Table 7.18
Characteristics of Aerators

type	operating head (ft)	loading capacity	efficiency in CO_2 removal	remarks
spray	8–28	4–180 gpm nozzle	high	requires protection from loss of water by wind; ice hazard in cold climates
cascade	3–10	20–50 gpm/sq ft	low to	requires large space
perforated tray			fair	requires larger space and higher head than coke tray
coke tray	6–10	<35 gpm sq ft	high	used also for iron and manganese removal
forced draft	10–25	16–18 gpm sq ft	high	compact but more complex than above types
diffused air	5–10 psi[1]	0.02–0.2 cfm/gpm[2]	high	requires compressed air; most complex

[1] Air pressure depends upon water depth and pipe friction losses.

[2] Air requirement.

Transfer efficiencies of diffused air systems vary with depth and bubble size. If coarse bubbles are produced, only 4% to 8% of the available oxygen will be transferred to the water. With medium-sized bubbles, the *transfer efficiency* varies between 6% and 15%. Fine bubble systems are capable of transferring 10% to 30% of the supplied oxygen to the water.

B. PLAIN SEDIMENTATION (CLARIFICATION)

Water contaminated with sand, dirt, mud, etc., can be treated in a sedimentation basin or tank. Up to 80% of the incoming sediment can be removed in this manner. Sedimentation basins are usually concrete, rectangular or circular in plan, and equipped with scrapers or raking arms to periodically remove accumulated sludge.

Settlement of water-borne particles depends on the water temperature (which affects viscosity), particle size, and particle specific gravity. Typical specific gravities are given in table 7.19.

Table 7.19
Properties of Particles

particle type	specific gravity	particle size, mm
coarse sand	2.65	0.50–2.00
medium sand	2.65	0.25–0.50
fine sand	2.65	0.10–0.25
very fine sand	2.65	0.05–0.10
silt	2.65	0.005–0.05
clay		0.001–0.005
flocculated mud	1.03	

Settlement time can be calculated from the settling velocity, flow-through velocity, and depth of the tank. Tank depths are typically 6 to 15 feet. The settling velocities for spherical particles in 68°F water are given in figure 7.6. Of course, settling velocities will be much less than those shown in figure 7.6 because actual sediment particles are not spherical.

If it is necessary to calculate the settling velocity of a particle of diameter d (in feet), the following procedure can be used.

step 1: Assume v_s.

step 2: Calculate the Reynolds number

$$N_{Re} = \frac{v_s d}{\nu} \qquad 7.37$$

step 3: If $N_{Re} < 1$, use Stoke's law.

$$v_s = \frac{(\rho_{\text{particle}} - \rho_{\text{water}})d^2 g}{18\mu g_c} = \frac{(\text{SG}_{\text{particle}} - 1)d^2 g}{18\nu} \qquad 7.38$$

If $1 < N_{Re} < 2000$, use figure 7.6.

If $N_{Re} > 2000$, use Newton's law.

$$v_s = \sqrt{\frac{4g(\rho_{\text{particle}} - \rho_{\text{water}})d}{3(\rho_{\text{water}})C_D}} \qquad 7.39$$

Values of C_D are given in table 7.20.