

SUBCHAPTER K: CHEMICAL DISINFECTION
§§217.271 - 217.283
Effective December 4, 2015

§217.271. Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination System Redundancy Requirements.

(a) Each gaseous chlorine disinfection and sulfur dioxide dechlorination system must include the number of cylinders required for normal operation at peak flow, plus at least one additional cylinder.

(b) Gaseous chlorine disinfection systems and sulfur dioxide dechlorination systems must include a device that automatically switches between cylinders in a manner that ensures continuous disinfection and dechlorination.

(c) A wastewater treatment facility must have sufficient space to store at least as many empty cylinders as the number of cylinders required for normal operation at peak flow.

(d) A gaseous chemical delivery system must meet the pounds per day requirements in §217.272 of this title (relating to Capacity and Sizing of Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination) when the largest chlorinator, sulfonator, or evaporator is out of service.

(e) If an injector water supply requires a booster pump, a duplicate backup pump is required.

(f) A gaseous chemical delivery system must include an emergency power source capable of operating the chlorination and dechlorination systems during an extended power outage, in accordance with §217.36 of this title (relating to Emergency Power Requirements).

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§217.272. Capacity and Sizing of Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems.

(a) The capacity of a chlorine or a sulfur dioxide gas-withdrawal system must be based on the peak flow, in compliance with §217.32(a)(1) of this title (relating to Organic Loadings and Flows for New Wastewater Treatment Facilities) and Equation K.1. in Figure: 30 TAC §217.272(a).

Figure: 30 TAC §217.272(a)

Equation K.1.

$$PPD = Q \times D \times 8.34$$

Where:

PPD = Pounds per day of chlorine or sulfur dioxide required for treatment

Q = Peak two hour flow (millions of gallons per day)

D = chlorine concentration from Table K.1. in Figure: 30 TAC §217.272(b), or sulfur dioxide dosage needed to dechlorinate the expected chlorine residual

8.34 = conversion factor

(b) Table K.1. in Figure: 30 TAC §217.272(b) establishes the minimum acceptable design chlorine dosage for disinfection:

Figure: 30 TAC §217.272(b)

Table K.1. - Minimum Design Chlorine Concentration Needed for Disinfection

Type of Effluent	Chlorine Concentration milligrams per liter (mg/l)
Primary	15
Fixed Film	10
Activated Sludge	8
Tertiary Filtration Effluent	6
Nitrified Effluent	6

(c) At the point of dechlorination, a dechlorination system must provide at least one unit of sulfur dioxide gas for each unit of residual chlorine.

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§217.273. Cylinder Requirements for Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems.

(a) Cylinder Withdrawal Rates for Chlorine and Sulfur Dioxide Gases.

(1) Gas Withdrawal. The gas withdrawal rate per cylinder for chlorine and sulfur dioxide cylinders must be based on Equation K.2. and the variables from Table K.2. in Figure: 30 TAC §217.273(a)(1).

Figure: 30 TAC §217.273(a)(1)

Equation K.2.

$$W_g = (T_A - T_{th}) \times F$$

Where:

T_A = Low ambient temperature, ° F

T_{th} = Threshold temperature, ° F

F = Withdrawal factor, pound/° F/day

W_g = Maximum gas withdrawal rate per cylinder, pound per day

Table K.2. - Threshold Temperatures and Withdrawal Rates for Chlorine and Sulfur Dioxide

Gas and Cylinder Size	Withdrawal Factor, (F) pound/° F/day	Threshold Temperature, (T_{th}) for Cylinder Mounted Vacuum Regulator, ° F	Threshold Temperature, (T_{th}) for Manifold Systems at 10-15 psig pressure, ° F
150 pound Chlorine Cylinder	1.0	0	10
1-ton Chlorine Cylinder	8.0	0	10
150 pound Sulfur Dioxide Cylinder	0.75	30	40
1-ton Sulfur Dioxide Cylinder	6.0	30	40

Values from the *Handbook of Chlorination*, Second Edition, White, Reinhold

(A) If the chlorine or sulfur dioxide cylinders are not stored in a temperature-controlled enclosure, the engineering report must include the ambient temperature based on the lowest consecutive seven-day average of the average daily local temperatures over the last ten years, as measured at the nearest National Oceanic and Atmospheric Administration's National Weather Service weather station with at least ten years of records.

(B) Heating blankets on chlorine gas cylinders are prohibited.

(2) Liquid Withdrawal. If liquid withdrawal from one-ton cylinders is proposed, the maximum withdrawal rates are:

(A) 9,600 pounds per day (lbs/day) of chlorine; and

(B) 7,200 lbs/day of sulfur dioxide.

(b) Number of Cylinders Required. The number of cylinders required for normal operation at peak flow must be based on Equation K.3. in Figure: 30 TAC §217.273(b).

Figure: 30 TAC §217.273(b)

Equation K.3.

$$Cyl = \frac{PPD}{W_{g1}}$$

Where:

Cyl = minimum number of cylinders required per bank (round up to the nearest whole number)

PPD = pound per day (lb/day) of chemical required as determined in Figure: 30 TAC §217.272(a), Equation K.1.

W_{g1} = lb/day of chemical that may be withdrawn per cylinder as determined in Figure: 30 TAC §217.272(a), Equation K.1. or Figure: 30 TAC §217.273(a)(1), Equation K.2.

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§217.274. Dosage Control for Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems.

Gaseous chlorine and sulfur dioxide systems must include automatic dosage control that adjusts the dosage relative to the flow of the effluent stream.

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§217.275. Requirements for 150 Pound Cylinders used in Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems.

(a) Heated Rooms.

(1) A chlorine and sulfur dioxide system that uses 150 pound cylinders must be located indoors at a minimum room temperature of 65 degrees Fahrenheit. This provision applies to all chemical feed equipment, including all connected cylinders, the chlorinators, and the sulfonators.

(2) An unconnected chlorine or sulfur dioxide cylinder may be stored outdoors, but the cylinder must reach a surface temperature of at least 65 degrees Fahrenheit before it is connected to a system.

(b) Heating Blankets.

(1) Heating blankets on chlorine gas cylinders are prohibited.

(2) A heating blanket may only be placed on a sulfur dioxide cylinder in a temperature-controlled room to increase the temperature inside the cylinder to above the ambient room temperature.

(A) A heating blanket on a sulfur dioxide cylinder must include a mechanism that ensures that a blanket does not heat a cylinder above 100 degrees Fahrenheit. The engineering report must include a calculation that documents the setting for a heating blanket to maintain a sulfur dioxide cylinder temperature of less than 100 degrees Fahrenheit.

(B) A cylinder with a heating blanket that is connected to a dechlorination system must have a downstream pressure-reducing valve.

(C) A sulfur dioxide system must be capable of automatically deactivating a heating blanket if high pressure is detected in the cylinder or the delivery system.

(c) Outdoor Storage. If a 150 pound cylinder is stored outdoors, it must be kept in a storage structure that:

(1) protects the cylinder from direct sunlight; and

(2) allows safe removal and replacement of the cylinder.

§217.276. Requirements for One-Ton and Larger Cylinders used in Gas-Withdrawal Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems.

(a) Heated Rooms. The chlorinators and sulfonators for a system using one-ton cylinders must be located indoors and maintained at a minimum room temperature of 65 degrees Fahrenheit.

(b) Outdoor Storage.

(1) If one-ton cylinders are stored outdoors, the system sizing must be done in accordance with §217.273(a) of this title (relating to Cylinder Requirements for Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems). Calculations supporting system sizing must be included in the engineering report.

(2) If a one-ton cylinder is stored outdoors, it must be kept in a storage structure that:

(A) protects the cylinder from direct sunlight; and

(B) allows safe removal and replacement of a cylinder.

(3) A one-ton cylinder stored outdoors may be connected to heated pipes to prevent gas from liquefying in the transfer pipes.

(c) Heating Blankets.

(1) A heating blanket on a one-ton chlorine gas cylinder is prohibited.

(2) A heating blanket may only be placed on a sulfur dioxide cylinder to increase the operating temperature of the sulfur dioxide system. The design must specify the temperature a heating blanket may be set to maintain an adequate temperature inside a cylinder, based on the lowest consecutive seven-day average of the local daily low temperatures over the last ten years, as measured at the nearest National Oceanic and Atmospheric Administration's National Weather Service weather station with at least ten years of records.

(3) The ambient temperature must be used to calculate a cylinder withdrawal rate in §217.273(a) of this title.

(4) A heating blanket on a sulfur dioxide cylinder must include a mechanism that ensures that a blanket does not heat the cylinder surface above 100 degrees Fahrenheit. The engineering report must include a calculation that documents

the setting for a heating blanket to maintain a sulfur dioxide cylinder surface temperature of less than 100 degrees Fahrenheit.

(5) A cylinder with a heating blanket that is connected to a dechlorination system must have a downstream pressure-reducing valve.

(6) A sulfur dioxide system must be capable of automatically deactivating a heating blanket if high pressure is detected in the cylinder or delivery system.

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§217.277. Requirements for One-Ton and Larger Cylinders used in Liquid-Withdrawal Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems.

(a) Heated Rooms. The chlorinators and sulfonators must be located indoors at a minimum room temperature of 65 degrees Fahrenheit.

(b) Outdoor Storage. The chlorine and sulfur dioxide cylinders for systems using liquid withdrawal may be stored outdoors without reducing the withdrawal rates calculated from §217.273(a)(2) of this title (relating to Cylinder Requirements for Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems).

(c) Separation. The separation requirements for a one-ton cylinder liquid-withdrawal systems are the same as those for a one-ton cylinder gas-withdrawal system under §217.278(e) of this title (relating to Safety Requirements for Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems).

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§217.278. Safety Requirements for Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems.

(a) Floor Drains. A floor drain from a chlorine or sulfur dioxide feed or storage room must not drain to a pipe system connected to any other room of the wastewater treatment facility. Drainage must be routed for safe disposal or for further processing at a rate that does not disrupt a treatment process or violate a water quality permit requirement.

(b) Doors and Windows.

(1) Each door in a chlorine or sulfur dioxide room must:

(A) open to the outside of the building; and

(B) include panic hardware.

(2) Each chlorine or sulfur dioxide room must have at least one clear, gas-tight window in a gas-tight exterior door.

(3) A chlorine or sulfur dioxide room may have additional clear, gas-tight windows to ensure the disinfection and dechlorination systems may be viewed without entering an enclosed room.

(c) Ventilation.

(1) An enclosed storage and feed room must have continuous forced mechanical ventilation with at least one complete air exchange every 3.0 minutes.

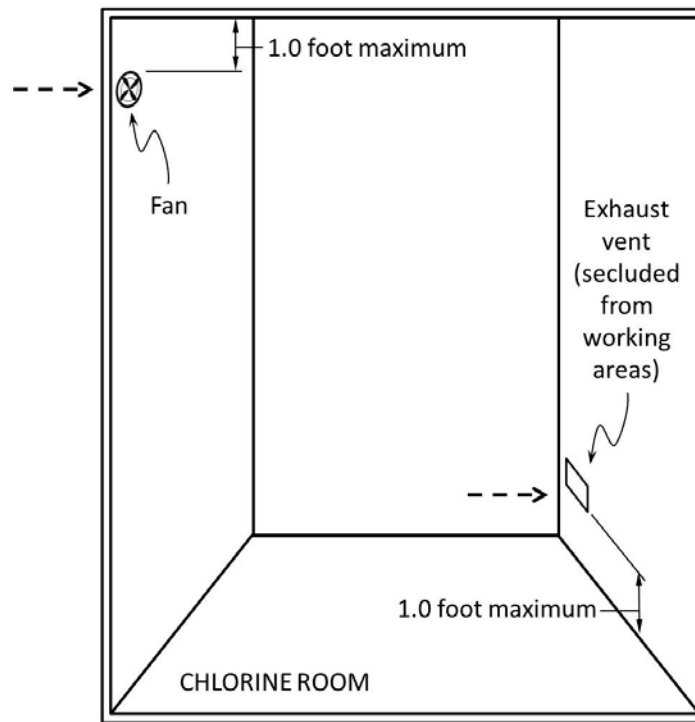
(2) Exhaust equipment must have:

(A) external controls; and

(B) leak detection equipment.

(3) A fan must be located at the top of the room to push air across the room and through an exhaust vent located at the bottom of the room on the opposite side (see Figure: 30 TAC §217.278(c)(3)). The top of the fan must be no more than one foot below the ceiling. The bottom of the exhaust vent must be no more than one foot above floor level.

Figure: 30 TAC §217.278(c)(3)



(4) An exhaust system may use vacuum pressure ventilation instead of forced mechanical ventilation if the ventilation facility has gas containment and treatment as prescribed by the National Fire Protection Association 1 Fire Code®.

(5) A vent from the sulfur dioxide or chlorine gas feed systems must:

(A) exhaust to a point that is not frequented by wastewater treatment facility staff, such as stairs, walkways, and common areas;

(B) exhaust to a point that is not near a fresh air intake; and

(C) be clearly marked with at least a four inch tall font that reads "Danger: Hazardous Exhaust."

(d) Gas Detectors and Protection.

(1) An area containing chlorine or sulfur dioxide under pressure must have a gas detector and alarm system.

(2) An area used for handling pressurized chlorine or sulfur dioxide gases must have respiratory and protective equipment. The respiratory and protective

equipment must meet the requirements of the National Institute for Occupational Safety and Health.

(A) The respiratory and protective equipment must be immediately accessible at the wastewater treatment facility. The location and use of the respiratory and protective equipment must be described in the wastewater treatment facility's operation and maintenance manual.

(B) The storage of respiratory equipment in any room where gas under pressure is stored or used is prohibited.

(C) Instructions for using the respiratory and protective equipment must be kept with or posted next to the equipment.

(D) The respiratory equipment must use compressed air and must have at least a 30-minute capacity.

(e) Separation.

(1) Chlorine cylinders must not be stored in the same room as sulfur dioxide cylinders.

(2) Chlorine feed equipment must not be housed in the same room as sulfur dioxide feed equipment.

(3) Cylinders and feed equipment that supply chlorine must be separated by at least one gas-tight wall from cylinders and feed equipment that supply sulfur dioxide.

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§217.279. Equipment and Material Requirements for Gaseous Chlorine Disinfection and Sulfur Dioxide Dechlorination Systems.

(a) All equipment and material used in a disinfection and dechlorination system must meet the manufacturer's recommendations.

(b) A 150 pound cylinder must be stored vertically and secured by a clamp or chain to prevent it from falling over. A one-ton cylinder must be stored horizontally on trunnions.

(c) Measurements. A gaseous chlorine and sulfur dioxide system must have a scale designed for determining the amount of chemical remaining in the connected cylinders.

(d) Pressure Pipe Systems for Gas Transport.

(1) Gas transport pressure pipes must be at least equivalent to Schedule 80 black seamless steel pipe. Gas transport fittings must be at least equivalent to 2,000 pound forged steel fittings.

(2) The use of polyvinyl chloride (PVC) in a pressure pipe system is prohibited.

(3) A one-ton cylinder system must use a gas filter upstream of a pressure-reducing valve.

(4) A pressure pipe system must have a pressure-reducing valve if:

(A) the system has more than 20 linear feet of supply pipes;

(B) the system is a gaseous sulfur dioxide system with a heating blanket; or

(C) there are pressure pipes on the discharge side of an evaporator.

(5) A pressure pipe on the gas discharge side of an evaporator must have a rupture disk and a high-pressure alarm to warn wastewater treatment facility staff of disk rupture.

(6) A gas pipe entering a chlorinator or sulfonator must have a heated leg drop sediment trap.

(7) A gaseous sulfur dioxide system must have a seat and stem constructed of material with corrosion resistance and brittle strength at least equivalent to 316 stainless steel.

(8) A gaseous chlorine system must have at least the equivalent of a Monel® seat and stem.

(e) Pressure Pipe Systems - Liquid Transport.

(1) The use of PVC in a pressure pipe system is prohibited.

(2) The manifolding of one-ton containers for simultaneous liquid chemical withdrawal is prohibited.

(3) A liquid pipe system must include a rupture disk, a pressure switch to warn wastewater treatment facility staff of disk rupture, and an expansion chamber.

(f) Vacuum Pipes.

(1) Vacuum pipes and fittings downstream from a vacuum regulator must have corrosion resistance equivalent to PVC or 316 stainless steel.

(2) A vacuum pipe must have socket joints.

(g) Diffusers. The minimum velocity through any chlorine or sulfur dioxide system diffuser must be at least 10 feet per second. The engineering report must include calculations that verify this requirement is met, unless a diffuser has a mechanical mixer.

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§217.280. Design of Sodium Hypochlorite Disinfection and Sodium Bisulfite Dechlorination Systems.

(a) Redundancy. Sodium hypochlorite and sodium bisulfite systems must include at least two chemical solution pumps and must ensure that the capacity requirements in subsection (b) of this section are met with the largest pump out of service.

(b) Capacity and Sizing. The size of a chemical liquid solution pump and pipe system must be determined as follows:

(1) Sodium Hypochlorite.

(A) Pounds Per Day of Chlorine Required. Figure: 30 TAC §217.272(b), Table K.1. and Figure: 30 TAC §217.272(a), Equation K.1. must be used to determine the pounds per day of chlorine required.

(B) Chlorine Determination. The pounds of available chlorine per gallon of sodium hypochlorite solution must be determined using values and appropriate references supplied by the chemical manufacturer.

(C) Gallons per Hour Determination. In order to size the chemical metering equipment, the gallons per hour must be calculated using Equation K.4. in Figure: 30 TAC §217.280(b)(1)(C).

Figure: 30 TAC §217.280(b)(1)(C)

Equation K.4.

$$R = \frac{PPD}{24C}$$

Where:

R = gallons per hour of sodium bisulfite solution

PPD = pounds per day of chlorine that must be delivered to the wastewater, pound per day

C = pounds of available chlorine in one gallon of sodium hypochlorite, (pound of chlorine per gallon)

(2) Sodium Bisulfite.

(A) Equation K.4. in Figure: 30 TAC §217.280(b)(1)(C) must be used to determine the pounds per day of sodium bisulfite required.

(B) The minimum amount of sodium bisulfite needed to dechlorinate one pound of chlorine is 1.465 pounds. The pounds per day of chlorine that must be dechlorinated, as determined in subparagraph (A) of this paragraph, multiplied by 1.465 pounds of sodium bisulfite per pound of chlorine, determines the pounds of sodium bisulfite needed.

(C) The gallons per hour of sodium bisulfite solution needed from the chemical metering equipment must be calculated using Equation K.5. in Figure: 30 TAC §217.280(b)(2)(C).

Figure: 30 TAC §217.280(b)(2)(C)

Equation K.5.

$$R = \frac{\text{lbs NaHSO}_3}{10.9 \text{ lbs NaHSO}_3/\text{gallon NaHSO}_3} \left(\frac{1}{S} \right) \times 24$$

Where:

S = solution strength in percent

R = gallons per hour of sodium bisulfite solution

(c) Dosage Control. A dosage control system may be positive pressure or vacuum and must automatically adjust the sodium hypochlorite or sodium bisulfite feed rate to correspond to the flow of the effluent stream.

(d) Chemical Handling.

(1) Storage Tank Sizing.

(A) A storage facility for sodium hypochlorite with a solution strength greater than or equal to 10% must not be sized to store more than a 15-day supply, based on the design average daily consumption, unless a residual analyzer or oxidation-reduction potential (ORP) monitor provides automatic feed control to compensate for solution degradation. Where a residual analyzer or ORP monitor is included in the design, a storage facility must not be sized to store more than a 30-day supply, based on the daily average consumption.

(B) A storage facility for sodium hypochlorite with a solution strength less than 10% must not be sized to store more than a 30-day supply, based on the daily average consumption.

(C) A wastewater treatment facility with a design flow greater than or equal to 1.0 million gallons per day must have at least two chemical storage tanks for each chemical.

(2) Temperature considerations.

(A) A sodium hypochlorite tank that is stored outdoors must be opaque or otherwise block sunlight from penetrating the tank.

(B) An outdoor sodium bisulfite storage facility and associated pipes must be insulated and heat traced if located in an area where the ambient temperatures fall below 40 degrees Fahrenheit, based on the lowest 7-day average of the average daily local temperatures over the last 10-years, as measured at the nearest National Oceanic and Atmospheric Administration's National Weather Service weather station with at least ten years of data.

(e) Equipment and Materials.

(1) Equipment and materials used for storage, pumping, and transport of sodium hypochlorite must be used according to the manufacturer's recommendations and designed for use in a corrosive chemical environment.

(2) Equipment and materials used for storage, pumping, and transport of sodium bisulfite must be used according to the manufacturer's recommendations and designed for use in an acidic chemical environment.

(f) Safety.

(1) Ventilation. A chemical storage area must be ventilated to exhaust fumes.

(2) Liquid-depth indicators. A chemical storage tank must have an external liquid-depth indicator.

(3) Spill Containment.

(A) A chemical storage area for sodium hypochlorite and sodium bisulfite must have secondary containment equal to 125% of the volume of the largest storage tank.

(B) Manifolded tanks must have secondary containment equal to 125% of the cumulative manifolded tank volume. If the pipe system is designed to prevent a combined release, then the secondary containment must equal 125% of the largest tank volume.

(C) A tank must either:

(i) be placed on an equipment pad that is elevated above the secondary containment maximum liquid level; or

(ii) be placed in a secondary containment structure that is able to be drained to prevent the tank from floating.

(D) A containment structure for sodium hypochlorite must be separate from a containment structure for sodium bisulfite.

(4) Emergency and Protective Equipment. A chemical storage area must have at least one emergency eyewash station and personal protective equipment for all wastewater treatment facility staff working in the area.

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§217.281. Application of Chlorination and Dechlorination Chemicals.

(a) Mixing Requirements.

(1) **Mixing Zones.** A mixing zone within a chlorine contact basin must not be considered as part of the volume needed for disinfection. A mixing zone must be designed to ensure that the chlorine is thoroughly mixed with the wastewater before entering a chlorine contact chamber, as described in paragraph (2) of this subsection.

(2) **Chlorine and Sodium Hypochlorite Application.** A disinfection system must apply the chlorine gas or solution in a highly turbulent flow regime created by in-line diffusers, mechanical mixers, or jet mixers. Effective initial mixing for the mean velocity gradient (G value) in the area of turbulent flow must exceed 500 per second. A serpentine disinfection channel may be used in place of turbulent initial mixing if the length-to-width ratio is at least 40-to-1 and complete mixing is demonstrated by a dye test.

(3) **Sulfur Dioxide and Sodium Bisulfite Application.**

(A) The mixing for a sulfur dioxide or sodium bisulfite system must ensure compliance with the effluent limits in the wastewater permit.

(B) A disinfection system must provide a mean velocity gradient (G value) of at least 250 per second.

(b) **Chlorine Contact Basins.**

(1) A chlorine contact basin must provide a minimum chlorine contact time of 20 minutes at the peak flow.

(2) A chlorine contact basin must prevent short-circuiting to ensure that the wastewater is retained in a chlorine contact basin for at least 20 minutes at peak flow.

(3) A rectangular chlorine contact basin must have rounded corners.

(4) If a wastewater treatment facility is designed with more than one chlorine contact basin:

(A) the design must provide a means of verifying the chlorine contact time and residual chlorine in each basin; and

(B) separate sampling points must be provided after each chlorine contact basin, unless the effluent from the basins is commingled at a single sampling point.

(5) The design of an aerated chlorine contact basin must include an analysis of the chlorine feed rate required to offset chlorine volatilization.

(6) The engineering report must include supporting data from a chlorine contact basin design model, performance data of a similar design, or a field tracer study.

(7) A chlorine contact basin must include a drain to facilitate removal of accumulated settled solids.

(c) Dechlorination Contact Time.

(1) A dechlorination system must have sufficient mixing and contact time between the disinfected wastewater and a dechlorinating agent to ensure continuous compliance with the chlorine limits in the wastewater permit.

(2) A dechlorination system must prevent short-circuiting and provide a minimum contact time of 20 seconds at the peak flow.

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§217.282. Other Chemical Disinfection and Dechlorination Processes.

(a) Any chemical disinfection or dechlorination process not discussed in this subchapter, such as chlorine dioxide, ozone, tablet or powder disinfection and dechlorination processes, and liquid solution disinfection and dechlorination processes are subject to the requirements of §217.7(b)(2) of this title (relating to Types of Plans and Specifications Approvals).

(b) Chemical disinfection processes not discussed in this subchapter must be flow-paced and must use chemicals approved by the manufacturer for the purpose of wastewater disinfection.

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§217.283. Post-Disinfection Requirements.

(a) Sampling points must be identified in the engineering report. A design must include a sufficient number of sampling points to:

(1) allow an operator to monitor the disinfection system for process control; and

(2) allow monitoring of permitted effluent limits.

(b) **Dissolved Oxygen Requirements.** A treatment facility must be designed with the ability to add post-aeration if needed to meet effluent limits for dissolved oxygen in the wastewater permit. If the wastewater permit requires a minimum dissolved oxygen of 5.0 milligrams per liter or greater, the engineering report must include calculations that demonstrate how the post-aeration system will maintain the minimum dissolved oxygen level.

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