Montana Department of
ENVIRONMENTAL QUALITY

CIRCULAR DEQ 2

DESIGN STANDARDS
FOR
WASTEWATER FACILITIES

CHAPTER 100
DISINFECTION

101. GENERAL

Disinfection of the effluent must be provided as necessary to meet applicable standards. The design must meet both the bacterial standards and the disinfectant residual limit in the effluent. The disinfection process should be selected after due consideration of waste characteristics, type of treatment process provided prior to disinfection, waste flow rates, pH of waste, disinfectant demand rates, current technology application, cost of equipment and chemicals, power cost, and maintenance requirements.

Chlorine is the most commonly used chemical for wastewater disinfection. The forms most often used are liquid chlorine and calcium or sodium hypochlorite. Other disinfectants, including chlorine dioxide, ozone, bromine, or ultraviolet disinfection, may be accepted by the approving authority in individual cases. If halogens are utilized, it may be necessary to dehalogenate if the residual level in the effluent exceeds effluent limitations or would impair the natural aquatic habitat of the receiving stream.

Municipalities are encouraged to investigate the use of U.V. disinfection due to safety and toxicity benefits.

Where a disinfection process other than chlorine is proposed, supporting data from pilot plant installations or similar full scale installations may be required as a basis for the design of the system.

102. CHLORINE DISINFECTION

102.1 Type

Chlorine is available for disinfection in gas, liquid (hypochlorite solution), and pellet (hypochlorite tablet) form. The type of chlorine should be carefully evaluated during the facility planning process. The use of chlorine gas or liquid will be most dependent on the size of the facility and the chlorine dose required. Large quantities of chlorine, such as are contained in ton cylinders and tank cars, can present a considerable hazard to plant personnel and to the surrounding area, should such containers develop leaks. Both monetary costs and the potential public exposure to chlorine should be considered when making the final determination.

102.2 Dosage

For disinfection, the capacity must be adequate to produce an effluent that will meet the coliform limits specified by the regulatory agency for that installation. Required disinfection capacity will vary, depending on the uses and points of application of the disinfection chemical. The chlorination system must be designed on a rational basis and calculations justifying the equipment sizing and number of units must be submitted for the whole operating range of flow rates for the type of control to be used. System design considerations must include the controlling wastewater flow meter (sensitivity and location), telemetering equipment and chlorination controls. For normal domestic sewage, the following may be used as a guide in sizing chlorination facilities:

Type of Treatment	Dosage
Trickling filter plant effluent	10 mg/L
Activated sludge plant effluent	8 mg/L
Tertiary filtration effluent	6 mg/L
Nitrified effluent	6 mg/L

102.3 Containers

102.31 Cylinders

150 pound (68 kg) cylinders are typically used where chlorine gas consumption is less than 150 pounds per day (68 kg/day). Cylinders should be stored in an upright position with adequate support brackets and chains at 2/3 of cylinder height for each cylinder.

102.32 Ton Containers

The use of one-ton (909 kg) containers should be considered where the average daily chlorine consumption is over 150 pounds (68 kg).

102.33 Liquid Hypochlorite Solutions

Storage containers for hypochlorite solutions must be of sturdy, non-metallic lined construction and must be provided with secure tank tops and pressure relief and overflow piping. Storage tanks should be either located or vented outside. Provision must be made for adequate protection from light and extreme temperatures. Tanks must be located where leakage will not cause corrosion or damage to other equipment. A means of secondary containment must be provided to contain spills and facilitate cleanup. Due to deterioration of hypochlorite solutions over time, it is recommended that containers not be sized to hold more than one month's needs. At larger facilities and locations where delivery is not a problem, it may be desirable to limit on-site storage to one week. Refer to Section 57.

102.34 Dry Hypochlorite Compounds

Dry hypochlorite compounds should be kept in tightly closed containers and stored in a cool, dry location. Some means of dust control should be considered, depending on the size of the facility and the quantity of compound used. Refer to Section 57.

102.4 Equipment

102.41 Scales

Scales for weighing cylinders must be provided at all plants using chlorine gas. At large plants, scales of the indicating and recording type are recommended. At least a platform scale must be provided. Scales must be of corrosion-resistant material.

102.42 Evaporators

Where manifolding of several cylinders or ton containers will be required to evaporate sufficient chlorine, consideration should be given to the installation of evaporators to produce the quantity of gas required.

102.43 Mixing

The disinfectant must be positively mixed as rapidly as possible, with a complete mix being effected in 3 seconds. This may be accomplished by either the use of turbulent flow regime or a mechanical flash mixer.

102.44 Contact Period and Tank

For a chlorination system, a minimum contact period of 15 minutes at design peak hourly flow or maximum rate of pumpage must be provided after thorough mixing. For evaluation of existing chlorine contact tanks, field tracer studies should be done to assure adequate contact time.

The chlorine contact tank must be constructed so as to reduce short-circuiting of flow to a practical minimum. Tanks not provided with continuous mixing must be provided with "over-and-under" or "end-around" baffling to minimize short-circuiting.

The tank should be designed to facilitate maintenance and cleaning without reducing effectiveness of disinfection. Duplicate tanks, mechanical scrapers, or portable deck-level vacuum cleaning equipment must be provided. Consideration should be given to providing skimming devices on all contact tanks. Covered tanks are discouraged.

102.45 Piping and Connections

Piping systems should be as simple as possible, specifically selected and manufactured to be suitable for chlorine service, with a minimum number of joints. Piping should be well supported and protected against temperature extremes.

Due to the corrosiveness of wet chlorine, all lines designated to handle dry chlorine must be protected from the entrance of water or air containing water. Even minute traces of water added to chlorine results in a corrosive attack. Low pressure lines made of hard rubber, saran-lined, rubber-lined, polyethylene, polyvinylchloride (PVC), or other approved materials are satisfactory for wet chlorine or aqueous solutions of chlorine.

102.46 Standby Equipment and Spare Parts

Standby equipment of sufficient capacity should be available to replace the largest unit during shutdowns. Spare parts must be available for all disinfection equipment to replace parts that are subject to wear and breakage.

102.47 Chlorinator Water Supply

An ample supply of water must be available for operating the chlorinator. Where a booster pump is required, duplicate equipment should be provided, and, when necessary, standby power as well. Protection of a potable water supply must conform to the requirements of Section 56.2. Adequately filtered plant effluent should be considered for use in the chlorinator.

102.48 Leak Detection and Controls

A bottle of 56 percent ammonium hydroxide solution must be available for detecting chlorine leaks. Where ton containers (909 kg) or tank cars are used, a leak repair kit approved by the Chlorine Institute must be provided. Consideration should be given to the provision of caustic soda solution reaction tanks for absorbing the contents of leaking one-ton (909 kg) containers where such containers are in use. At large chlorination installations, consideration should be given to the installation of automatic gas detection and related alarm equipment.

102.5 Housing

102.51 Feed and Storage Rooms

If gas chlorination equipment or chlorine cylinders are to be in a building used for other purposes, a gas-tight room must separate this equipment from any other portion of the building. Floor drains from the chlorine room may not be connected to floor drains from other rooms. Doors to this room may open only to the outside of the building, and must be equipped with panic hardware. Chlorine rooms must be at ground level, and should permit easy access to all equipment. Storage areas for 1-ton (909 kg) cylinders should be separated from the feed area. In addition, the storage area must have designated areas for "full" and "empty" cylinders. Chlorination equipment should be situated as close to the application point as reasonably possible. For additional safety considerations, refer to Section 57.

102.52 Inspection Window

A clear glass, gas-tight, window must be installed in an exterior door or interior wall of the chlorinator room to permit the units to be viewed without entering the room.

102.53 Heat

Rooms containing disinfection equipment must be provided with a means of heating so that a temperature of at least 60 F (16 C) can be maintained. The room should be protected from excess heat. Cylinders must be kept at essentially room temperature.

102.54 Ventilation and Accidental Release

With chlorination systems, forced, mechanical ventilation must be installed that will provide one complete air change per minute when the room is occupied. The entrance to the air exhaust duct from the room must be near the floor and the point of discharge must be located so as not to contaminate the air inlet to any buildings or inhabited areas. Air inlets must be located so as to provide cross ventilation with air and at such temperature that will not adversely affect the chlorination equipment. The outside air inlet must be at least three feet above grade. The vent hose from the chlorinator must discharge to the outside atmosphere above grade. Where public exposure may be extensive, scrubbers may be required on ventilation discharge.

See the Uniform Fire Code requirements for treatment of gases as:

Treatment systems may be necessary to handle the accidental release of gas.

Treatment systems may be necessary to process all exhaust ventilation to be discharged from gas cabinets, exhausted enclosures or separate gas storage rooms.

102.55 Electrical Controls

Switches for fans and lights must be outside of the room at the entrance. A labeled signal light indicating fan operation must be provided at each entrance, if the fan can be controlled from more than one point.

102.56 Protective and Respiratory Gear

Respiratory air-pac protection equipment, meeting the requirements of the National Institute for Occupational Safety and Health (NIOSH), must be available where chlorine gas is handled, and must be stored at a convenient location, but not inside any room where chlorine is used or stored. Instructions for using the equipment must be posted. The units must use compressed air, have at least 30-minute capacity and be compatible with the units used by the fire department responsible for the plant.

102.6 Sampling and Control

102.61 Sampling

Facilities must be included for sampling disinfected effluent after contact. In large installations, or where stream conditions warrant, provisions should be made for continuous monitoring of effluent chlorine residual.

102.62 Testing and Control

Equipment must be provided for measuring chlorine residual using accepted test procedures. The installation of demonstrated effective facilities for automatic chlorine residual analysis, recording, and proportioning systems should be considered at all large installations.

Equipment must also be provided for measuring fecal coliform organisms, using accepted test procedures as required by the regulatory agency.

103. DECHLORINATION

103.1 Types

Dechlorination of wastewater effluent may be necessary to reduce the toxicity due to chlorine residuals. The most common dechlorination chemicals are sulfur compounds, particularly sulfur dioxide gas or aqueous solutions of sulfite or bisulfite. Pellet dechlorination systems are also available for small facilities.

The type of dechlorination system should be carefully selected considering criteria including the following: type of chemical storage required, amount of chemical needed, ease of operation, compatibility with existing equipment, and safety.

103.2 Dosage

The dosage of dechlorination chemical should depend on the residual chlorine in the effluent, the final residual chlorine limit, and the particular form of the dechlorinating chemical used. The most common dechlorinating agent is sulfite. The following forms of the compound are commonly used and yield sulfite (SO_2) when dissolved in water.

Dechlorination Chemical	Theoretical mg/L Required to Neutralize 1 mg/L Cl_2
Sulfur dioxide (gas)	0.9
Sodium meta bisulfite (solution)	1.34
Sodium bisulfite (solution)	1.46

Theoretical values may be used for initial approximations, to size feed equipment with the consideration that under good mixing conditions 10% excess dechlorinating chemical is required above theoretical values. Excess sulfur dioxide may consume oxygen at a maximum of 1.0 mg dissolved oxygen for every 4 mg SO_2.

The liquid solutions come in various strengths. These solutions may need to be further diluted to provide the proper dose of sulfite.

103.3 Containers

Depending on the chemical selected for dechlorination, the storage containers will vary from gas cylinders, liquid in 50 gallon (190 L) drums or dry compounds. Dilution tanks and mixing tanks will be necessary when using dry compounds and may be necessary when using liquid compounds to deliver the proper dosage. Solution containers should be covered to prevent evaporation and spills.

103.4 Feed Equipment, Mixing, and Contact Requirements

103.41 Equipment

In general, the same type of feeding equipment used for chlorine gas may be used with minor modifications for sulfur dioxide gas. However, the manufacturer should be contacted for specific equipment recommendations. No equipment should be alternately used for the two gases. The common type of dechlorination feed equipment utilizing sulfur compounds include vacuum solution feed of sulfur dioxide gas and a positive displacement pump for aqueous solutions of sulfite or bisulfite.

The selection of the type of feed equipment utilizing sulfur compounds must include consideration of the operator safety and overall public safety relative to the wastewater treatment plant's proximity to populated areas and the security of gas cylinder storage. The selection and design of sulfur dioxide feeding equipment must take into account that the gas reliquifies quite easily. Special precautions must be taken when using ton (909 kg) containers to prevent reliquification.

Where necessary to meet the operating ranges, multiple units must be provided for adequate peak capacity and to provide a sufficiently low feed rate on turn down to avoid depletion of the dissolved oxygen concentrations in the receiving waters.

103.42 Mixing Requirements

The dechlorination reaction with free or combined chlorine will generally occur within 15-20 seconds. Mechanical mixers are required unless the mixing facility will provide the required hydraulic turbulence to assure thorough and complete mixing. The high solubility of SO_2 prevents it from escaping during turbulence.

103.43 Contact Time

A minimum of 30 seconds for mixing and contact time must be provided at the design peak hourly flow or maximum rate of pumpage. A suitable sampling point must be provided downstream of the contact zone. Consideration must be given to a means of reaeration to assure maintenance of an acceptable dissolved oxygen concentration in the stream following sulfonation.

103.44 Standby Equipment and Spare Parts

The same requirements apply as for chlorination systems. See Section 102.46.

103.45 Sulfonator Water Supply

The same requirements apply as for chlorination systems. See Section 102.47.

103.5 Housing Requirements

103.51 Feed and Storage Rooms

The requirements for housing SO_2 gas equipment should follow the same guidelines as used for chlorine gas. Refer to Section 102.5 for specific details.

When using solutions of the dechlorinating compounds, the solutions may be stored in a room that meets the safety and handling requirements set forth in Section 57. The mixing, storage, and solution delivery areas must be designed to contain or route solution spillage or leakage away from traffic areas to an appropriate containment unit.

103.52 Protective and Respiratory Gear

The respiratory air-pac protection equipment is the same as for chlorine. See Section 102.56. Leak repair kits of the type used for chlorine gas that are equipped with gasket material suitable for service with sulfur dioxide gas may be used. (Refer to The Compressed Gas Association Publication CGA G-3-1988, "Sulfur Dioxide.") For additional safety considerations, see Section 57.

103.6 Sampling and Control

103.61 Sampling

Facilities must be included for sampling the dechlorinated effluent for residual chlorine. Provisions must be made to monitor for dissolved oxygen concentration after sulfonation when required by the regulatory agency.

103.62 Testing and Control

Provision must be made for manual or automatic control of sulfonator feed rates based on chlorine residual measurement or flow.

104. ULTRAVIOLET RADIATION DISINFECTION

Design standards, operating data, and experience for this process are not well established. Therefore, expected performance of the ultraviolet radiation disinfection (UVRD) units must be based upon experience at similar full scale installations or thoroughly documented prototype testing with the particular wastewater. Critical parameters for UVRD units are dependent upon the manufacturers' design, lamp selection, tube materials, ballasts, configuration, control systems, and associated appurtenances. Proposals on this disinfection process will be reviewed on a case-by-case basis at the discretion of the reviewing authority under Section 53.2.

Open channel designs with modular UVRD units that can be removed from the flow are required. At least two banks in series must be provided in each channel for disinfection reliability and to ensure uninterrupted service during tube cleaning or other required maintenance. Operator safety and tube cleaning frequency must also be considered. The hydraulic properties of the system must be designed to simulate plug flow conditions under the full operating flow range. In addition, a positive means of water level control must be provided to achieve the necessary exposure time. Also refer to paragraphs 54.2 and 54.3.

This process should be limited to high quality effluent having at least 65% ultraviolet radiation transmittance at 254 nanometers wave length. As a general guide in systems sizing for an activated sludge effluent with the preceding characteristics at the design peak hourly flow, a UV radiation dosage of at least 30,000 $uWsec/cm^2$ may be used after adjustments for maximum tube fouling, lamp output reduction after 8760 hours of operation, and other energy absorption losses.

105. OZONE

Ozone systems for disinfection should be evaluated on a case-by-case basis. Design standards, operating data, and experience for this process are not well established. Therefore, design of these systems should be based upon experience at similar full scale installations or thoroughly documented prototype testing with the particular wastewater.

CHAPTER 110
SUPPLEMENTAL TREATMENT PROCESSES

111. PHOSPHORUS REMOVAL BY CHEMICAL TREATMENT

111.1 General

111.11 Method

Addition of lime or the salts of aluminum or iron may be used for the chemical removal of soluble phosphorus. The phosphorus reacts with the calcium, aluminum or iron ions to form insoluble compounds. These insoluble compounds may be flocculated with or without the addition of a coagulant aid such as a polyelectrolyte to facilitate separation by sedimentation.

111.12 Design Basis

111.121 Preliminary Testing

Laboratory, pilot or full scale studies of various chemical feed systems and treatment processes are recommended for existing plant facilities to determine the achievable performance level, cost-effective design criteria, and ranges of required chemical dosages.

The selection of a treatment process and chemical dosage for a new facility should be based on such factors as influent wastewater characteristics, effluent requirements, and anticipated treatment efficiency.

111.122 System Flexibility

Systems must be designed with sufficient flexibility to allow for several operational adjustments in chemical feed location, chemical feed rates, and for feeding alternate chemical compounds.

111.2 Process Requirements

111.21 Dosage

The design chemical dosage must include the amount needed to react with the phosphorus in the wastewater, the amount required to drive the chemical reaction to the desired state of completion, and the amount required due to inefficiencies in mixing or dispersion. Excessive chemical dosage should be avoided.

111.22 Chemical Selection

The choice of lime or the salts of aluminum or iron should be based on the wastewater characteristics and the economics of the total system. When lime is used, it may be necessary to neutralize the high pH prior to subsequent treatment in secondary biological systems or prior to discharge in those flow schemes where lime treatment is the final step in the treatment process.

111.23 Chemical Feed Points

Selection of chemical feed points must include consideration of the chemicals used in the process, necessary reaction times between chemical and polyelectrolyte additions, and the wastewater treatment processes and components utilized. Flexibility in feed locations must be provided to optimize chemical usage.

111.24 Flash Mixing

Each chemical must be mixed rapidly and uniformly with the flow stream. Where separate mixing basins are provided, they should be equipped with mechanical mixing devices. The detention period should be at least 30 seconds.

111.25 Flocculation

The particle size of the precipitate formed by chemical treatment may be very small. Consideration should be given in the process design to the addition of synthetic polyelectrolytes to aid settling. The flocculation equipment should be adjustable in order to obtain optimum floc growth, control deposition of solids, and prevent floc destruction.

111.26 Liquid - Solids Separation

The velocity through pipes or conduits from flocculation basins to settling basins should not exceed 1.5 feet per second (0.46 m/s) in order to minimize floc destruction. Entrance works to settling basins should also be designed to minimize floc shear.

Settling basins must be designed in accordance with Chapter 70. For design of the sludge handling system, special consideration should be given to the type and volume of sludge generated in the phosphorus removal process.

111.27 Filtration

Effluent filtration must be considered where effluent phosphorus concentrations of less than 1 mg/l must be achieved.

111.3 Feed Systems

111.31 Location

All liquid chemical mixing and feed installations should be installed on corrosion resistant pedestals and elevated above the highest liquid level anticipated during emergency conditions. The chemical feed equipment must be designed to meet the maximum dosage requirements for the design conditions. Lime feed equipment should be located so as to minimize the length of slurry conduits. All slurry conduits must be accessible for cleaning.

111.32 Liquid Chemical Feed System

Liquid chemical feed pumps should be of the positive displacement type with variable feed rate. Pumps must be selected to feed the full range of chemical quantities required for the phosphorus mass loading conditions anticipated with the largest unit out of service. Consideration should be given to systems including pumps and piping that will feed either ferric or aluminum compounds to provide flexibility. Refer to Section 111.51.

Screens and valves must be provided on the chemical feed pump suction lines.

An air break or anti-siphon device must be provided where the chemical solution stream discharges to the transport water stream to prevent an induction effect resulting in overfeed.

Consideration must be given to providing pacing equipment to optimize chemical feed rates.

111.33 Dry Chemical Feed System

Each dry chemical feeder must be equipped with a dissolver that is capable of providing a minimum 5-minute retention at the maximum feed rate.

Polyelectrolyte feed installations should be equipped with two solution vessels and transfer piping for solution make-up and daily operation.

Make-up tanks must be provided with an educator funnel or other appropriate arrangement for wetting the polymer during the preparation of the stock feed solution. Adequate mixing should be provided by a large-diameter, low-speed mixer.

111.4 Storage Facilities

111.41 Size

Storage facilities must be sufficient to insure that an adequate supply of the chemical is available at all times. Exact size required will depend on size of shipment, length of delivery time, and process requirements. Storage for a minimum of 10-days' supply should be provided.

111.42 Location and Containment

The liquid chemical storage tank and tank fill connections must be located within a containment structure having a capacity exceeding the total volume of all storage vessels. Valves on discharge lines must be located adjacent to the storage tank and within the containment structure. Refer to Section 57.2. Auxiliary facilities, including pumps and controls, within the containment area must be located above the highest anticipated liquid level. Containment areas must be sloped to a sump area and may not contain floor drains.

Bag storage should be located near the solution make-up point to avoid unnecessary transportation and housekeeping problems.

111.43 Accessories

Platforms, stairs, and railings should be provided as necessary, to afford convenient and safe access to all filling connections, storage tank entries, and measuring devices.

Storage tanks must have reasonable access provided to facilitate cleaning.

111.5 Other Requirements

111.51 Materials

All chemical feed equipment and storage facilities must be constructed of materials resistant to chemical attack by all chemicals normally used for phosphorus removal. Refer to Section 57.

111.52 Temperature, Humidity, and Dust Control

Precautions must be taken to prevent chemical storage tanks and feed lines from reaching temperatures likely to result in freezing or chemical crystallization at the concentration employed. A heated enclosure or insulation may be required. Consideration should be given to temperature, humidity, and dust control in all chemical feed room areas.

111.53 Cleaning

Consideration must be given to the accessibility of piping. Piping should be installed with plugged wyes, tees or crosses with removable plugs at changes in direction to facilitate cleaning.

111.54 Filling Drains and Draw-off

Above-bottom draw off from chemical storage or feed tanks must be provided to avoid withdrawal of settled solids into the feed system. A bottom drain must also be installed for periodic removal of accumulated settled solids. Provisions must be made in the fill lines to prevent back siphonage of chemical tank contents.

111.6 Safety and Hazardous Chemical Handling

The Chemical handling facilities must meet the appropriate safety and hazardous handling facilities requirements of Section 57.

111.7 Sludge Handling

Consideration must be given to the type and additional capacity of the sludge handling facilities needed when chemicals are added. Design of dewatering systems should be based, where possible, on an analysis of the characteristics of the sludge to be handled. Consideration should be given to the ease of operation, effect of recycle streams generated, production rate, moisture content, dewaterability, final disposal, and operating costs. Refer to Chapter 80.

112. HIGH RATE EFFLUENT FILTRATION

112.1 General

112.11 Applicability

Granular media filters may be used as an advanced treatment device for the removal of residual suspended solids from secondary effluents. Filters may be necessary where effluent concentrations of less than 20 mg/L of suspended solids and/or 1.0 mg/L of phosphorus must be achieved. A pre-treatment process such as chemical coagulation and sedimentation or other acceptable process should precede the filter units where effluent suspended solids requirements are less than 10 mg/L.

112.12 Design Considerations

Care should be given in designing pipes or conduits ahead of filter units, if applicable, to minimize shearing of floc particles. Consideration should be given in the plant design to providing flow-equalization facilities to moderate filter influent quality and quantity.

112.2 Filter Types

Filters may be of the gravity type or pressure type. Pressure filters must be provided with ready and convenient access to the media for inspection or cleaning. Where abnormal quantities of greases or similar solids, which result in filter plugging are expected, filters should be of the gravity type.

112.3 Filtration Rates

112.31 Allowable Rates

Filtration rates may not exceed 5 gpm/sq. ft. (3.40 l/m^2s) based on the design peak hourly flow rate applied to the filter units. The expected design maximum suspended solids loading to the filter should also be considered in determining the necessary filter area.

112.32 Number of Units

Total filter area must be provided in two or more units, and the filtration rate must be calculated based on the total available filter area with one unit out of service.

112.4 Backwash

112.41 Backwash Rate

The backwash rate must be adequate to fluidize and expand each media layer a minimum of 20 percent based on the media selected. The backwash system must be capable of providing variable backwash rates. Minimum and maximum backwash rates must be based on demonstrated satisfactory field experience under similar conditions. The design must provide for a backwash period of at least 10 minutes.

112.42 Backwash Pumps

Pumps for back-washing filter units must be sized and interconnected to provide the required backwash rate to any filter with the largest pump out of service. Filtered water from the clear well or chlorine tank must be used as the source of backwash water. Waste filter backwash must be adequately treated.

112.43 Backwash Surge Control

The rate of return of waste filter backwash water to treatment units must be controlled so that the rate does not exceed 15 percent of the design average daily flow rate to the treatment unit. The hydraulic and organic load from waste backwash water must be considered in the overall design of the treatment plant. Surge tanks must have a capacity of at least two backwash volumes, although additional capacity should be considered to allow for operational flexibility. Where waste backwash water is returned for treatment by pumping, adequate pumping capacity must be provided with the largest unit out of service.

112.44 Backwash Water Storage

Total backwash water storage capacity provided in an effluent clearwell or other unit must equal or exceed the volume required for two complete backwash cycles.

112.5 Filter Media Selection

Selection of proper media type and size will depend on required effluent quality, the type of treatment provided prior to filtration, the filtration rate selected, and filter configuration. In dual or multi-media filters, media size selection must consider compatibility among media. Media must be selected and provided to meet specific conditions and requirements relative to the project under consideration. The selection and sizing of the media must be based on demonstrated satisfactory field experience under similar conditions. All media must have a uniformity coefficient of 1.7 or less. The uniformity coefficient, effective size, depth, and type of media must be set forth in the specifications.

112.6 Filter Appurtenances

The filters must be equipped with wash-water troughs, surface wash or air scouring equipment, means of measurement and positive control of the backwash rate, equipment for measuring filter head loss, positive means of shutting off flow to a filter being backwashed, and filter influent and effluent sampling points. If automatic controls are provided, there must be a manual override for operating equipment, including each individual valve essential to the filter operation. The underdrain system must be designed for uniform distribution of backwash water (and air, if provided) without danger of clogging from solids in the backwash water. If air is to be used for filter backwash, separate backwash blower(s) must be provided. Provision must be made to allow periodic chlorination of the filter influent or backwash water to control slime growths. When chemical disinfection is not provided at the plant, manual dosage of chlorine compounds is acceptable.

112.7 Access and Housing

Each filter unit must be designed and installed so that there is ready and convenient access to all components and the media surface for inspection and maintenance without taking other units out of service. Housing for filter units must be provided. The housing must be constructed of suitable corrosion-resistant materials. All controls must be enclosed and the structure housing filter, controls and equipment must be provided with adequate heat and ventilation equipment to minimize problems with excess humidity.

112.8 Proprietary Equipment

Where proprietary filtration equipment not conforming to the preceding requirements is proposed, data which supports the capability of the equipment to meet effluent requirements under design conditions must be provided. Such equipment will be reviewed on a case-by-case basis at the discretion of the regulatory agency. Refer to Section 53.2.