CHAPTER 60
SETTLING

61. GENERAL CONSIDERATIONS

61.1 Number of Units

___ Multiple units capable of independent operation are desirable and shall be provided in all plants where design flows exceed 100,000 gpd (379 m^3/d). Plants not having multiple units shall include other provisions to assure continuity of treatment.

61.2 Arrangement

___ Settling tanks shall be arranged in accordance with Section 43.5 and 62.6.

61.3 Flow Distribution

___ Effective flow measurement devices and control appurtenances (i.e., valves, gates, splitter boxes, etc.) shall be provided to permit proper proportion of flow to each unit.

61.4 Tank Configuration

___ Consideration should be given to the probable flow pattern in the selection of tank size and shape, and inlet and outlet type and location.

62. DESIGN CONSIDERATIONS

62.1 Dimensions

___ The minimum length of flow from inlet to outlet should be 10 feet (3 m) unless special provisions are made to prevent short circuiting. The sidewater depth for primary clarifiers shall be as shallow as practicable, but not less than 7 feet (2.1 m). Clarifiers following the activated sludge process shall have sidewater depths of at least 12 feet (3.7 m). Clarifiers following fixed film reactors shall have sidewater depth of at least 10 feet (3.0 m).

62.2 Surface Settling Rates (Overflow Rates)

62.2.1 Primary Settling Tanks

Surface settling rates for primary tanks should not exceed 1000 gpd/ft^2 (41 m^3/m^2*d) at design average flows or 1500 gpd/ft^2 (61 m^3/m^2*d) for peak hourly flows. Clarifier sizing shall be calculated for both flow conditions and the larger surface area determined shall be used. Primary settling of normal domestic sewage can be expected to remove 30% to 35% of the influent BOD. However, anticipated BOD removal for sewage containing appreciable quantities of industrial wastes (or chemical additions to be used) should be determined by laboratory tests and consideration of the quantity and character of the wastes.

62.2.2 Intermediate Settling Tanks

___ Surface settling rates for intermediate settling tanks following series units of fixed film reactor processes shall not exceed 1500 gpd/ft^2 (61 m^3/m^2*d) based on peak hourly flow.

62.2.3 Final Settling Tanks

62.2.3.1 Final Settling Tanks - Fixed Film Biological Reactors

___ Surface settling rates for settling tanks following trickling filters or rotating biological contactors shall not exceed 800 gpd/ft^2 at design average flow or 1200 gpd/ft^2 (49 m^3/m^2*d) based on peak hourly flow.

62.2.3.2 Final Settling Tanks - Activated Sludge

___ The hydraulic design of intermediate and final settling tanks following the activated sludge process shall be based upon the anticipated peak hourly rate for the areas downstream of the inlet baffle. The peak/design average hydraulic loadings shall not exceed: 1200/800 gpd/ft^2 for conventional, step aeration, contact stabilization and the carbonaceous stage of separate-stage nitrification; 1000/700 gpd/ft^2 for extended aeration; and 800/600 gpd/ft^2 for the separate nitrification stage. The solids loadings for all activated sludge processes shall not exceed 20 lb/d/ft^2 (98 kg/m^2*d) at the design average flow or 50 lb/d/ft^2 (244 kg/m^2*d) at the peak rate. Consideration should be given to flow equalization.

62.3 Inlet Structures

___ Inlets should be designed to dissipate the inlet velocity, to distribute the flow equally both horizontally and vertically and to prevent short circuiting. Channels should be designed to maintain a velocity of at least one fps (0.3 m/s) at one-half the design flow. Corner pockets and dead ends should be eliminated and corner fillets or channeling used where necessary. Provisions shall be made for elimination or removal of floating materials in inlet structures.

62.4 Weirs

62.4.1 General

___ Overflow weirs shall be adjustable for leveling.

62.4.2 Location

___ Overflow weirs shall be located to optimize actual hydraulic detention time, and to minimize short circuiting.

62.4.3 Design Rates

___ Weir loadings should range from 10,000 gpd/ft (124 m^3/m*d) to 40,000 gpd/ft (500 m^3/m*d). If pumping is required, weir loadings should be related to pump delivery rates to avoid short circuiting.

62.4.4 Weir Troughs

___ Weir troughs shall be designed to prevent submergence at maximum design flow, and to maintain a velocity of at least one fps (0.3 m/s) at one-half design flow.

62.5 Submerged Surfaces

___ The top of troughs, beams, and similar submerged construction elements shall have a minimum slope of 1.4 vertical to 1 horizontal; the underside of such elements should have a slope of 1 to 1 prevent the accumulation of scum and solids.

62.6 Freeboard

___ Walls of settling tanks shall extend at least 6 inches (15 cm) above the surrounding ground surface and shall provide not less than 12 inches (30 cm) freeboard. Additional freeboard or the use of wind screens is recommended where larger settling tanks are subject to high velocity wind currents that would cause tank surface waves and inhibit effective scum removal.

63. SLUDGE AND SCUM REMOVAL

63.1 Scum Removal

___ Effective scum collection and removal facilities, including baffling, shall be provided for all settling tanks. The unusual characteristics of scum that may adversely affect pumping, piping, sludge handling and disposal, should be recognized in design. Provisions may be made for the discharge of scum with the sludge; however, other special provisions for disposal may be necessary.

63.2 Sludge Removal

63.2.1 Sludge Hopper

___ The minimum slope of the side walls shall be 1.7 vertical to 1 horizontal. Hopper wall surfaces should be made smooth with rounded corners to aid in sludge removal. Hopper bottoms shall have a maximum dimension of two feet (0.6 m). Extra depth sludge hoppers for sludge thickening are not acceptable. Cross-collectors serving one or more settling tanks may be used in lieu of multiple sludge hoppers.

63.2.2 Sludge Removal Piping

___ Each hopper shall have an individually valved sludge withdrawal line at least six inches (15 cm) in diameter (8 inches is recommended). The static head available for withdrawal of sludge shall be 30 inches (76 cm) or greater, as necessary to maintain a three fps (0.91 m/s) velocity in the withdrawal pipe. Clearance between the end of the withdrawal line and the hopper walls shall be sufficient to prevent "bridging" of the sludge. Adequate provisions shall be made for rodding or back-flushing individual pipe runs. Piping shall also be provided to return waste sludge to primary clarifiers.

63.2.3 Sludge Removal Control

___ Sludge wells equipped with telescoping valves or other appropriate equipment shall be provided for viewing, sampling and controlling the rate of sludge withdrawal. The use of easily maintained sight glass and sampling valves may be appropriate. A means of measuring the sludge removal rate shall be provided. Air lift type of sludge removal will not be approved for removal of primary sludges. Sludge pump motor control systems shall include time clocks and valve activators for regulating the duration and sequencing of sludge removal.

64. PROTECTIVE AND SERVICE FACILITIES

64.1 Operator Protection

___ All settling tanks shall be equipped to enhance safety for operators. Such features shall appropriately include machinery covers, life lines, stairways, walkways, handrails, slip-resistant surfaces, etc. OSHA guidance shall be followed.

64.2 Mechanical Maintenance Access

___ The design shall provide for convenient and safe access to routine maintenance items such as gear boxes, scum removal mechanisms, baffles, weirs, inlet stilling baffle areas, effluent channels, etc.

64.3 Electrical Fixtures and Controls

___ Electrical fixtures and controls in enclosed settling basins shall meet the requirements of Section 32.3.5. The fixtures and controls shall be located so as to provide convenient and safe access for operation and maintenance. Adequate area lighting shall be provided.