American Manufacturing Company, Inc.
P.O. Box 97, Elkwood, VA 22718   1-800-345-3132

AMC - Recirculating Sand Filter (RSF)

GENERAL OVERVIEW & SEQUENCE OF OPERATION

Overview of the AMERICAN MFG. COMPANY RSF SYSTEM

The ***AMERICAN RSF*** utilizes age old technology and EPA recirculating sand filter standards to provide secondary treatment to primary treated effluent. The primary treated effluent is either pumped or flows by gravity to a Recirculation/Pump tank. Tank is sized for 0.5 to 1.5 days peak design flow. Effluent is pumped to the sand filter on a timed basis via duplex alternating pump system. Pumps are effluent rated turbine pumps situated inside our patented Cool Guide (laminar flow collar). Recirculation rates, pump run times and pump rest times are adjustable. The effluent is distributed through hydraulically activated sequencing valves which direct effluent to a manifold and onto a series of evenly spaced parallel PVC laterals with pre drilled orifices. A series of under drains collects the treated effluent. The American RSF recirculation technique allows for various recirculation rates including a 100% recirculation option during periods of low flow.

Basic Components:

Recirculation Tank: Total recirculation tankage shall be sized to equal a volume of a minimum of 0.5-1.5 days raw wastewater flow. For larger projects several smaller tanks may be used to feed sections (zones) of the RSF.

Sand Filter Zone: A zone is a section of the RSF that has it's own duplex pump system, manifolds, laterals and sequencing valve. The zone will be timed dosed independently of other zones. Each zone will have several manifolds that will automatically be dosed on a rotational basis via a hydraulic sequencing valve. The number of zones required and the zone size will vary depending on GPD and the recirculation rate with many standard options available. RSF's with multiple zones typically have equal sized zones.

Pumps: Each RSF zone shall have a duplex alternating pump system. Pumps are effluent rated submersible turbines each housed in a prefabricated patented laminar flow collar (LFC). Pumps shall have individual breakers and Hand-Off-Auto (H-O-A) switches. Cycle counters and ETM's are optional

Force Main: The force main from each duplex pump system shall be typical 2.0" dia. SCH40 PVC pipe feeding the sequencing valve. The force mains from each pump shall each have a check valve, disconnect (SCH80 PVC) and a gate valve prior to teeing together to form a single feed line. Force main material and size may change per the engineer's specifications.

Sequencing Valve: The hydraulically operated sequencing valve shall automatically rotate one outlet port every dose. Each outlet port feeds a manifold. The sequencing valve shall be located in a 30” dia. PVC riser. The valve shall be positioned to drain after each dose. Each valve shall have 3, 4 or 5 outlet ports.

Manifold Supplies: Typically 1.5” dia. SCH40 PVC pipe. Each manifold supply shall originate from an outlet port on the sequencing valve and feed one manifold. Manifold size may change per specifications.

Manifolds: Manifolds are typically 1.5” SCH40. Each manifold shall evenly distribute effluent to 3, 4 or 5 distribution laterals. Manifolds within a zone are dosed individually. Manifolds are dosed when the rest timer has timed out and the there is enough effluent in the recirculation tank. After a manifold is dosed the next manifold must wait for the pump rest timer to time out again prior to being dosed.

Laterals: Distribution laterals are typically 1.0” dia. SCH40 PVC with 1/8” dia. orifices spaced 2.0’ on center. Lateral spacing is typically 2.0’ on center. Lateral length varies but is standard 48’.

Under Drains: Typical 4” slotted class 125 PVC perforated under drain pipe. Slope 0-0.1 %.

Optional Motorized BRV: This optional electric valve provides for 100% recirculation to continually polish the effluent during periods of low flow. If the “Off” level float switch is the only float activated the Motorized BRV will automatically turn to divert all effluent collected from the under drains back to the recirculation tank. When the tank level returns to normal conditions the valve will automatically turn to divert water to the distribution box. The inlet port and both outlet ports are 4.0” SCH40 female slip connection. The valve operates on 115 volt and is housed in a 24” dia. PVC riser. Optional heater available.

Distribution Box: Collected effluent shall flow by gravity to the distribution box (ratio box). The d-box may be a prefabricated high density polyethylene with one inlet port and typical 4 or 5 outlet ports depending on the desired recirculation ratio. Flow rates on certain projects may necessitate the need for a prefab concrete or cast in place d-box. The d-box shall evenly distribute the effluent through several ports with a specific number of ports returning to the recirculation tank and the remaining port to final discharge.

SEQUENCE OF OPERATION

The ***AMERICAN RECIRCULATING SAND FILTER*** is operated via a "state of the art" controller which is activated by level sensing devices (standard mechanical differential float switch) located in a recirculation tank downstream of the primary settling process. Each controller manages one or more automatic alternating duplex pump systems. When activated by the rising level of effluent in the dosing tank, the controller will enable the dispersal cycle, and as dictated by the time clock, pump the effluent through a force main feeding a hydraulically activated sequencing valves. The sequencing valve will distribute effluent through one outlet port and into a single manifold feeding several parallel distribution laterals. The sand filter pump control panel is equipped with four float switches to control the timed doses to be discharged. The four float switches, "Redundant Off", "Standard Dose Enable", “Peak Dose Enable", and "High Level" function as follows:

w Redundant Off - The water level must be high enough to overcome the "Redundant Off" (first & bottom) float in order for the pump to be permitted to run.

w Standard Dose Enable - When the water level rises high enough to overcome the "Standard Dose Enable" (second) float and the time clock has timed out the preset time delay (rest between dosing cycles for two zone designs) the pump will activate and the lead zone is dosed. The pump will continue to run for the length of time as adjusted on the pump run timer and then shut off. The pump will remain off until the internal time clock again times out the preset time delay after which the pump will activate (as long as the "Standard Dose Enable" float is still up) and will run until the pump run timer finishes timing out. This process will repeat until the water level drops below the "Standard Dose Enable" float and the pump run timer has timed out.

w Peak Dose Enable - The control system will be equipped with a "Peak Dose Enable" circuit to manage peak flows and excess water use. If the rising water level activates the "Peak Dose Enable" (third) float, the "Pump - Off - Pump & Alarm" switch is set to "Pump", and the preset time delay has been exceeded ("Peak Dose Enable" rest between cycles), the lead zone will be dosed. When the “Peak Dose Enable” circuit has been deactivated the normal pumping cycle will resume. If the rising water level activates the "Peak Dose Enable" (third) float, the "Pump - Off - Pump & Alarm" switch is set to "Pump & Alarm", and the preset time delay has been exceed ("Peak Dose Enable" rest between cycles), the lead zone will be dosed and the "Peak Dose Enable" alarm will be activated. The audio portion of the alarm may be silenced by pressing the Test-Normal-Silence switch to the silence position. When the "Peak Dose Enable" float has returned to the down position the alarm will be deactivated and the normal pumping cycle will resume.

w High Level - If the water level rises enough to overcome the "High Level" (fourth) float, the audiovisual alarm will activate. The audio portion of the alarm may be silenced by pressing the Test-Normal-Silence switch (located on the outside of the control panel) to the silence position. The alarm circuit will latch until manually reset after the "High Level" float returns to its normal (down) position. The alarm circuit is manually reset by switching the High Level Reset/Off-Normal switch (located inside the control panel on the inner door) to the Reset position then back to normal.

DESIGN PARAMETERS:

Design parameters are based on EPA recommendations. Standard AutoCAD details are provided by American Mfg. for use by the design engineer.

MEDIA:

Recommended effective size of the media ranges from 1.0-3.0 mm. Coarse material is preferred. Uniformity coefficient should be 3.5 to 4.0 (3.5 preferred) (Teske,1978; Hines and Favreau, 1975). The media must be carefully placed in the filter to prevent stratification of the material. It should be homogenous throughout it’s depth. To prevent the media from sifting into the gravel below, several inches of 1/4” to 3/8” pea gravel should be placed on top of the 1/2” to 3/4” size bottom layer of gravel before the media is added.

HYDRAULIC LOADING RATE:

Hydraulic loading rates are dependent on the media size. They should range from 3.0 - 5.0 gpd/sq.ft. based on forward flow. A recirculation rate of 3:1 to 5:1 (recycle:forward flow) is typically used (Hines & Favreau, 1975).

DOSING & DISTRIBUTION:

Each zone will be dosed 48-120 times (or more) per day with ideal volumes equaling 1-2 gal/orifice/dose. Flow rate (gpm) per lateral is determined by lateral length, orifice size, orifice spacing and head pressure. All run and rest times are easily adjustable. Orifice shields are required to prevent clogging of the orifice from the outside. Distribution shall be primarily through low pressure pipe using standard low pressure distribution design procedures. A hydraulically activated sequencing valve automatically rotates flow through several manifolds. Each sequencing valve is supplied by a duplex alternating submersible pump system controlled by automatic time and level settings.

FILTER ENCLOSURE:

Most large scale commercial filters are constructed in ground. A typical 30 mil PVC liner is placed over a shallow (2.0”) sand leveling layer. The liner extends up and over the four side walls. Side walls are supported by 1/2” untreated plywood. All pipes penetrating the liner shall be equipped with an appropriately sized liner boot. Smaller filters are usually made of either prefabricated or poured in-place concrete or masonry walls set on a poured slab. Any portion of exposed filter walls should be well insulated to protect from freezing. Covers may be necessary in severe climates. Buried sand filters are covered with a light filter fabric and several inches (typical 6”) of soil with established vegetation (i.e. grass). A sandy loam is recommended.

OPERATION & MAINTENANCE:

Routine O & M is required for all recirculating sand filters. Influent and effluent sampling and analysis is typically required on a periodic basis. Verification of flow rates, run times, rest times, pump & controls operation is standard. Flushing of laterals and measuring of orifice head pressure should be done annually. Normal sludge measurement procedures should be used to determine if a pump out is required.

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Selecting a typical RSF configuration:

Area Required:

GPD / Recirculation Rate (3.0-5.0 gpd/sq.ft.) = SF Area Required (sq. Ft.)

Sand Filter Length:

Typical Sand Filter Length = 50'

Sand Filter Width:

Area Required (sq.ft.) / 50' length

Determine Number of Laterals Required:

Typical lateral spacing: 2.0'

Note: Sand filter length is 50' but laterals have 1 ft separation from both ends creating an effective lateral length of 48'.

Width (ft.) / Lateral Spacing (typ. 2') = Number of 48' laterals required

Determine which standard configuration to use:

Refer to selection chart in Table 1

Example:

20,000 gpd w/ a 5.0 gpd/sq.ft. loading rate

Area Required:

20,000 GPD / 5.0 gpd/sq.ft. = 4000 sq. ft. required

Sand Filter Length:

Typical Sand Filter Length = 50'

Sand Filter Width:

Area Required (sq.ft.) / 50' length

4000 sq.ft.. / 50' = 80' width

Determine Number of Laterals Required:

Typical lateral spacing: 2.0'

Width (ft.) / Lateral Spacing (typ. 2') = Number of 48' laterals required

80 ft / 2.0 ft = 40 laterals of 48' length required.

Determine which standard configuration to use:

Refer to selection chart in *Table #1*

Options for 40 laterals from *Table #1* are **SF 245** or **SF 254**