X-RAY DIFFRACTION STUDY OF SOIL SAMPLES FROM GHATANJI TALUKA, DISTRICT YAVATMAL

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ABSTRACT

The X-ray diffraction analysis of the soil samples in the present work reveals that the soil contains an admixture of Smectite, Illite, Muscovite and Feldspar mineral structutres. Where the smectite shows an increasing trend, the illite shows a decreasing trend. This means that the two minerals compliment their actions. The distinguishing feature of smectite structure is that water and other polar molecules (in the form of certain organic substances) can, by entering between unit layers, cause the structure to expand in the direction normal to the basal plane. On the other hand, in the case of illite structure there is no swelling with water molecule as in the case of smectite. The presence of smectite and illite together balances the effect of each other giving rise to more passage for cation exchange making the soil more fertile. The Muscovite and Feldspar do not show any significant change suggesting that these structures do not contribute mainly to the fertility of the soil.

Introduction

The X-ray diffraction study of 10 soil samples from Ghatanji Taluka of Yavatmal district have been carried out in the present work. X-ray diffraction is a technique that provides detailed information about the atomic structure of crystalline substances. It is a powerful tool in the identification of minerals in rocks and soils. The bulk of the clay fraction of many soils is crystalline, but clay particles are too small for optical crystallographic methods to be applied. Therefore, XRD has long been a mainstay in the identification of clay sized minerals in soils. [Gee, G. W. *et. al*.1986]. Soil mineralogy is determined routinely because of its strong influence on soil behavior, its use in soil classification, and its relevance to soil genetic processes. Soils commonly contain primary minerals, secondary minerals, and may have crystallographic characteristics that strongly influence the physical and chemical properties of soils. X-ray diffraction is the technique most heavily relied upon in soil mineralogical analysis. [Chen, Y.1988, Sullivan L.A.1990].

Materials and Methods

The soil samples from the 10 fields were collected by the normal method of sample collection. The samples thus collected were then prepared for XRD as per the usual procedure. A Philips X-ray diffractometer has been used for the collection of XRD data which are in the form of diffractographs and tables with the values of the d spacing and the peak intensity.

Results and Discussion

The X-ray diffractographs show the peaks for d-values at 15.7 A, 11.73A, 10.01A, 7.16 A, 4.99 A, and 3.35A respectively for Ca saturation of the soil samples. When the sample is treated with glycerol the peaks of the d-values are found at 28.07 A, 17.02 A, 10.07 A, 9.09A, 7.12 A, 5.58 A, 4.15 A and 3.33A respectively. The broad peak at 15.07A shifting to 17.02 A on glycerol solvation indicates the presence of smectite structure. The peaks at 10.07 -10.01A are due to illite structure. However, the peak at 4.99A could not be seen in the case of glycerol solvated sample. Instead, two additional peaks at 5.55A and 4.51A were observed, indicating the presence of smectite glycol and chlorite. Presence of kaolonite and muscovite was indicated by the 7.12A and 3.55A peaks. The 3.33A is an indication of the K-feldspar which is invariably present in all the samples and does not disappear even after Ca saturation , glycerol solvation or heating up to 550C.[Jackson M.L. 1973, Whiting L.D. 1965, McKeague H.A. 1978].The percentage of the different mineral present in the samples obtained according to the XRD patterns are given in Table 1.

In order to see how the smectite and illite structures in the soil samples in the present work are related to each other, we have plotted a graph between the smectite percentage and illite percentage as shown in Figure 1. It is very interesting to note that the smectite percentage and illite percentage show an exact opposite behavior; be it glycerol solvation or temperature variation. Where the smectite shows an increasing trend, the illite shows a decreasing trend. [Ghosh S.K. and Datta N.P. 1974]. This means that the two minerals compliment their actions. The distinguishing feature of smectite structure is that water and other polar molecules (in the form of certain organic substances) can, by entering between unit layers, cause the structure to expand in the direction normal to the basal plane. On the other hand, in the case of illite structure there is no swelling with water molecule as in the case of smectite. The presence of smectite and illite together balances the effect of each other giving rise to more passage for cation exchange making the soil more fertile. This trend also indicates that the soil physical and chemical properties that are dependent upon the mineral structure should show a similar trend of variation among one another. The plots between smectite percentage and soil pH, EC, CEC etc. and illite percentage against these soil parameters very well support the relationship between smectite percentage and illite percentage.

Smectite	Illite	Muscovite	Feldspar
68.74	15.32	5.15	10.44
77.19	4.88	6.51	11.4
77.57	8.76	3.28	4.92
86.62	0	2.05	3.45
83.33	0	13.33	0
88.03	0	7.18	4.78
39.25	6.79	4.75	49.18
51.23	2.11	21.39	16.16
57.96	9.13	5.47	27.39
75.79	13.12	2.79	8.34

Table 1.Percentage of Minerals in the soil samples.

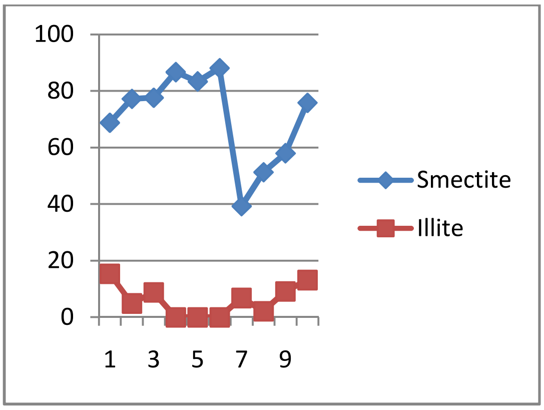

Figure 1.Plot between Smectite and Illite Percentage

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