

< Cation Exchange Capacity >

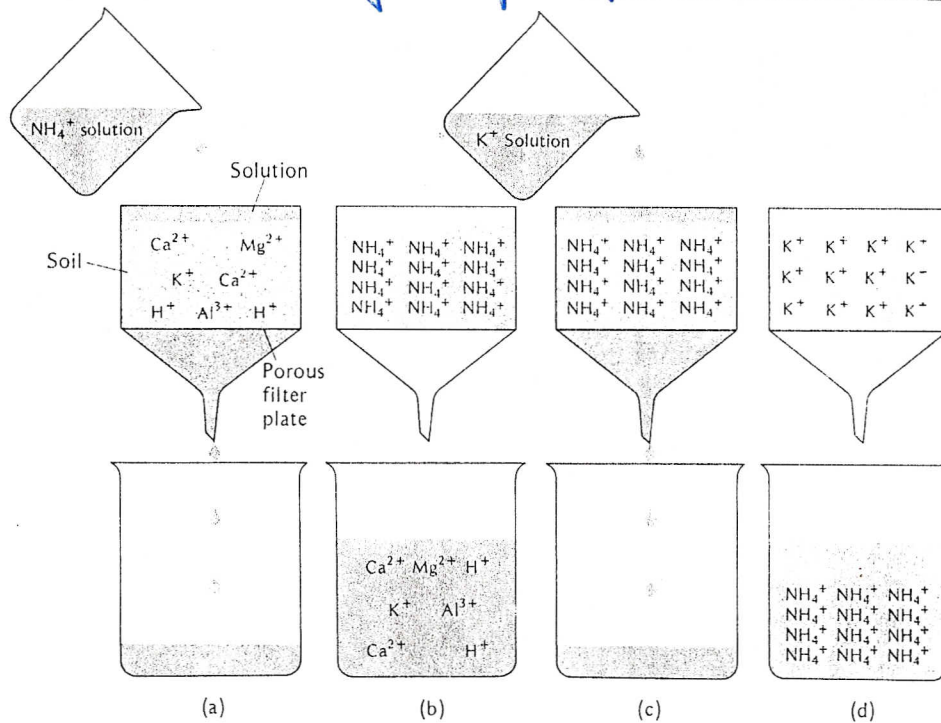


FIGURE 7.15

Illustration of a method for determining the cation exchange capacity of soils. (a) A given mass of soil containing a variety of exchangeable cations is leached with an ammonium (NH_4^+) salt solution. (b) The NH_4^+ ions replace the other adsorbed cations, which are leached into the container below. (c) After the excess NH_4^+ salt solution is removed with an organic solvent, such as alcohol, a K^+ salt solution is used to replace and leach the adsorbed NH_4^+ ions. (d) The amount of NH_4^+ released and washed into the lower container can be determined, thereby measuring the chemical equivalent of the cation exchange capacity (i.e., the negative charge on the soil colloids).

The CEC of a soil is usually measured by saturating a soil or soil component with an index cation such as Ca^{2+} , removal of excess salts of the index cation with a dilute electrolyte solution, and then displacing the Ca^{2+} with another cation such as Mg^{2+} . The amount of Ca^{2+} displaced is then measured and the CEC is calculated. For example, let us assume that 200 mg of Ca^{2+} were displaced from 100g of soil. The CEC would then be calculated as

$$\text{CEC} = \left(\frac{200 \text{ mg } \text{Ca}^{2+}}{100 \text{ g}} \right) \left/ \left(\frac{20 \text{ mg } \text{Ca}^{2+}}{\text{meq}} \right) \right. = 10 \text{ meq}/100 \text{ g} = 10 \text{ cmol}_c \text{ kg}^{-1}.$$

The CEC of various soil minerals were provided in Chapter 2. The CEC of a soil generally increases with soil pH due to the greater negative charge that develops on organic matter and clay minerals such as kaolinite due to deprotonation of functional groups as pH increases. The anion exchange capacity increases with decreasing pH as the variable charge surfaces become more positively charged due to protonation of functional groups.

The magnitude of the CEC in soils is usually greater than the AEC. However, in soils that are highly weathered and acidic, e.g., some tropical soils, copious quantities of variable charge surfaces such as oxides and kaolinite may be present and positive charge on the soil surface may be significant. These soils can exhibit a substantial AEC.