**Section 604.605 Rapid Rate Gravity Filters**

a) The use of rapid rate gravity filters requires pretreatment.

b) For community water supplies treating surface water, groundwater under the direct influence of surface water, or using lime soda softening treatment, unless otherwise approved by the Agency under Section 604.145(b), the nominal filtration rates must not exceed 3 gal/min/ft2 of filter area for single media filters and 5 gal/min/ft2 for multi-media filters. Filtration rates must be reduced when treated water turbidity exceeds the standards in 35 Ill. Adm. Code 611.

c) For community water supplies treating groundwater and not using lime soda softening treatment, unless otherwise approved by the Agency under Section 604.145(b), the rate of filtration must not exceed 4 gal/min/ft2 of filter area.

d) Number of Filter Units

1) A minimum of two units must be provided. Each unit must be capable of meeting the plant design capacity or the projected maximum daily demand at the approved filtration rate.

2) Where more than two filter units are provided, the filters must be capable of meeting the plant design capacity at the approved filtration rate with one filter removed from service.

3) Where declining rate filtration is provided, the variable aspect of filtration rates and the number of filters must be considered when determining the design capacity for the filters.

e) Structural Details and Hydraulics. The filter structure must be designed to provide for the following:

1) vertical walls within the filter;

2) no protrusion of the filter walls into the filter media;

3) cover by superstructure;

4) head and walking room to permit normal inspection and operation;

5) minimum depth of filter box of 8.5 feet;

6) minimum water depth over the surface of the filter media of 3 feet;

7) trapped effluent to prevent backflow of air to the bottom of the filters;

8) prevention of floor drainage to the filter with a minimum 4-inch curb around the filters;

9) prevention of flooding by providing overflow;

10) maximum velocity of treated water in pipe and conduits to filters of 2 ft/sec;

11) cleanouts and straight alignment for influent pipes or conduits where solids loading is heavy, or following lime soda softening;

12) construction to prevent cross-connections, short-circuiting, or common walls between potable and non-potable water; and

13) wash water drain capacity to carry maximum flow.

f) Wash water troughs must be constructed such that:

1) the bottom elevation is above the maximum level of expanded media during washing;

2) a 2-inch freeboard is provided at the maximum rate of wash;

3) the top edge is level and is all at the same elevation;

4) troughs are spaced so that each trough serves the same number of square feet of filter area; and

5) the maximum horizontal travel of suspended particles to reach the trough does not exceed 3 feet.

g) The filter media must be composed of clean silica sand or other natural or synthetic media free from detrimental chemical or bacterial contaminants and must meet the following requirements:

1) a total depth of not less than 24 inches;

2) a uniformity coefficient of the smallest material not greater than 1.65;

3) a minimum of 12 inches of media with an effective size range of 0.45 mm to 0.55 mm;

4) filter media specifications:

A) Filter anthracite must consist of hard, durable anthracite coal particles of various sizes. Blending of non-anthracite material is not acceptable. Anthracite must have:

i) an effective size of 0.45 mm to 0.55 mm with a uniformity coefficient not greater than 1.65 when used alone;

ii) an effective size of 0.8 mm to 1.2 mm with a uniformity coefficient not greater than 1.7 when used as a cap;

iii) an effective size less than 0.8 mm for anthracite used as a single media on potable groundwater for iron and manganese removal only (effective sizes greater than 0.8 mm may be approved based upon on-site pilot plant studies);

iv) a specific gravity greater than 1.4;

v) an acid solubility less than 5 percent; and

vi) a Moh's scale of hardness greater than 2.7.

B) Sand must have:

i) an effective size of 0.45 mm to 0.55 mm;

ii) a uniformity coefficient of not greater than 1.65;

iii) a specific gravity greater than 2.5; and

iv) an acid solubility less than 5 percent.

C) High-density sand must consist of hard, durable, and dense grain garnet, ilmenite, hematite or magnetite, or associated minerals of those ores that will resist degradation during handling and use, and must:

i) contain at least 95 percent of the associated material with a specific gravity of 3.8 or higher;

ii) have an effective size of 0.2 to 0.3 mm;

iii) have a uniformity coefficient of not greater than 1.65; and

iv) have an acid solubility less than 5 percent.

D) Granular activated carbon as a single media may be considered for filtration only after pilot or full-scale testing and with prior approval of the Agency. The design must include the following:

i) The media must meet the basic specifications for filter media in subsections (g)(1) through (g)(3).

ii) There must be provisions for a free chlorine residual and adequate contact time in the water following the filters and prior to distribution.

iii) Provisions must be made for frequent replacement or regeneration.

E) Other media types or characteristics must be approved by the Agency;

5) supporting media designed as follows based on the type of filter material:

A) A three-inch layer of torpedo sand must be used as a supporting media for filter sand when supporting gravel is used, and must have:

i) an effective size of 0.8 mm to 2.0 mm; and

ii) a uniformity coefficient not greater than 1.7.

B) Gravel

i) When gravel is used as the supporting media, it must consist of cleaned and washed, hard, durable, rounded silica particles and must not include flat or elongated particles.

ii) The coarsest gravel must be 2.5 inches in size when the gravel rests directly on a lateral system, and must extend above the top of the perforated laterals.

iii) Not less than four layers of gravel must be provided in accordance with the following size and depth distribution:

**Size** **Depth**

2½ to 1½ inches 5 to 8 inches

1½ to ¾ inches 3 to 5 inches

¾ to ½ inches 3 to 5 inches

½ to 3/16 inches 2 to 3 inches

3/16 to 3/32 inches 2 to 3 inches

iv) Reduction of gravel depths and other size gradations may be approved by the Agency upon justification for slow sand filtration or when proprietary filter bottoms are specified.

h) Filter Bottoms and Strainer Systems

1) Water quality must be reviewed before the use of porous plate bottoms to prevent clogging and failure of the underdrain system.

2) The design of manifold type collection systems must:

A) minimize loss of head in the manifold and laterals;

B) ensure even distribution of washwater and even rate of filtration over the entire area of the filter;

C) provide the ratio of the area of the strainer systems' final openings to the area of the filter at about 0.003;

D) provide the total cross-sectional area of the laterals at about twice the total area of the final openings;

E) provide the cross-sectional area of the manifold at 1.5 to 2 times the total area of the laterals; and

F) direct lateral perforations without strainers downward.

3) The Agency may approve departures from these standards for high-rate filters and propriety bottoms.

i) The following appurtenances must be provided for every filter:

1) influent and effluent sampling taps;

2) a gauge indicating loss of head;

3) a meter indicating the instantaneous rate of flow;

4) a pipe for filtering to waste that has a six-inch or larger air gap, or other Agency-approved cross-connection control measure;

5) a continuously recording Nephelometer capable of measuring and recording filter effluent turbidity at maximum 15-minute intervals, and with alarm capability to notify the operator if filtered water turbidity exceeds 0.3 NTU (Nephelometric Units);

6) an adjustable-rate valve to allow the operator to gradually control the flow rate increase when placing the filters back into operation; and

7) a hose and storage rack for washing filter walls.

j) Backwash. Provisions must be made for washing filters as prescribed in this subsection.

1) The community water supply must use filtered water provided at the required rate by washwater tanks or a dedicated washwater pump to wash the filters.

2) Backwash rate must meet the following requirements:

A) a minimum rate of 15 gal/min/ft2, consistent with water temperatures and specific gravity of the filter media;

B) a rate sufficient to provide for a 50 percent expansion of the filter bed; and

C) a reduced rate of 10 gal/min/ft2 for full depth anthracite or granular activated carbon filters, upon approval by the Agency.

3) Washwater pumps in duplicate must be provided unless an alternate means of obtaining washwater is available.

4) The main washwater line must have a regulator or valve to obtain the desired rate of filter wash with the washwater valves on the individual filters open wide.

5) The main washwater line or backwash waste line must have a rate of flow indicator, preferably with a totalizer, located so that it can be easily read by the operator during the washing process.

6) Rapid changes in backwash water flow must be prevented.

7) Backwash must be completed with an operator in attendance to initiate the backwash cycle and to control the return-to-service procedure to assure that the effluent turbidity is less than 0.3 NTU when the filter is placed back into operation for discharge to the clearwell.

8) Appropriate measures for cross-connection control must be provided.

k) Surface or subsurface wash facilities are required except for filters used exclusively for iron, radionuclides, arsenic, or manganese removal. Wash facilities may include a system of fixed nozzles or a revolving-type apparatus. All devices must be designed:

1) to provide water pressures of at least 45 psi;

2) to prevent back-siphonage by properly installing a vacuum breaker or other approved device, if connected to the treated water system; and

3) to provide a rate of flow of 2.0 gpm/ft2 of filter area with fixed nozzles or 0.5 gpm/ft2 with revolving arms.

l) Air scouring may be used in place of surface wash if the air scouring meets the following requirements:

1) Air flow for air scouring the filter must be 3 to 5 ft3/min/ft2 of filter area when the air is introduced into the underdrain; a lower air rate must be used when the air scour distribution system is placed above the underdrains;

2) A method to avoid filter media loss during backwashing must be provided;

3) Air scouring must be followed by a fluidization wash sufficient to restratify the media;

4) Air must be free from contamination;

5) If air scour distribution systems are placed at the media and supporting bed interface, the air scour nozzles must be designed to prevent media from clogging the nozzles or the air entering the air distribution system;

6) Piping for the air distribution system must not be flexible hose or other soft material;

7) Air delivery piping must not:

A) pass down through the filter media; and

B) have any arrangement in the filter design that would allow short-circuiting between the applied unfiltered water and the filtered water;

8) When air scouring is being used, the backwash rate must be variable and must not exceed 8 gal/min, unless a higher rate is necessary to remove scoured particles from filter media surfaces; and

9) Air scouring piping must not be installed in the underdrain unless the underdrain was designed to accommodate the piping.

(Source: Amended at 47 Ill. Reg. 7503, effective May 16, 2023)