THE KINETICS AND MECHANISMS OF BORON ADSORPTION AND DESORPTION IN MID-ATLANTIC COASTAL PLAIN SOILS

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Abstract

The kinetics of boron (B) adsorption and desorption were investigated on horizons from seven soils from Delaware. The physicochemical characteristics of these soils varied widely. Boron adsorption was determined using a miscible displacement technique and the soil samples were leached with a 1.85x10-4 mol kg^{-1} B solution at a flow rate of 1 ml min^{-1}. Boron was then desorbed using 0.01M $CaC1_2$. The adsorption process conformed to first-order kinetics. The apparent B adsorption rate coefficients (k_a) ranged from 0.029 to 0.129 min^{-1}. The k_a values were similar between horizons of a given soil indicating that the same reaction was responsible for B adsorption in both horizons. The total amount of B adsorbed/g of soil ranged from 3.14 x 10^{-5} to 1.39 x 10^{-4} mol kg^{-1}. The total amount of B adsorbed was strongly related to the organic matter and clay contents of the soil horizons.

The adsorption-desorption processes in the soil horizons exhibited marked hysteresis. The nonsingular reactions were attributable to the organic matter content of the soil horizons. The magnitude of reversibility increased with decreasing organic matter levels.

Reversibility was increased 20% in selected topsoil horizons by the use of 0.01M $CaC1_2$-Mannitol as the desorbing reagent. This indicated the greater efficiency of mannitol to desorb organically bound B. It also emphasized the tenacity with which organically bound B is adsorbed indicating that it is not readily available for plant use.