March 2013
Sarka Voriskova

The Waste Water Treatment System in Sunseed Desert Technology Description and Maintenance

There are three types of waste water commonly produced in household: black water, yellow water and grey water. The black water comes from toilet flushing or washing of baby diapers – it often contains faeces. The yellow water is the urine mixed with flush water. In Sunseed the flush contains vinegar and sometimes wormwood. Grey water is the waste from laundry, showers and kitchen. As there are compost toilets available, there is no black water produced in Sunseed. The water being treated consists of only grey and yellow (kitchen, shower, laundry and urine).

There are coarse **screens** installed in water outlets as a pretreatment. Those in shower basin and kitchen sinks are cleaned regularly as a part of household duty and the big screen outside the kitchen is cleaned weekly. There is a screen installed outside the urinals which is being forgotten to clean. All the grey water from Main house and its facilities is collected in pipes in from of the kitchen and directed with slope above the irrigation line into the **grease trap**. The grease trap's function is to separate oily particles and the settleable solids from the water. The oils generally float to surface and create scum while the solids settle and form sludge at the bottom. Our grease trap contains from three plastic barrels (180 l, 160 l, 160 l) connected in the middle with a pipe. The water flows into the first barrel by elbowed pipe, prolonged to the lower part of the barrel to avoid disturbance of the scum. The outlet pipe from the third barrel goes from the middle but is again elbowed to keep the desired water level.
The water consumption in Sunseed varies from 400 l – 1000 l and as the capacity of the grease trap is around 430 l, the retention time can be 6 hours or the whole night. This period is long enough to provide time for floating 70% of the grease, settling near the 100% of solids with higher density than water and near 20% of the suspended solids.

The urine pipes are placed beside the grey water ones and continue into the grease trap too. There is a tap and connection to another pipe leading to an **urine storage barrel** to be used in the gardens. At the moment this is not operating because of the solids blockage.

The grease trap is followed by a **retention tank** designed for dosing of the waste water to the following system. The retention tank consists of a 180 l barrel with an upper side covered inlet and lower side outlet. Inside there is a floating bucket perforated on sides. This bucket is connected to the outlet with a spiralled pipe. As the water flows into the barrel the empty bucket floats up until it's stopped by the lid. Then the water passes inside through the side holes. Once the bucket is heavy enough it sinks down and releases major part of the water from the barrel on the principle of siphon. Then the process repeats. There is a stone inside the bucket balancing the buoyant force.

The next step of the treatment are the **vertical gravel bed filters**. It's a system of four plastic containers, 1 m^3 each. These are filled from up with a thin layer of coarse gravel, thick layer of fine gravel, thick layer of sand, thick layer of fine gravel and a thin layer of coarse gravel. The bottom outlet is protected with perforated plastic containers supported by stones. The surface is planted with common reed and other semi-aquatic plants growing nearby. The water is distributed on the surface with a perforated pipe spiral. The water is treated mostly by oxygenation and bacteria decomposition in the media. For good operation aerobic conditions should be ensured inside the filters.
The upper two filters are connected at the outlet with a Ø 50 pipe while the lower ones have their own outlet each. The outlets have taps at the bottom of the filters.

The **horizontal gravel bed filters** follow the vertical ones. In these filters water flows on the bottom from one end to the other and gets treated anaerobically by bacteria, filter medium and plant uptake.
They are constructed as a concrete basin with a bottom slope. These basins are lined with plastic and filled with gravel. There are outlet pipes collecting the water at the other side of the inlet. At the moment there are four beds operating, one at the terrace where the vertical filters stand, the others on a lower terrace next to compost toilet. They are connected in series one lower then each other.
The bottom three filters are separated in the middle with a liner and have crossing outlets. This application was designed to conduct an experiment with waste water hydroponics and can be used this way again after. To the date there is no particular plant growing on filter 1, nettles on filter 2, comfrey on filter 3 and mint on the last one.
The outflow from the last filter is piped onto a spiral bed next to it where it soaks in the ground. There is a possibility of water collection and reuse.

Maintenance

Different parts of the waste water treatment system need different attention and frequency of cleaning as stated below. Although I recommend to dedicate one half day each week to check up all parts of the system and maintain the filters.

Urinals

The urinals get rather often blocked with particles of wormwood flushing and the urine sediments. An instant solution can be the rubber sink bell to push through.
To prevent the sedimentation I recommend a big flush with clean water with a bit of vinegar once a week (although not on the communal cleaning day as too much water is used), could be a Saturday task. If blocking occurs anyway, the pipe can be cleaned with the long wire cleaner. For this it has to be disconnected in the toilet and at the corner of the stairs next to Main house.

Screens

The shower screens are being cleaned during the rota task. Although the screen next to urinals is being forgotten and I suppose should be included in weekly cleaning. The kitchen sink screens and the big screen outside are cleaned every day.

Grease Trap

To keep the grease trap operating sediments and scum have to taken out manually. It should be done at least four times a year and adapted to amount of people staying in Sunseed. Consider also the rainy seasons (end of September and beginning of March) because the possible storms would interfere with the grease trap processes. In winter times around four months intervals can be taken while in summer every two months seemed to be needed. Another option is to clean the sludge continuously and do the big cleaning less often. For this release the sludge form the bottom tap into a bucket, every week one barrel on rotation. This sludgy water could be possibly used to water the humanure compost. There are no clear guidelines about disposing or reusing the scum. Surely it shouldn`t be composted in garden heaps, The best option for both scum and sludge could be a small biodigester or a vermicompost.
To clean it close the tap of the incoming water before the grease trap. Open the tap for urine collection into the urine barrel. Collect the scum from the water surface. Open the tap on the bypass pipe lading to the retention tank. Release the rest of the water into buckets by opening the taps at the bottom of each barrel. Put the water into the retention tank. The sludge at the bottom can be drawn

out with a pan made of half canister and stick (it's behind the grease trap). The connecting pipes should be cleaned with cane stick or the long metal wire. After cleaning connect the piping again.
Occasionally the trap overflows. To solve that check the piping with a wire for blockings.

Retention Tank

There is some amount of sludge settling inside the tank as well and I recommend to clean it together with the grease trap just while the trap is filling up. Open the tank and force it to release with pushing the inside bucket down. When empty clean the insides of the bucket of sludge and run the wire through the outlet pipe as far as possible. Clean the inlet pipe with a wire too. Remove the bucket and take out the rest of the water. Clean the bottom like in grease trap. Put the bucket inside again and close the tank.

Vertical Filters

These filters are sensitive and occasionally problems occur. Whenever there is water standing on the surface they should be left to rest for 10 days to recover the aerobic conditions. For this close the tap of the filters' inlet and open the one for a bypass pipe. The taps are above the site hanging on the pomegranate tree.
As a general maintenance the perforated inlet pipe should be cleaned with a long wire. The holes often get clogged with sediments or gypsum so they should be cleaned with small piece of wire or a thin stick. The unblocking is ideally done every week. The surface should be always kept free of organic matter (leaves, pomegranates...). The vegetative cover should be cut down to half a meter in autumn. The site vegetation and trees should be cut down occasionally to keep an easy access.

Horizontal Filters

The general maintenance of the hydroponic beds is just the same as in the vertical ones. The outlet/inlet pipes should be cleaned with a long wire and the holes opened with a small wire. The surface should be cleaned from leaves. This should be also done weekly. The vegetation is going to be harvested by the gardeners as a green manure.