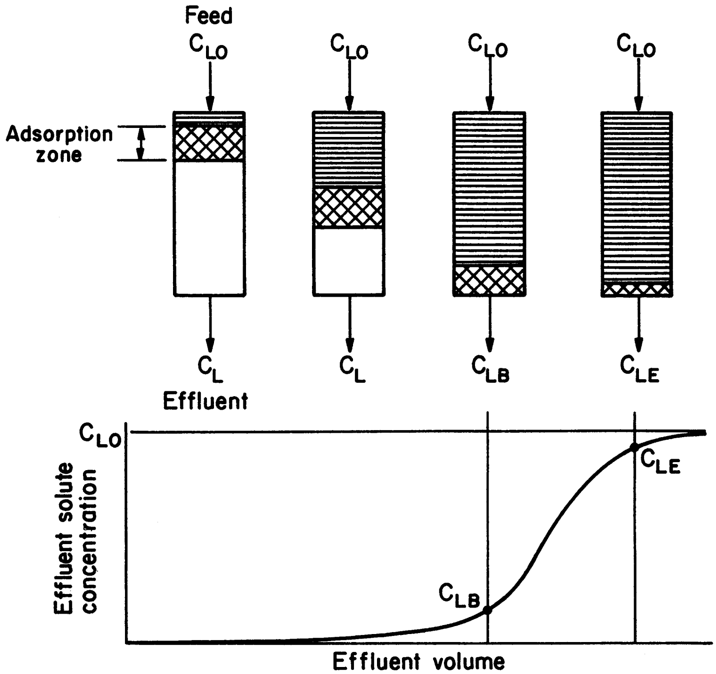

Figure 11.17. Movement of adsorption zone through a fixed-bed downflow adsorber and the corresponding breakthrough curve. (With permission, from D. W. Sundstrom and H. E. Klei, *Wastewater Treatment*, Pearson Education, Upper Saddle River, NJ, 1979, p. 281.)

would observe the *breakthrough* curve of the adsorption zone. This process is depicted in Fig. 11.17.

Under these circumstances, eq. 11.47 would describe the concentration profile in the adsorption zone of a height H. If the column were of total height H_t, then the time to exhaustion of the column would be equal to the ratio of H to H_t multiplied by the velocity of the adsorption zone, plus the time required to form the adsorption zone (usually negligible).

Example 11.3.

Cephalosporin is separated from fermentation broth by adsorption on an ion-exchange resin in a moving-bed column. The bed is 4 cm in diameter and contains 0.8 cm^3 resin/cm^3 bed. The density of the resin is 1.3 g/cm^3, and the feed solution contains 5 g/l of the antibiotic. If the superficial velocity of liquid is 1.5 m/h and the overall mass transfer coefficient is 15 h^{-1}, determine the height of the column for an effluent antibiotic concentration of $C_L = 0.2$ g/l. Assume an equilibrium relationship of

$$C_S = 25(C_L^*)^{1/2}$$

where C_S is g solute/l resin and C_L is g solute/l solution. The ratio of volumetric flow rate of broth to resin is 10.