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WASTEWATER FACILITIES DESIGN STANDARDS

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IOWA WASTEWATER DESIGN STANDARDS

CHAPTER 16

SETTLING

16.1 GENERAL

16.1.1 Applicability

This chapter is applicable to construction, installation or modification of any disposal system required to obtain a construction permit from this Department under the Iowa Code, Section 455B.183, and 567--64.2 of the Iowa Administrative Code (I.A.C.).

16.1.2 Variances [567--64.2(9)"c" I.A.C.]

When engineering justification satisfactory to the executive director is provided substantially demonstrating that variation from the design standards or siting criteria will result in either: at least equivalent effectiveness while significantly reducing cost, or improved effectiveness, such a variation from design standards or siting criteria may be accepted by the executive director.

16.1.3 Explanation of Terms

The terms "shall" or "must" are used in these standards when it is required that the standard be used. Other terms such as "should" and "recommended" indicate desirable procedures or methods which should be considered but will not be required.

16.2 GENERAL CONSIDERATIONS

16.2.1 Number of Units

Multiple units capable of independent operation are desirable and shall be provided in all plants except those specified in Section 14.5

16.2.2 Flow Distribution

Flow splitting devices and control appurtenances (i.e., valves, gates, splitter boxes, etc.) shall be provided to permit proper proportioning of flow to each unit in accordance with Section 14.4.9.3.

16.3 DESIGN CONSIDERATION

16.3.1 Dimensions

The sidewater depth for primary settling tanks shall not be less than 7 feet. Settling tanks following the activated sludge process shall have sidewater depths of at least 12 feet to provide adequate separation zone between the sludge blanket and the overflow weirs. Settling tanks following the activated sludge process may have 10 foot sidewater depths provided that less than 340 lbs/day of BOD_5 is treated and provided the clarifier is followed by a 5-day pond. Intermediate settling tanks following first stage fixed film reactors shall have sidewater depths of at least 7 feet. Final settling tanks following fixed film reactors shall have sidewater depth of at least 10 feet.

16.3.2 Surface Overflow Rates

16.3.2.1 General

Settling rates stated in this section are based on typical clarifier designs for domestic wastewaters without additions of chemical settling aids. If chemical coagulants are added to aid settling, overflow rates may be increased based on pilot studies or similar facilities already in operation.

The flows used in the following sections are designated by the appropriate initials as they were identified in 14.4.5.1 for municipal treatment plants. The corresponding flow designations for AWW and PHWW flows for industrial wastewater treatment facilities would be the average rated flows and the peak hour flows.

16.3.2.2 Primary Settling Tanks

Surface overflow rates for primary tanks should not exceed 1,000 gallons per day per square foot at AWW flows or 1,500 gallons per day per square foot for PHWW flows. Clarifier sizing shall be calculated for both flow conditions and the larger surface area determined should be used. At these rates, primary settling of normal domestic sewage can be expected to remove 30 to 35% of the influent BOD. The overflow rates may be increased, but lower removal rates shall be assumed unless adequate chemical addition is provided.

Anticipated BOD removal for sewage containing appreciable quantities of industrial wastes should be determined by laboratory tests, actual settling data,

and consideration of the quantity and character of the wastes.

16.3.2.3 Intermediate Settling Tanks

Surface settling rates for intermediate settling tanks following the carbonaceous stage of a separate stage nitrification activated sludge process shall not exceed 900 gallons per day per square foot at AWW flows or 1,200 gallons per day per square foot for PHWW flows. Higher surface settling rates may be permitted if such rates are shown to have no adverse effects on subsequent treatment units.

Surface Settling rates for intermediate settling tanks following other treatment units shall not exceed 1,500 gallons per day per square foot based on PHWW flows.

16.3.2.4 Final Settling Tanks

16.3.2.4.1 Final Settling Tanks - Fixed Film Biological Reactors

Surface overflow rates for settling tanks following trickling filters or rotating biological contactors treating domestic wastewater shall not exceed 1,200 gallons per day per square foot for PHWW flows.

The allowable surface overflow rates may be increased if chemical addition is provided. This determination shall be based on data from pilot studies, similar systems already in operation, or the literature.

16.3.2.4.2 Final Settling Tanks - Activated Sludge

To perform properly while producing a concentrated return flow, activated sludge settling tanks must be designed to meet thickening as well as solid separation requirements. Since the rate of recirculation of return sludge from the final settling tanks to the aeration or reaeration tanks is quite high in activated sludge processes, surface overflow rates shall be low enough to minimize the problems with high solids loadings, density currents, inlet hydraulic turbulence, and occasional poor sludge settleability. The surface settling rates of final settling tanks following the activated sludge processes

shall be based on PHWW flow. The hydraulic loadings for facilities treating domestic wastewater shall not exceed the following:

Process Type	Hydraulic Loading at PHWW Flow gpd/s.f.
All (except as listed below)	1,200
Contact Stabilization	1,200
Extended Aeration	1,000
Separate Nitrification	800
High-Purity Oxygen With Primary Settling	1,200

The final settling tank solids loading for all activated sludge processes shall not exceed 30 pounds solids per day per square foot at AWW flow or 50 pounds solids per day per square foot at PHWW flow. Settling tank sizing shall be calculated for both flows and both solids loading conditions and the largest surface area determined shall be used.

The allowable surface overflow rates may be increased if chemical addition is provided. This determination shall be based on data from pilot studies, similar systems already in operation, or the literature.

16.3.2.4.3 Final Settling Tanks - Industrial Waste

For industrial waste treatment facilities and domestic waste treatment facilities with significant industrial contributions, the surface overflow rates shall be based on pilot studies, data from similar systems already in operation, or literature data. The surface overflow rates shall not exceed those allowed in Section 16.3.2.4.1 and 16.3.2.4.2.

When the department has actual operating experience with two similar facilities it may require lower settling rates or additional solids removal capability.

16.3.3 Inlet Structures

Inlet structures shall be designed to dissipate the inlet velocity, to distribute the flow equally both horizontally and vertically and to prevent short circuiting. Channels shall be designed to maintain a velocity of at least one foot per second at one-half the AWW flow. Corner pockets and dead ends shall not be allowed and corner fillets or channeling shall be used where necessary. Provisions shall be made for elimination or removal of floating materials in the inlet structures.

16.3.4 Weirs

16.3.4.1 General

Overflow weirs shall be readily adjustable for leveling. The range of adjustment shall take into account uneven settling over the life of the structure. Overflow weirs shall be serrated with V-Notches or similar notches.

16.3.4.2 Location

Overflow weirs shall be located to optimize actual hydraulic detention time, and minimize short circuiting. Peripheral weirs should be placed at least one foot away from the clarifier wall or baffles should be provided to minimize wall effects. Interior weirs are permissible if accompanied with effective means of scum removal.

16.3.4.3 Design Rates

Weir loadings shall not exceed 10,000 gallons per day per lineal foot for plants designed for AWW flows of 1.0 mgd or less. Higher weir loadings may be used for plants designed for larger AWW flows, but should not exceed 15,000 gallons per day per lineal foot. If pumping to the settling tanks is required, weir loading should be related to pump delivery rates to avoid short circuiting. Pumping should not be intermittent, but as nearly continuous as possible, and pumping into a final clarifier should be avoided.

16.3.4.4 Weir Troughs

Weir troughs shall be designed to prevent submergence at PHWW flow with the largest tank out of service, and

to maintain a velocity of at least 1 foot per second at one-half the AWW flow.

16.3.5 Unit Dewatering and Bypassing

Unit dewatering features shall conform to the provisions outlined in section 14.4.8.2. Unit bypass design shall also provide for proportional redistribution of the plant flow to the remaining units.

16.3.6 Freeboard

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

16.4 SLUDGE AND SCUM REMOVAL

16.4.1 Scum Removal

Scum collection and removal facilities, including baffling, shall be provided for all primary and final settling tanks. Characteristics of certain treatment process scum (i.e. nitrification, industrial wastewater) which may adversely affect pumping, piping, sludge handling and disposal, shall be recognized in design.

16.4.2 Sludge Removal

Sludge collection and withdrawal facilities shall be designed to assure rapid removal of the sludge. Suction withdrawal should be provided for activated sludge settling tanks.

16.4.2.1 Sludge Hopper

The minimum slope of the side walls shall be 1.7 vertical to 1 horizontal. Hopper wall surfaces shall be made smooth with rounded corners to aid in sludge removal. Hopper bottoms shall have a maximum plan dimension of 2 feet. Extra depth sludge hoppers for sludge thickening are not acceptable.

16.4.2.2 Cross-Collectors

Cross-collectors serving one or more settling tanks may be useful in place of multiple sludge hoppers.

16.4.2.3 Sludge Removal Piping

Each hopper shall have an individual valved sludge withdrawal line at least 6 inches in diameter. The

static head available for withdrawal of sludge shall be 30 inches or greater, as necessary to maintain a 3 foot per second velocity in the withdrawal pipe. Clearance between the end of the withdrawal line and the hopper walls should be sufficient to prevent "bridging" of the sludge. Provisions shall be made for rodding or backflushing individual pipe runs. Piping may also be provided to return waste sludge to primary clarifiers.

16.4.2.4 Sludge Removal Control

Sludge wells equipped with telescoping valves or other appropriate equipment should be provided for viewing, sampling and controlling the rate of sludge withdrawal. The use of easily maintained sight glass, sampling valves, and sludge density meters 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 should include time clocks and valve activators for regulating the duration and sequencing of sludge removal.

16.5 PROTECTIVE AND SERVICE FACILITIES

16.5.1 Operation Protection

All settling tanks should be equipped to enhance safety for operators. Such features should appropriately include machinery covers, life lines, stairways, walkways, handrails and slip resistant surfaces.

16.5.2 Mechanical Maintenances Access

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

16.5.3 Electrical Fixtures and Controls

The fixtures and controls should be located so as to provide convenient and safe access for operation and maintenance. Adequate area lighting should be provided. [Also see Chapter 14, paragraph 8 - safety]. Appropriate pump controls should be located near sludge and scum viewing points.

16.5.4 Cold Weather Protection

The design should provide measures for cold weather protection such as the use of wind screens, protective walls, and other means, as appropriate, to alleviate the problems of freezing.