Example 2-7: Determining alkalinity species Determine the species, and the quantity of each specie, of alkalinity in Example 2-6 if the 8.3 equivalence point is reached at 11 mL of acid.

SOLUTION

1. Because the initial pH is 10, the initial pOH of the water is 4. A determination of the OH^- concentration can be made as follows.

$$[OH^-] = \frac{10^{-4} \text{ mol } OH^-}{L} \times \frac{1 \text{ equiv}}{\text{mol } OH^-} \times \frac{50{,}000 \text{ mg } CaCO_3}{1 \text{ equiv}}$$
$$= 5 \text{ mg/L as } CaCO_3$$

2. Five milliliters of acid would be required to measure the OH^- in a 1-L sample. However, this sample is only 200 mL so the necessary volume of acid is:

$$5 \frac{200}{1000} = 1.0 \text{ mL}$$

3. If 1 mL of acid measures the OH^-, then 10 mL of acid measures one-half of the carbonate and 10 more will be required to measure the remaining one-half of the CO_3^{2-}, leaving 9 mL to measure the HCO_3^-. (See Fig. 2-4.) Thus, the quantity of each species is as follows:

$$OH^- \text{ (calculated from pH)} = 5 \text{ mg/L}$$

$$CO_3^{2-} = \frac{20 \text{ mg}}{200 \text{ mL}} \times \frac{1000 \text{ mL}}{L} = 100 \text{ mg/L}$$

$$HCO_3^- = \frac{9 \text{ mg}}{200 \text{ mL}} \times \frac{1000 \text{ mL}}{L} = 45 \text{ mg/L}$$

$$\text{Total alkalinity} = 150 \text{ mg/L}$$