Water for the World

Operating and Maintaining Slow Sand Filters

Technical Note No. RWS. 3.0.3

A well-designed and well-constructed slow sand filter requires a simple but essential program of operation and maintenance. Operation and maintenance of slow sand filters can be done by local workers with little training. Neither expensive machinery nor highly skilled labor is needed. This technical note describes the basic steps in operating and maintaining small slow sand filters in rural areas. Follow the procedures included in this technical note to ensure that sand filters function properly and that good quality water is produced.

Useful Definitions

EFFLUENT - Settled sewage.

HEAD - Difference in water level between the inflow and outflow ends of a water system.

SCHMUTZDECKE - A layer of biologically active microorganisms that forms on the top of a filter bed; the microorganisms break down organic matter and kill bacteria in water.

The procedures for operating and maintaining slow sand filters include: (a) initial start-up of the filter, (b) daily operation and control of water flow, (c) cleaning the filter and (d) replacing the sand. Each procedure is discussed in detail.

Filter Start-up and Operation

Once the filter is constructed, it must be put into operation. Preparation of the filter takes several weeks as the sand bed must be adequately prepared to act as a biological filter.

- Close all outlet valves in the filter system and add potable water to the filter from the bottom as shown in Figure 1. The water that enters from the bottom forces air bubbles out of the filter bed and ensures that all grains of sand are in contact with water. Continue adding water until the water level is approximately 0.1m above the sand bed.

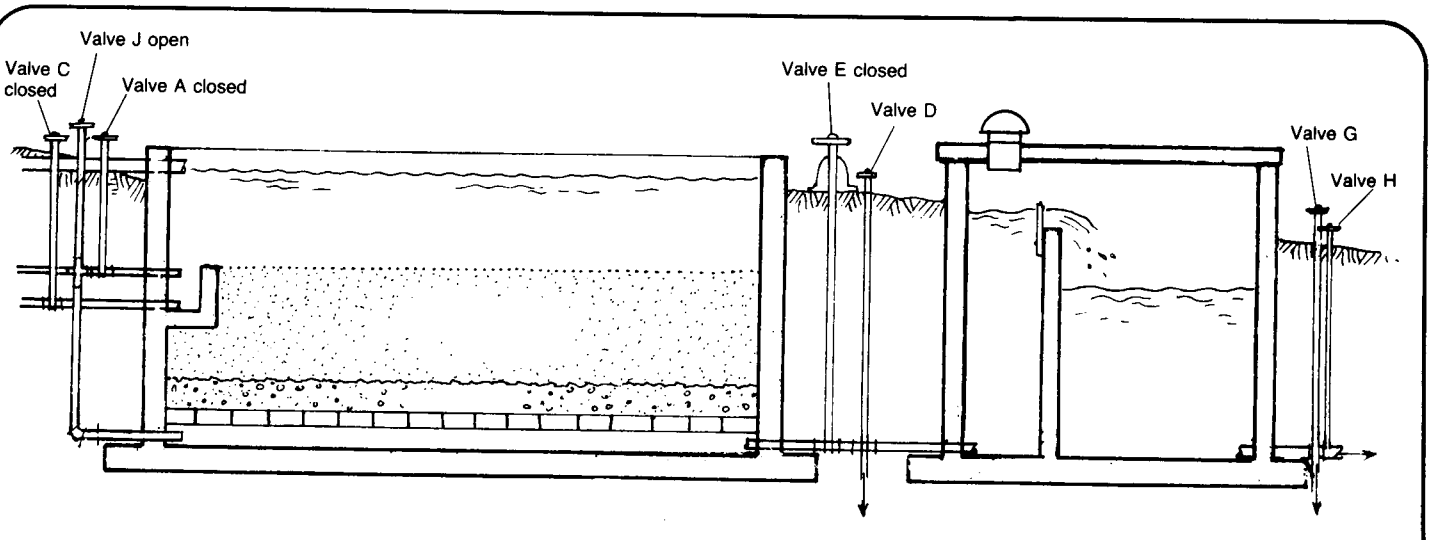

Figure 1. Filling the Slow Sand Filter

• When the water reaches 0.1m above the sand, begin to let water in through the raw water inlet. At first, let the water in very slowly so as not to disturb the sand layer. Once the water deepens, the rate of inlet flow can increase.

• When the water reaches the working level, open valve D as shown in Figure 2 and let the water run to waste at a rate of about one-quarter the normal filtration rate. Control the flow with the filter regulating valve. Run the filter for several weeks to allow the schmutzdecke to form on the sand. This is called the ripening process.

• During the ripening process, gradually increase the filtration rate until it reaches the design rate. Test the effluent water to see that the filter is working properly. Once the filter works, close the drain and open the valve that directs the water to the clear water tank.

• Regulate the flow of water in the filter using valve E. When the filter first begins operation, it will operate with the regulatory valve almost completely closed. As the filter bed becomes partially clogged, the valve is opened a little more each day to keep a constant head in the reservoir and a constant flow rate. Open the valve as needed. Once the valve is completely open and flow begins to decrease, the filter should be cleaned.

Cleaning the Filter

After several months of operation, a filter will need cleaning. For cleaning the filter, follow these steps:

• Close inlet valve A shown in Figure 2 to stop the flow of water to the filter. As the head in the water reservoir drops, the rate of filtration decreases. Let filtration continue for a few hours, usually overnight.

• In the morning, close the valve that controls the effluent flow to the clear water tank and open valve D, which lets the water flow to waste. Run the water to waste until the level of water in the filter bed is 0.1-0.2m below the surface of the filter bed.

• As soon as the top layer of the filter is exposed, begin removing it using flat-nosed shovels. Carefully remove the schmutzdecke and the surface sand sticking to it by stripping it off and piling it into heaps. Remove as little sand as possible, not more than 20 to 30mm. Remove the waste with wheelbarrows or large baskets or buckets. See Figure 3.

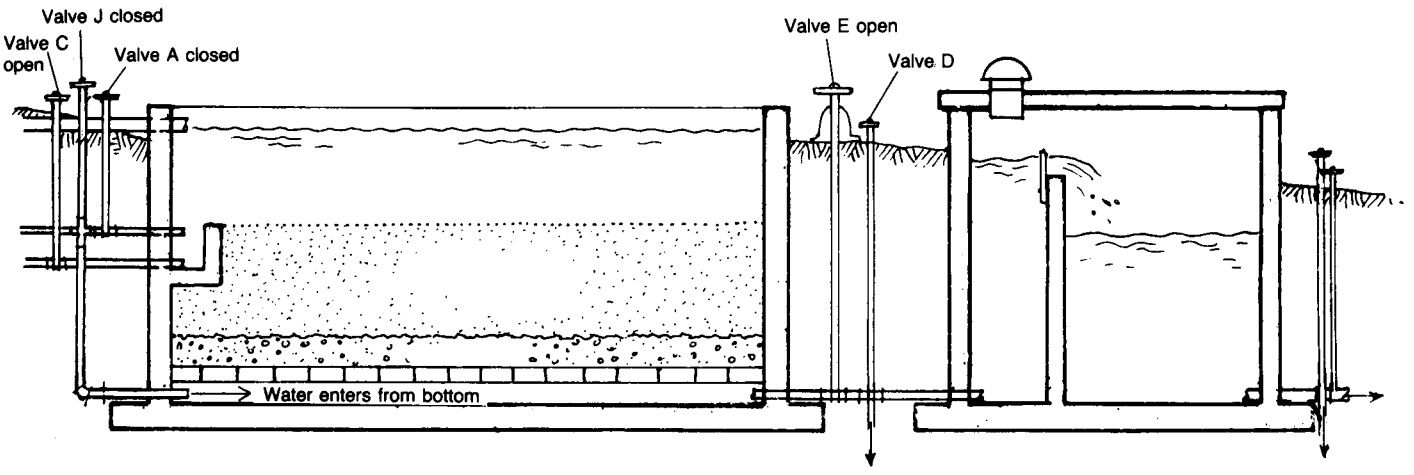

Figure 2. Draining the Filter for Cleaning

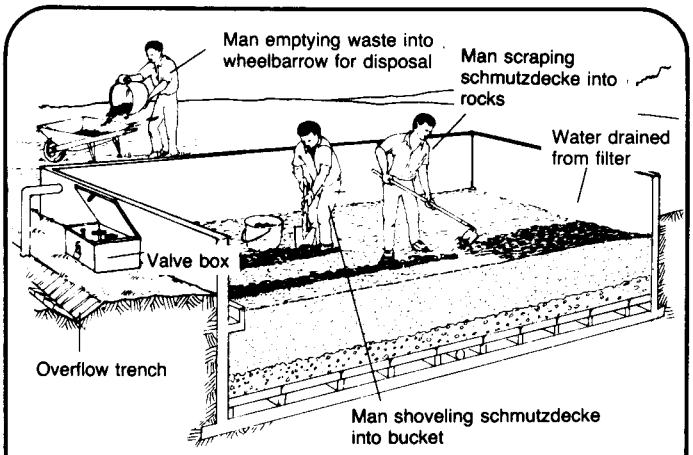

Figure 3. Cleaning the Schmutzdecke Layer

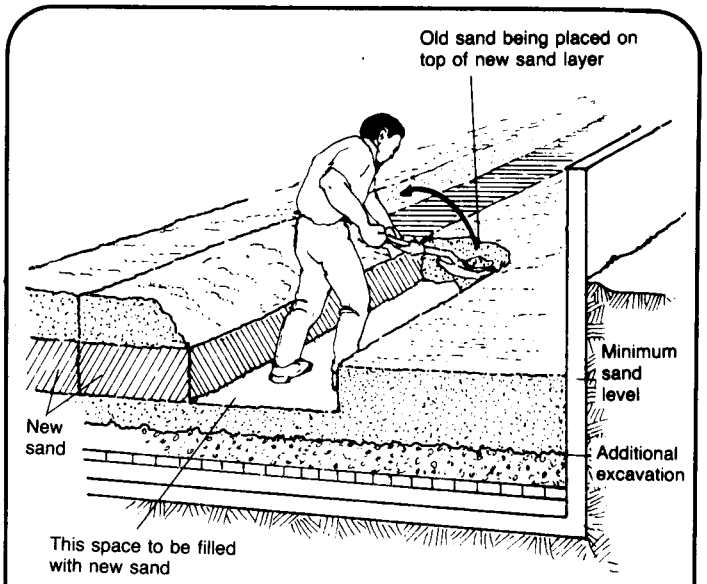

Figure 4. Turning the Filter Layer

• Clean the filter as quickly as possible to prevent deterioration of the bed. The quicker the bed is cleaned, the less bacteria in the lower layers will be disturbed. Re-opening the bed is therefore much quicker. Quick cleaning of the filter prevents damage caused by scavenging birds that may be attracted to the filter bed. These birds contaminate the surface of the bed and disturb the sand at a greater depth than is affected by scraping.

• After scraping and removing the schmutzdecke, level the sand in the filter.

• To restart the filter, follow the same steps as for start-up. The time required for both backfilling and re-ripening is much less than needed for initially putting the filter into operation. Backfilling requires only a few hours and re-ripening a few days.

Replacing the Sand

After 20-30 scrapings, or several years, the filter bed will reach its minimum thickness (0.5-0.8m above the gravel layer) and new or washed filter sand should be added to the filter bed. Sand is replaced through a process called "throwing over" and is done as follows:

• Dig a strip into the remaining sand layer as shown in Figure 4. Dig down a maximum of 0.3-0.5m being sure not to disturb the gravel layer.

• Place the excavated sand to the side and add new filter sand to the trench. Excavate a second strip next to the first. Throw the sand excavated from this second trench on top of the new sand in the first. Follow this process until the whole filter is refilled with new sand, and the upper 0.5m is made up of the old sand taken from the bottom. The last excavated strip is covered with the sand taken out from the excavation of the first strip.

• Once resanding is completed and the filter bed levelled, the re-ripening process can begin. Because a layer of sand containing some bacteria is placed at the top of the filter bed, the re-ripening process should not take as long as for a new filter.

Where sand is difficult to obtain or expensive, the sand taken from the filter can be washed and stored. The scrapings should be washed as soon as they are taken from the filter to prevent taste- and odor-producing substances that are impossible to remove later from developing. Care should be taken not to lose too many small sand particles during the washing.

The manual cleaning and other operation and maintenance work described in this technical note do not require special equipment or skills, especially when small filters are being used. For large filters, many workers are needed and the expense and time required are very demanding for rural communities. Mechanical cleaners are available but are too expensive and difficult to operate and maintain for small treatment systems.

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.

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