$$v_p = \frac{g(\rho_p - \rho_w)d_p^2}{18\mu} \approx \frac{g(sg_p - 1)d_p^2}{18\nu} \tag{5–22}$$

Terms are as defined previously.

For laminar-flow conditions, Stokes found the drag force to be

$$F_D = 3\pi\mu v_p d_p \tag{5–23}$$

Stokes' law [Eq. (5–22)] can also be derived by equating the drag force found by Stokes to the effective weight of the particle [Eq. (5–16)].

Settling in the Transition Region. In the transition region, the complete form of the drag equation [Eq. (5–16)] must be used to determine the settling velocity, as illustrated in Example 5–5. Because of the nature of the drag equation, finding the settling velocity is an iterative process. As an aid in visualizing settling in the transition region, Fig. 5–21 has been prepared, which covers the laminar and the transition region for particle sizes of interest in environmental engineering.

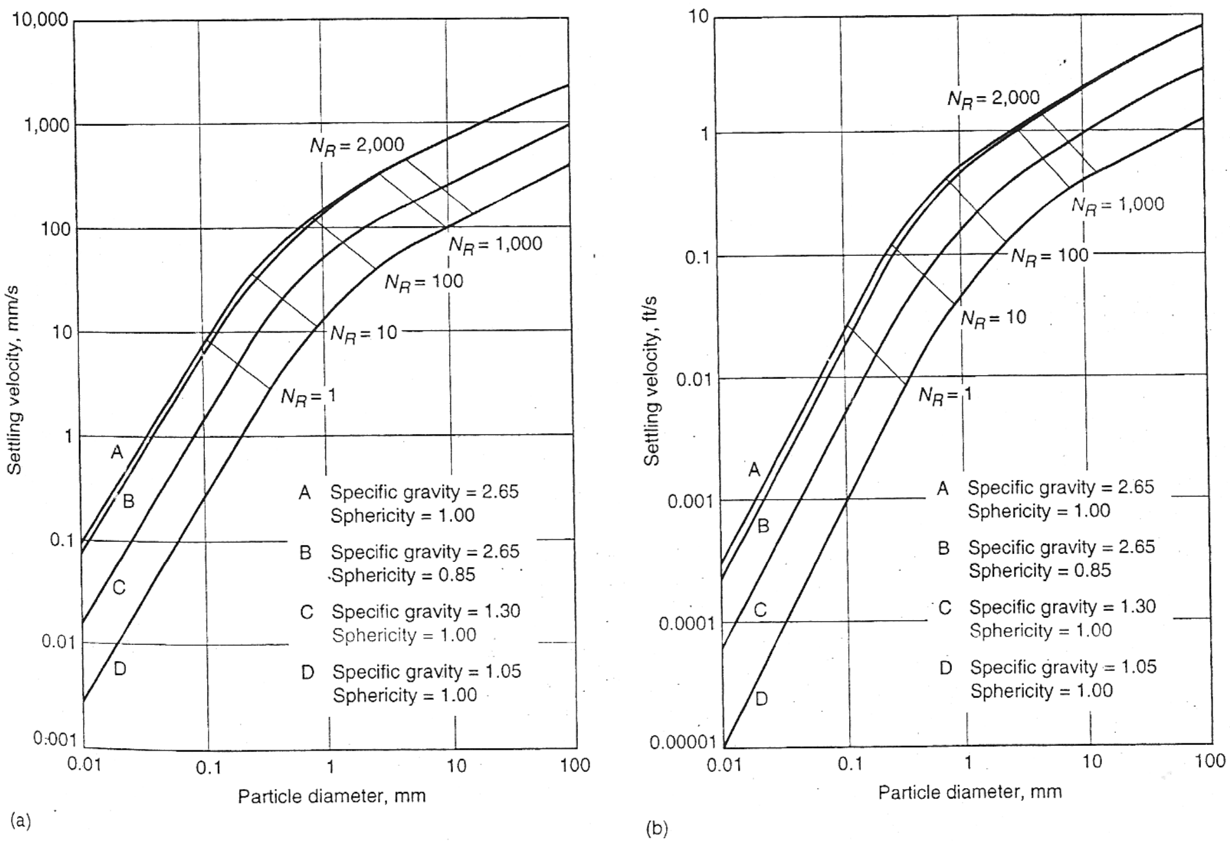

Figure 5–21

Settling velocities for various particle sizes under varying conditions at 20°C: (*a*) settling velocity in m/s versus particle size in mm, (*b*) settling velocity in ft/s versus particle size in mm. *(Crites and Tchobanoglous, 1998.)*