Slow flow filtration design, construction and use

Nursery & Garden Industry Queensland

When compared to other disinfestation methods, slow flow filtration (SFF) systems can be constructed from a variety of components without specialist skills being required.

In designing SFF systems, the size and distribution of sand particles, the ratio of filter bed surface area to depth, the flow rate of water through the filter and penetration of light to the sand bed all affect the efficiency of the filter. Because other types of media can be used in place of sand in these systems, the nursery industry now uses the term 'slow flow filtration' instead of 'slow flow sand filtration'.

SFF systems can be housed in a range of tank types and sizes from 200L up to 100,000 L. The housing must be constructed of, or lined with, a non-reactive material such as plastic and able to prevent the penetration of light to reduce algal growth. Constructing two smaller units instead of one larger unit means that one unit can be stood down for repairs or cleaning, without impacting significantly on treatment capacity.

The first layer installed in the tank is a gravel drainage system to stop the movement of fine sand into the filter outlet. In the bottom of the filter, perforated drainage pipes are located in a layer of the coarsest gravel to form a network of pipes across the base. If insufficient drainage pipes are installed in this layer, or the gravel

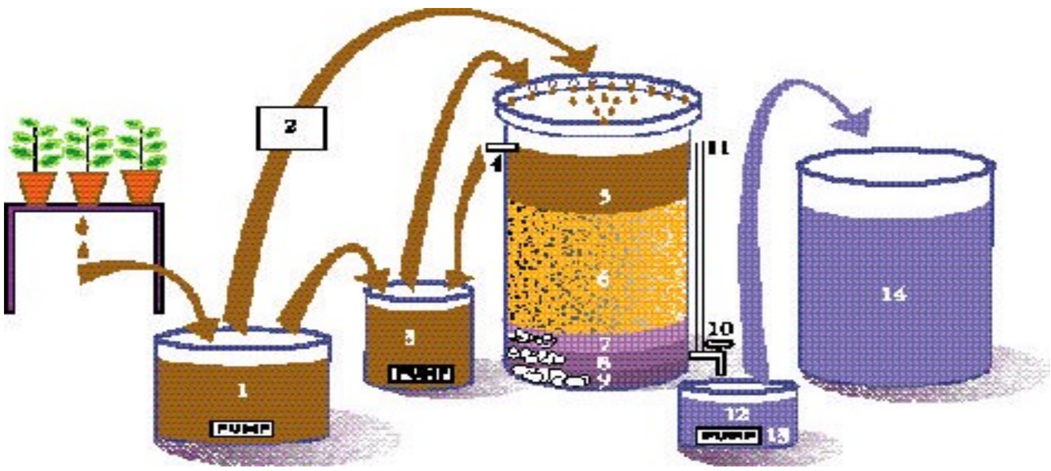

Figure 1: Slow Flow Filtration Layout – From the Nursery Paper "Slow Flow Sand Filtration (SSF) for water treatment in nurseries and greenhouses".
Water drains from the crop and is collected in a catchment tank or dam (1). Water is pumped to the SFF via a holding tank (3) or through a fast media filter (2) to remove suspended material. Overflow outlet (4) back to the holding tank maintains a constant depth of the water layer. The SFF consists of: a water storage layer (5), a sand or media filter bed (6) and gravel layers (7-9) to support the filter bed. The outflow (10) may be fitted with a flow regulating valve and an open tube (11) to measure filter head loss. A small collection tank (12) lower than the SFF collects filtered water for distribution by a pump (13). An optional holding tank (14) is used for the filtered water.

Tel: 07 3277 7900
www.ngiq.asn.au

Nursery & Garden Industry Queensland
Queensland Government
RURAL WATER USE EFFICIENCY
IRRIGATION FUTURES
Improving irrigation management for a profitable and sustainable future

layer is too fine, the flow rate of the SFF system will be reduced. The gravel drainage consists of 3 layers of graded gravel (2-8 mm, 8-16 mm and 16-32 mm) arranged with the coarsest grade at the bottom, and the finest gravel between the sand and coarser gravel layers. Geotextile fabric can be used to support the sand as an alternative to some gravel layers. Granulated rockwool may be used as an alternative media to reduce the requirement for the gravel drainage layers thus reducing filter depth. If Rockwool is used, a fine screen over the outlet is recommended to prevent rockwool granules escaping the filter.

The SFF filter bed is composed of washed uniform fine sand (0.15 - 0.35 mm) or granulated rockwool, which have been found to be the most effective materials in controlling diseases such as *Phytophthora*, *Pythium* and *Fusarium*. Sand that isn't uniform will settle in volume, reducing the porosity and flow of water through the filter bed. The uniformity of sand particles is determined by the Uniformity Coefficient (UC) and should always be less than 3 and preferably less than 2. The filter bed is constructed to a minimum depth of 0.8m (on smaller filters) and preferably 1 to 1.5 m. This allows for losses of sand which occur during removal of algae and particulate matter from the top of the filter bed during regular cleaning.

Controlling the flow rate of water through the filter bed by the use of a regulating tap is critical to the efficiency of pathogen control of the units. Industry best practice (NIASA) has determined that maximum flow rates must not exceed 100 $L/hr/m^2$ to maintain efficacy against the broadest range of diseases.

During operation, the SFF must have a constant 0.5 m to 1.5 m of water above the filter bed to provide both the pressure to push the water through the filter bed, and act as a temperature buffer to stabilise the filter and stop the biologically active area from drying out or becoming stagnant. When the system is not actively filtering irrigation water this is achieved by using a small pump from an overflow tank, or from the tank containing the filtered water to constantly pump water through the SFF. Prior to water entering the SFF, a media filter should be used to remove as much particulate matter as possible to maximise the interval between filter bed maintenance cleaning.

Once the SFF is commissioned and water run through, microbial activity builds up quickly and the SFF will become biologically active without any special inoculation. Research suggests that water circulating through the SFF for four weeks is required to establish biological activity before the filtered water can be used for irrigation. Regular testing of the treated water to ensure it is free of pathogens is recommended. For SFF this can be done by baiting the water and using Pocket Diagnostic Kits to determine if there are any pathogens present.

With time, a build-up of material on the filter bed surface will reduce the flow through the SFF. This can be monitored by installing a clear pipe on the outside of the filter to monitor head loss, When the flow rate though the SFF reduces, the water layer above the sand is drained, and the top layer of sand containing accumulated organic matter and silt is removed. After cleaning, the SFF should be operated for a couple of days before water is diverted into the treated water system.

Steve Hart and Lex McMullin
Farm Management Systems Officers
Nursery & Garden Industry Queensland

Published March 2015

Tel: 07 3277 7900
www.ngiq.asn.au