Construction Guidelines for a Single Pass Sand Filters

A. General

In an intermittent sand filter treatment system, wastewater receives primary treatment in the anaerobic environment of a septic tank, secondary treatment in the aerobic environment of a sand filter and is disposed of in soil trenches where additional biodegradation occurs. Most of the decomposition takes place in the sand filter. Naturally occurring microorganisms reside on the surfaces of the sand particles and thrive on the regular doses of nutrients contained in the wastewater. Following sand filter treatment and prior to drainfield discharge, effluent can be expected to produce:

BOD <15 mg/L

TSS <15 mg/L

Fecal 1000 cts/100mL

NH3-N <1.0 mg/L

NO3-N <30 mg/L

Operationally, it works like this:

The septic tank is equipped with a screen vault and a pump or followed by a lift station with a pump to discharge effluent under pressure to the sand filter.

Piping on the surface of the filter is the vehicle for uniformly distributing effluent over the surface of the sand bed or filter media.

Solids and other contaminants in the effluent are mechanically, biologically, and chemically reduced as the effluent passes through the filter media.

The treated effluent is collected at the bottom of the sand filter by the underdrain and either drains out by gravity into a lift station or is pumped out for final treatment and disposal in a shallow drainfield.

B. Typical design for low-rate intermittent sand filter with pump basin

Sand filters are usually loaded at 0.5 to 1.2 gpd/ft2.

Here are the main component parts of sand filters normally installed.

- A 19’ x 21’ x 35" deep hole, flat on the bottom, with a depression where the pump basin will be located. Any over-excavation should be filled and well compacted. A two-inch cushion of sand in the bottom of the hole is to protect the liner from penetration by sharp objects. The depth of hole can actually vary from 0" to 41" depending on specific site conditions.

- A perimeter support frame to hold the liner in place during construction may be needed. This box protects the liner and provides support to prevent the whole from collapsing. If the whole will maintain its shape and no sharp objects are present in the soil this may not be necessary. If a box is needed plywood with 2" x 4" framing support is appropriate. Treated wood is unnecessary as once the system is backfilled and complete, it is supported by the earth and sand and the wood can decompose without harm. During construction of the sand filter (placement of the media), it is important that sand be placed between the excavated soil and the plywood framework. This keeps the framework and liner vertical during the course of construction and results in a sand cushion around the outside perimeter of the liner. All nails or staples used must have their sharp ends pointed away from the liner.

- The 30-mil PVC liner is unfolded from the center of the excavation and draped over the top edges of the perimeter support frame (b). Care must be taken to ensure that the liner is in full contact with the bottom and sides and that no bridging occurs. Pleats or wrinkles in the liner are not a concern.

- There are two methods for constructing the removal of the effluent after it has based through the sand filter.

    1. The first is a PVC pump basin is installed in the depression located in the center of the sand filter. The pump basin must have a PVC or fiberglass bottom to prevent damage to the liner. It is important to verify all dimensions to ensure the pump basin is the correct height. The pump basin should have 4" grommets installed opposite one another to accommodate the 4" slotted PVC underdrain pipe.

    2. The other option is to have the bottom of the filter sloped slightly and the effluent flowing out by gravity through the underdrain out to a tank. A boot will then be needed to be used. The PVC boot permits a watertight penetration of the liner. When installing boots, the manufacturer’s installation instructions must be followed exactly, orienting the boot so the clamp is outside the sand filter. In the event high ground water was to reach that elevation, the boot

would prevent infiltration. The 4" slotted PVC underdrain pipe should be Class 125 (or higher) pressure rated. Slots are cut half way through the pipe _ " wide, 4" on center. If using a pump basin the pipe is laid flat with the slots pointed upward and capped with 4" end caps and the 4" underdrain pipe should penetrate the pump basin 1"-2".

- Drainfield rock is then mounded at least 2" over the 4" slotted PVC drainpipe to prevent finer material from entering the pipe.

- A level course of _" to 3/8" pea gravel, 6" deep, is placed in the bottom of the sand filter. Water will pond 2" to 3" deep in the bottom of the sand filter and the pea gravel will prevent unwanted capillary action from occurring and will allow the treated effluent to move freely toward the 4" drain pipe.

- Filter sand must be placed and compacted while it is damp. If the sand is not damp, it will not compact well and settlement may cause dislocation and breakage of the distribution laterals; wet the sand when necessary. The sand surface must be flat. It is critical that water never come in contact with the sand to saturate it. This saturation will greatly impact performance of the system.

- 3" of _" to 3/8" pea gravel is placed on top of the compacted sand, disturbing the sand as little as possible. The pea gravel serves to support the distribution system and to keep the sand from eroding under the action of the effluent being applied. After the laterals are installed and a pressure test performed, more pea gravel (enough to cover the pipe) will be added.

- A valve box located at the end of each lateral is to permit annual flushing of the laterals. Turning on the pump in the dosing septic tank for one or two minutes and opening a flushing valve allows water to flow in the _" diameter laterals at a velocity of more than three times the normal dosing velocity. The effluent may be dosed directly in the valve box. The higher flow rate scours biological growth that occurs on the inside walls of the lateral pipes. If these growths are not removed periodically, they may slough off and plug the orifices. When too many orifices are plugged, the effluent is not spread over the entire sand surface and a small portion of the filter becomes overloaded, turns anaerobic and can eventually cause the entire sand surface to plug. Following annual flushing of the laterals, the PVC 90° elbows are removed and replaced temporarily with a PVC capped adapter having a 1/8" orifice drilled in its top. The dosing septic tank pump is turned on and the proper squirt height verified–normally five feet for systems without distribution valves and twenty feet for systems with distribution valves. If the squirt increases from five to eight feet, or from twenty to thirty feet or more, it is likely that too many orifices are plugged and each lateral should be cleaned with a bottlebrush or a pressure washer.

- Assembly of the 2" PVC manifold (Class 200 minimum), 1". The 1/8" or _" diameter orifices should be drilled with a drill press or drill guide using a new 1/8"

drill bit and should not have any visible burrs. All PVC joins should be glued according to the manufacturer’s instructions, e.g. primers shall be used if required.

- Orifice shields are required to prevent the orifices from being blocked by rocks resting against the outside of the PVC pipe. In locations where there is a possibility the laterals could freeze solid, orifice shields for cold climates should be used. These are an optional feature of sand filters.

- Filter fabric is placed over the final course of pea gravel. The purpose of the filter fabric is to keep soil, silts, and fine-grained material from moving down into the sand filter, at the same time allowing air and water to pass freely. It is important not to use a filter fabric so dense that air and water movement are impaired since that could cause the sand filter to clog and turn anaerobic.

- When attached to a PVC stem, the floats should have a maximum tether length of 2". The floats should be either mercury or mechanical and must be UL or CSA listed unless otherwise approved. The on, off, and alarm settings depend on the type of drainfield to be dosed. The designer should provide a narrative, describing what is to be accomplished. The high-water alarm float must be connected to the pump control panel in such a manner that a high-water alarm in the sand filter will disable the pump in the dosing septic tank until the high-water alarm is canceled.

- The electrical splice box must be UL or CSA listed and corrosion-proof, with the proper number of cord grips installed. Heat shrink must be used on the individual wire splices within the box. Sufficient length of wires must be provided in the box to allow for future repairs.

- The conduit seal must be UL or CSA listed and must be installed using the proper conduit sealant as recommended by the manufacturer. Bubble gum or silicone is not allowed.

- The electrical conduits must be UL or CSA listed for the purpose. _" diameter is most common. There are electrical code rules restricting the number of bends between panels and junction boxes. Refer to NEC 1993 section 347-14.

- The pump must be UL or CSA listed and specifically selected for its intended use by a knowledgeable person (not necessarily a pump salesperson). Pump capacity (gpm) and total dynamic head (Tdh~ft) should be considered.

- The hose and valve discharge assembly should be easily removable and have the flexibility to be easily installed. It should be constructed of moisture- and corrosion-resistant materials.

- The pump basin lid should be durable and should have durable, tamper-resistant mechanical fasteners.

- The soil cover must be loamy-sand. Its purpose is to provide insulation against cold winter temperatures, to allow the free movement of air into the sand filter below, and to prevent odors from escaping the sand filter. Establishing a grass cover over the sand filter is very beneficial.