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CHARACTERIZATION OF THE COMPOUNDS PRESENT IN THE AIRBORNE PARTICULATE MATTER COLLECTED FROM THE SELECTED SITES OF LAHORE USING X-RAY DIFFRACTION TECHNIQUE

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Dust samples were collected through the filters of air conditioners from the selected sites. The samples were analyzed using x-ray diffraction technique to find out the actual compounds present in the dust samples. The sites were either commercial or residential. The contributory sources of different pollutants as detected from this study have been discussed. It was found that in the dust samples Albite, Clinochlore, Dolomite, Gypsum, Halite, Kaolinite, Quartz and Talc were identified as the major components in the atmosphere of Lahore.

Key words: airborne particulate matter, x-ray diffraction technique

INTRODUCTION

Air becomes polluted when it carries suspended particulate matter (SPM), which is any dispersed matter whose individual particle varies in size from less than 1 µm to approximately IOO/lm. The particulates up to diameter of 1Oµm are respirable. However, when the size of aerosol approaches to about 1 Sµm it becomes uninhalable. Suspended particulate matter (SPM) can penetrate deep into the lungs and may cause many diseases of the respiratory tract such as bronchitis, bronchial asthma, tuberculosis and even can cause lung cancer (Boix et al., 1994).

Lahore is the second largest city of Pakistan where the focal points of industrial emissions are located. The identified emissions are supplemented by motor vehicle emissions. Thus the SPM has a great importance with respect to its constituents in the atmosphere. This study was conducted to determine the constituents of the SPM and to identify minerals present in the atmospheric dust.

MATERIALS AND METHODS

Airborne dust samples were collected by jolting the filters of air conditioners, which ran during the months of June, July and August, 1999 at the selected sites in the Lahore city. The sites were selected using space syntax method and SRC standard techniques (Faqir, 1995). The sample collection sites were Gawalmandi, Lahore and its surroundings. This site situated on the roadside, is a commercial market; the sources of air pollution were the activities carried out in its vicinity. The samples were collected on a neat and clean paper and labeled accordingly. The collected samples were strained with the help of muslin cloth to remove the fibrous material. These were then ground to make them homogeneous. The prepared samples were placed in the specific aluminium rectangular sample holders and were loaded at the Goniometer of the x-ray diffractometer which is controlled with the help of a software package.

The diffractometer gives reflections from all possible planes of crystalline material. The set of reflections so obtained is called diffraction pattern. Each crystalline material has a x-ray diffraction pattern unique to the crystalline structure of the specimen material (Kittel, 1976).

RESUL TS AND DISCUSSION

The minerals present in the collected dust were identified with the help of XRD patterns. Diffraction can occur only when the Bragg's Law is satisfied. The law is given by the relation (Kittel, 1976)

$$2d\sin\theta = n\lambda \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(A)}$$

where:
d = Inter planner distance
θ = Angle of diffraction
λ = Wavelength

The XRD pattern contains two parameters, the Bragg's angles '0' and integrated intensities of diffraction peaks. The d- (inter planner distance) value corresponding to Bragg's angles was determined using Bragg's equation (A). The d-values and integrated intensities of reflection in XRD pattern were used for qualitative phase analysis employing the well-known Hanawalt method (Cullity, 1978). The analysis showed that the samples had the following minerals:

Albite: Silicate of sodium and aluminium, colour usually snow-white, sometimes grey, greenish or redish brown. It is found as a constituent of several granites, pegmatites and other rocks.

Clinochlore: A group of minerals which have very similar physical, chemical and crystalline properties. They hydrate silicates of aluminium with magnesium; commonly found in dull green and sometimes as brownish green colour.

Dolomite: This is a carbonate of calcium and magnesium. Its crystals are hexagonal rhombo-hedral and its colour is pearl white to pink.

Gypsum: Hydrous calcium sulphate. It is colourless, grey, pink or brown and is found in monoclinic crystalline form.

Halite: Common rock salt of sodium chloride. It is found in cubic crystalline form.

Kaolinite: A hydrous aluminium silicate. It has monoclinic crystals and has white colour. It is commonly formed as a result of the weathering of feldspars.

Quartz: It is one of the commonest minerals called silicon dioxide. It is found in crystalline form. Rock crystal is colourless white, occasionally it is yellow in colour. Its crystals are either right-handed or left-handed and

correspondingly rotate the plane of polarization of transmitted light.

Talc: A hydrated magnesium silicate. It is found in grey or yellowish grey colour.

The aerosols settle out slowly and are dependent upon air movement. These inhalable particles may even reach the lungs and may cause alveolar retention. In the breathing process, the particles of size larger than 10µm are usually removed in nasal chamber. Small particles penetrate into respiratory system to varying depths and may require long periods for removal (Henry and Perkins, 1974).

There is still a probability that certain amount of absorbed materials accumulate in various specific organs and reach the level of concentration that may cause toxicity (Seithi and Seithi, 1991).

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