Road |
| S2 | Bus Stand |
| S3 | Gandhi Road |
| S4 | Puliyarambakkam, Kancheepuram Road |
| S5 | Arni Road |
| S6 | Near Police Station |
| S7 | Near Post Office |
| S8 | Arni X Road |
| S9 | Kancheepuram Road |
| S10 | Near School area in Cheyyar town |

110oC in oven and are used for analysis.

C. Sample preparation

The mineral content of the dust particles in the atmosphere are qualitatively determined by using FTIR technique. Bruker Alpha-T FTIR Spectrometer is used in the present work for recording the FTIR spectra of the samples at room temperature. The samples are subjected to wet grinding by placing 5 to 10 mg of the sample in an agate mortar along with 10 to 15 drops of ethanol. The samples are ground by hand gently until ethanol evaporates completely. The samples were oven dried and then the samples are mixed with KBr at various ratios 1:10, 1:20, 1:30, 1:40 and 1:50. The pellets were prepared and the spectra

Table II Observed absorption frequencies (cm^{-1}) and its tentative assignment of bond vibrations for dust samples from Cheyyar

were taken. The maximum absorption and large number of peaks are observed for the samples in the ratio of 1:30 (sample-KBr) and chosen for analysis.

D. Fourier Transform Infrared Spectroscopic Technique (FTIR)

Infrared spectroscopy has been used extensively for diagnosing the molecular structure since the change in dipole moment in a molecule due to its motion after absorbing the Infrared radiation is a characteristic feature of the molecular species and attributes for a characteristic spectrum. Even though infrared technique studies are most commonly qualitative one, careful analysis of intensity peaks in the spectrum makes it as a most useful tool for quantitative analysis as well⁵. One of the most important and value added applications of the infrared spectroscopic study is the identification of minerals in the sediment samples.

D. Instrument used and Procedure

Using the Bruker Alpha-T FTIR spectrometer Facility at SCSVMV University, Enathur, Kancheepuram, the infrared spectra for all sediment samples were recorded in the region 4000-400 cm^{-1} at room temperature. The resolution of the instruments is 0.001 cm^{-1} and the accuracy is $\pm 4 \text{ cm}^{-1}$.

IV. RESULTS AND DISCUSSION

The representative FTIR spectrum is displayed (Fig. I) and tentative vibration assignments for bonds have been done with the available literature. The mineralogical composition of dust particles are identified and tabulated (Table II).

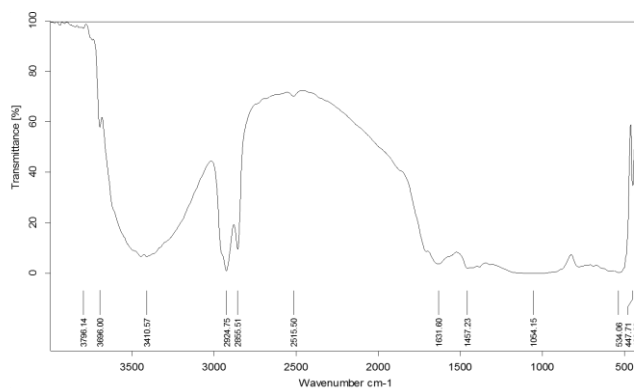


Fig.I FTIR Transmittance Spectrum for Sample S1

| Mineral Name | Observed Frequency cm ⁻¹ | Site Number | Mode of Assignment |
|---------------------|-------------------------------------|----------------------------|-------------------------------------------------------------------------------------|
| Kaolinite | 3693-3696, 3618-3619 | 1,2,4,5,6,8,9,10 1,5,10 | Inner surface OH stretching vibration Inner OH Stretching vibration ⁶ |
| Coal | 2924 | 1,5,6,7,9,10 | Carbon Peak ¹ |
| Calcite | 1425 | 1,7,8,9,10 | Doubly degenerate planar bending ¹ |
| Asbestos | 1030-1034 | 1,5,7,8,9 | Si-O Stretching ¹ |
| Hematite | 533-534 | 1,6 | Si-O Asymmetrical bending ⁶ |
| Orthoclase Feldspar | 435-436 536 | 2,5,8,10 2,5 | Si-O Asymmetrical bending ⁶ |
| Montmorillonite | 1631-1636 | 5,6,7,9,10 | OH deformation of water content ⁶ |

From the above tentative assignment, the following conclusions are arrived.

1. The air suspended dust particles collected in and around cheyyar contain the minerals Kaolinite, Calcite, Asbestos, Hematite, Orthoclase Feldspar and Montmorillonite.
2. Few of the minerals like Asbestos may create harmful health effect to human beings.

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