BASE UNSATURATION AND pH IN RELATION TO SOIL TYPE

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In measuring the base exchange capacity, base unsaturation, and pH of some North Carolina soils appreciable differences in base unsaturation and pH in relation to soil type were encountered. These differences appeared to be characteristic of some property relating to the nature of the base exchange complex.

Differences in base saturation and pH of soils of different origin were reported by Pierre and Scarseth (11). They found that at a given pH value highly weathered soils indicated a lower degree of saturation than less weathered soils and no relationship between organic matter content or the nature of bases present and the percentage saturation at similar pH values. The silica-sesquioxide ratio and the total base exchange capacity of the colloids were generally, although imperfectly, correlated with the percentage base saturation at the same pH values. They obtained a good correlation between avidity of soil acids and the percentage saturation at pH 4.80. Mattson (6) assumes that a direct relationship of base saturation and pH is not to be expected, and that it will vary with the acidoid-basoid ratio of the colloid.

Pierre and Scarseth (11) reviewed the results of other investigators who reported a general but imperfect relationship of base saturation to pH. The results of Morgan (9) with Connecticut soils and those of Pech (10) with Florida soils show a general relationship of base saturation and pH, although there were decided individual variations. Similar results were obtained with North Carolina soils. Since the differences in percentage base saturation of various soils at like pH values are of considerable practical, as well as theoretical importance, a detailed examination of the significance of these variations with special reference to soil type was therefore made, and the more pertinent results are discussed in this paper.

MATERIALS AND METHODS

Detailed descriptions of the profile characteristics of the soils of North Carolina reported in Table I are given by Williams, Cobb, and Mann (13). Natural soils were used which were partially hydrogen saturated. In this condition the air dry soil, after having been screened through a i-mm sieve, was treated with 0.1 N HCl equivalent to the exchangeable bases present. The soil was shaken for about 24 hours in a mechanical shaker, allowed to stand over night; throughout the following day the contents of the shaker were presumed to be due to the presence of different clay minerals and montmorillonitic and beidellitic soils.

The base exchange capacity and exchangeable bases were determined with the barium chloride-triethanolamine method (7). The samples containing more than 75% hydrogen were treated with 0.2 N Ba(OH)₂ to obtain a 75, 50, and 25, and 0% unsaturated soil. The barium hydroxide was added to 20-gram portions of soil and sufficient water added to give a final soil solution ratio of 1:10 for clays and a ratio of 1:1 for sandy soils. The samples were shaken for 30 minutes in a mechanical shaker, allowed to stand over night; throughout the following day the samples were shaken several times for a few minutes at a time, usually by hand at convenient intervals. After 42 to 48 hours the samples were again thoroughly shaken and measured using a glass electrode. At the end of this period equilibrium was established. The time and the treatment used were found to be essential in order to obtain equilibrium for the organic, montmorillonitic, and beidellite minerals (Fig. 1), whereas 24 hours were found to be sufficient for the kaolinitic and halloysitic soils.

In a preliminary test the neutralizing value of barium hydroxide was compared with that of barium hydroxide. The results were found to be very similar and subsequently 0.1 N HCl results with the natural soil are recorded.

RESULTS

The base exchange capacity values, base saturation, and pH in relation to some soils of the Piedmont, Mountain, and Coastal Plain areas are given in Table I. With the exception of soil Nos. 233 and AU 104-123, which were pretreated with hydrochloric acid results with the natural soil were reported.

COMPARISON OF RELATIONSHIP OF BASE UNSATURATION AND pH OF SOILS WITH BASE EXCHANGE MINERALS

Differences of base unsaturation and pH with the base exchange minerals