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DEWATS Operation & Maintenance Manual

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Bremen Overseas Research and Development Association

Contents

1. Overview

Decentralized Wastewater Treatment Systems (DEWATS) treat wastewater biologically, without the need for additional energy input. DEWATS is a sustainable wastewater treatment solution, thus contributes to keeping the environment clean and in provision of better health to society. BORDA started designing and implementing DEWATS in 1989 with partners from France, Indian and China. Since then, BORDA, together with its international network implemented more than 3,000 systems worldwide. These systems are easy to operate and maintain. If the tasks related to operation and maintenance are carried out as per guidelines and in time, DEWATS will work efficiently throughout its lifetime.

This manual describes in detail how and when tasks have to be carried out to ensure effective and efficient performance of DEWATS.

The objectives of this manual are to:

• Provide a practical guide to carry out tasks related to operation and maintenance for the upkeep of DEWATS.

• Transfer knowledge about the functioning of DEWATS to operators and users.

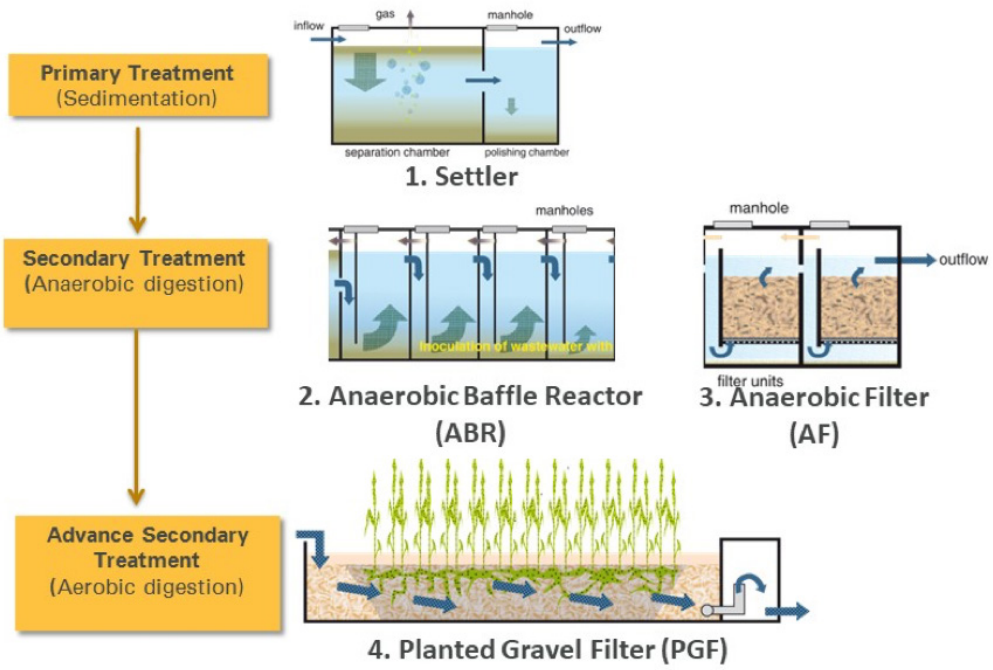
• Ensure long term-functionality of DEWATS.

2. Introduction to Decentralize Wastewater Treatment Systems (DEWATS)

Decentralized Wastewater Treatment System "DEWATS" is an effective, efficient, affordable and proven wastewater treatment solution for Afghanistan. DEWATS is a combination of well-known wastewater treatment modules. The treatment is based on physical and biological (anaerobic, aerobic) wastewater treatment processes.

DEWATS applications are based on the principle of low maintenance since, the most important parts of the system work without energy inputs. They can be provided at affordable costs as, all the materials used for construction are locally available and the area required for construction can be used in different ways, as most of the system is underground and therefore not immediately visible or obstructive. DEWATS consists of primary, secondary and advance secondary treatment units which are combined according to specific requirements depending on the characteristics of wastewater, the desired quality of treated wastewater and site conditions.

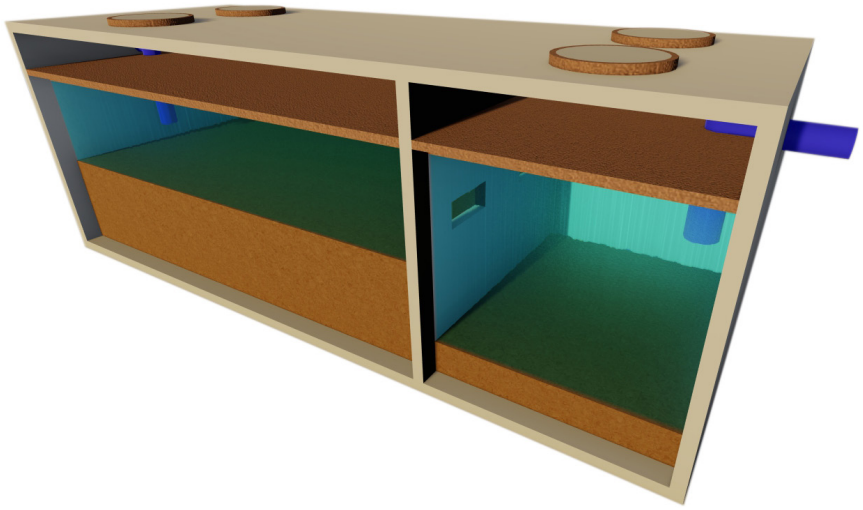
The Combination of DEWATS Modules designed for this project shown in the following diagram.



2.1 Primary Treatment:

1. Settler

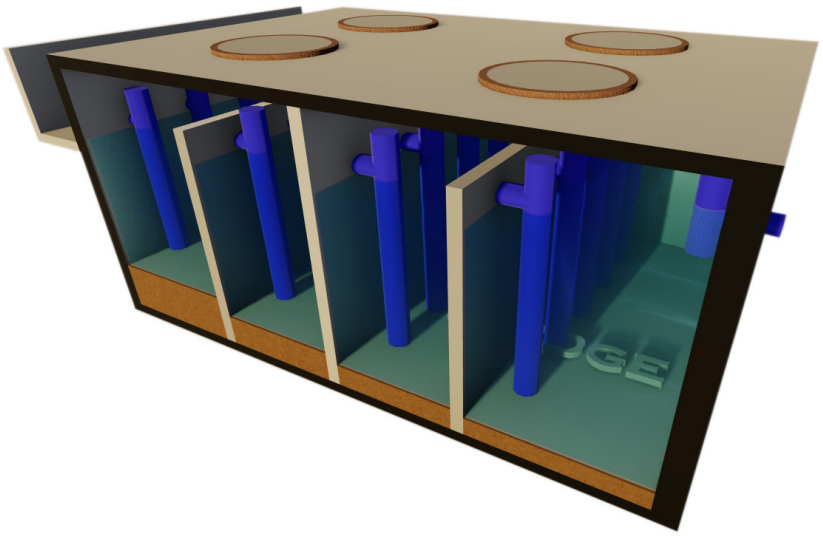
The Settler is the most common, small scale and decentralized treatment module. It is compact, robust and extremely efficient when compared with cost of constructing it. It is basically a sedimentation tank in which settled sludge is stabilized by anaerobic digestion and light materials such as grease and plastic will float on top and will create a scum layer. Dissolved and suspended matter leaves the tank untreated.



2.2 Secondary Treatment:

1. Anaerobic Baffle Reactor (ABR)

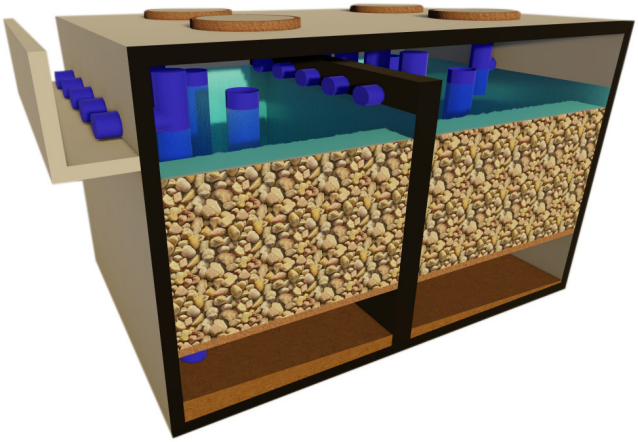
The anaerobic baffled reactor (ABR) is an upflow and anaerobic system. In ABR the anaerobic degradation of suspended and dissolved solids takes place. They are simple, reliable, has high efficiency and can be build underground. Also, the hydraulic and organic shock loads have little effect on treatment efficiency.



2. Anaerobic Filter (AF)

The anaerobic filter (AF) treats non-settle able and dissolved solids by bringing them in close contact with a surplus of active bacterial mass. This surplus together with "hungry" bacteria digests the dispersed or dissolved organic matter within short retention times. Most of the bacteria are immobile. They tend to fix themselves to solid particles or, e.g. at the reactor walls. Filter material, such as gravel, rocks and cinder provide additional surface area for bacteria to settle. Thus, the fresh wastewater is forced to come into contact with active bacteria intensively, the larger the surface for bacterial growth, the quicker the digestion.

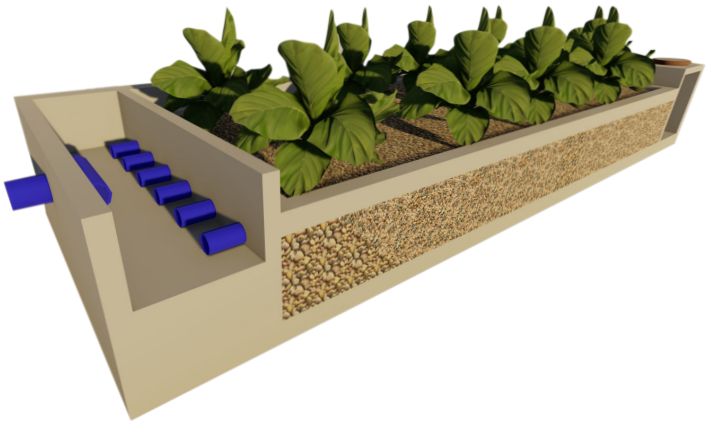
They are also simple, reliable, has high efficiency and can be build underground.



2.3 Third treatment:

1. Planted Gravel Filter (PGF)

A horizontal flow planted gravel filter is a large gravel and sand-filled basin that is planted with wetland vegetation. As wastewater flows horizontally through the basin, the Filter material filters out particles and microorganisms degrade the organics. The filter media acts as a filter for removing solids, a fixed surface upon which bacteria can attach, and a base for the vegetation. Although facultative and anaerobic bacteria degrade most organics, the vegetation transfers a small amount of oxygen to the root zone so that aerobic bacteria can colonize the area and degrade organics as well. The plant roots play an important role in maintaining the permeability of the filter.



3. General Rules and tool for Operation and Maintenance of DEWATS

3.1 General Site Safety

- Do always be careful and observant
- Do ensure manholes are suitably covered or supervised when no operation and maintenance activity is being performed.
- Don't leave open chambers unattended. Always close the manholes if not required.

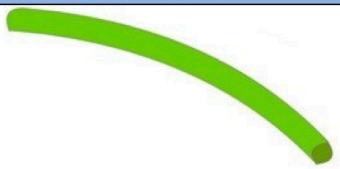
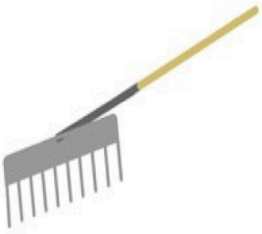
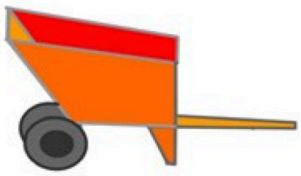
3.2 Personal Safety Precautions

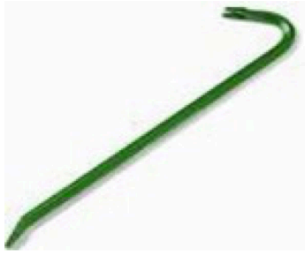
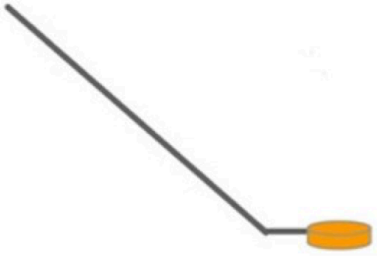
- Wash your hands or disinfect them after working on the DEWATS.
- Wear shoes, gloves, apron and mask while maintaining the DEWATS system.
- Do let the modules get proper aeration for at least 30 minutes before entering them if you have to.
- Do properly protect wounds from getting in contact with wastewater.
- Do avoid coming in contact with the wastewater.
- Don't be barefoot or bare handed while maintaining the DEWATS.





3.3 Operation and Maintenance Tools for DEWATS

Equipment	Picture	Equipment	Picture
Shovel		Hose pipe	
Perforated Shovel		Bucket	
Rake		Wheelbarrow	
Steel wire brush		Sludge level indicator	

Broom Stick		Agriculture sickle	
Crowbar		Transparent glass bottle	
Meter Tool		Wooden Stick	
Torch		First Aid Kit	
Ladder		L-Steel Sieve	

4. O&M activities for DEWATS plant

The O&M Tasks for each treatment module is described in below;

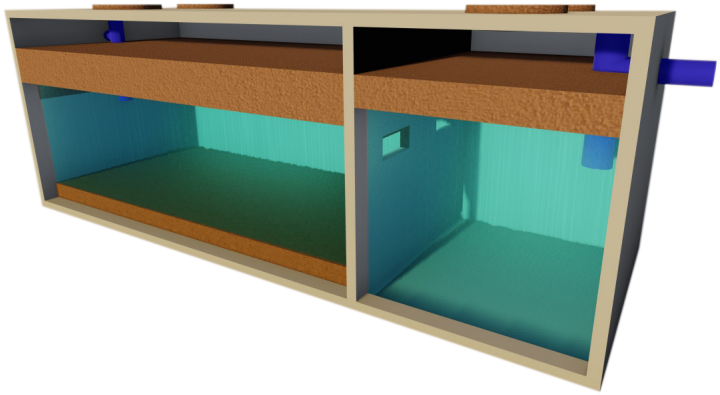
4.1. O&M Activities for Grease Trap

In the most basic terms, a grease trap works by slowing down the flow of warm/hot greasy water and allowing it to cool. As the water cools, the grease and oil in the water separate out and float to the top of the trap. The cooler water - minus the grease - continues to flow down the pipe to the sewer.

Maintenance

Open manhole each 15 days or monthly: Grease or foreign matters like plastic and sand clog the channel into the Grease trap. Remove the grease and foreign matters with a shovel or a proper tool and disposed into a container for disposal.

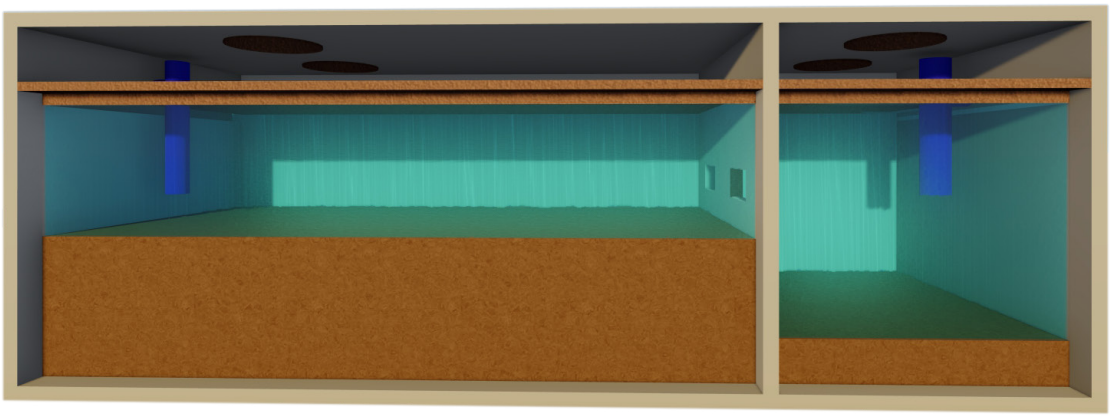
NOTE: Please open the heavy concrete manhole cover or cast-iron manhole covers carefully with the metal hooks.



4.2 O&M Activities for Settler

As mentioned earlier the settler of the first compartment consists of two chambers. First chamber is designed to separate and to remove more large and floatable solids. The chamber fulfills his task and can be considered as an option to typical wastewater screens which require much more operation and maintenance.

1. Open once in a month the manhole of 1st chamber: remove foreign matters/ scum like plastic or debris and poke and stir the floating organic material into the water. Disposed the plastic waste and debris into a proper container.



2. Open once in two months the manholes of the second chamber: Check the scum and remove if required.

3. The process of removing scum from Settler is shown in this diagram

1 2 3 4

4. Once in a year check the sludge level in Settler using a wooden stick

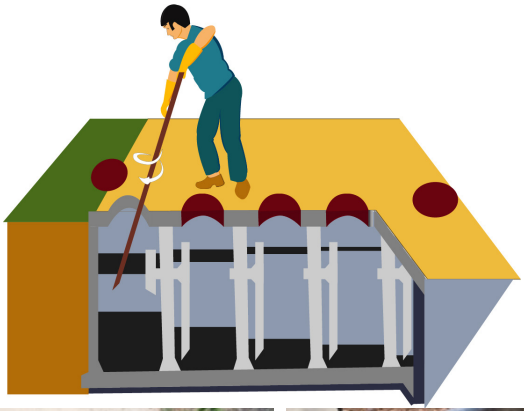
5. If the level of the sludge in the Settler has reach to its maximum, then it is required to fully dislodge the settler. The complete desludging of settler is required once in 2-3 year based on the project design.

4.3. O&M Activities for Anaerobic baffled reactor (ABR) and anaerobic filter (AF)

Is biological treatment system where the solid-free wastewater is passing through active bio-sludge sedimented on the bottom or settled on filter material of the AF. ABR and AF requires very minimum maintenance work.

Maintenance

1. Once in 5-6 months, open the manholes of ABR, stir the scum in each baffle so the heavier particles can sink down, also remove the foreign materials like plastics and any other materials



2. Ensure that all lids are closed properly in order to avoid odor. Also, this prevents from mosquitos breeding in the system

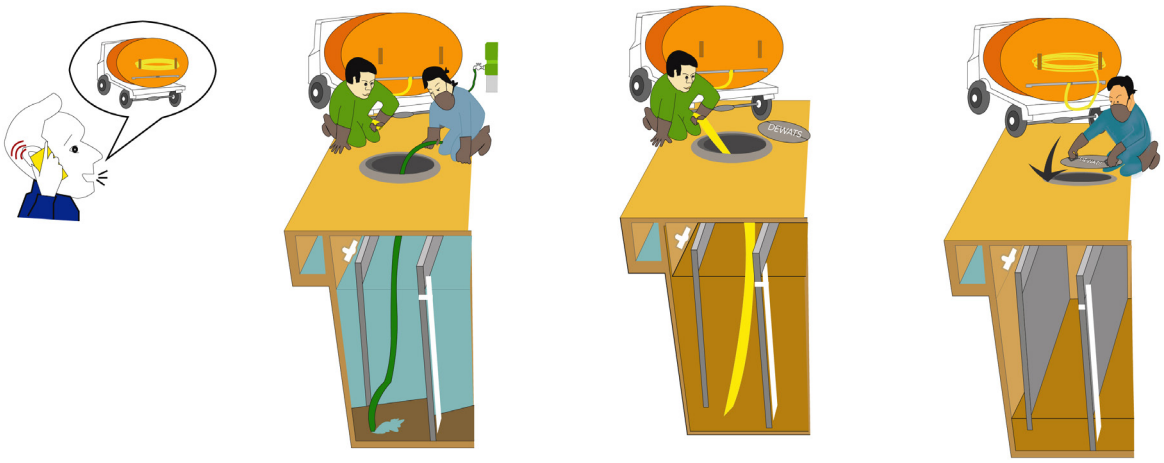
3. Check the sludge level of the last ABR chamber once in 3-4 years by sludge measuring device.

Step 1: Open Manhole Cover

Step 2: Measure the sludge level by sludge measuring device

Step 3: Remove excess (more than 50 cm) sludge from the chambers using the desludging equipment. Leave around 15 cm of sludge in each chamber to ensure continuous treatment of wastewater. Chambers with less sludge inoculated with this sludge using sludge pump with hosepipe placed in the sludge collection tank.

Step 4: Place the manhole cover back over the manhole



1. Cleaning/washing of the filter material in Anerobic Filter system will be required once in 5-6 years

There are two option for cleaning of filter material

Option 1:

i. Pump out all the wastewater from the filter chamber and then fill the chamber with fresh water.

ii. Then place the hose of the pump in the down-flow or desludging pipe. Hold the other end back in the chamber and start the pump for 10 minutes. This will let the water circulate through the filter material and will wash and clean the filter material.

iii. Repeat the step 2.

iv. Do the same with the other chambers of AF.

Option 2:

i. Open the manhole covers of AF chambers

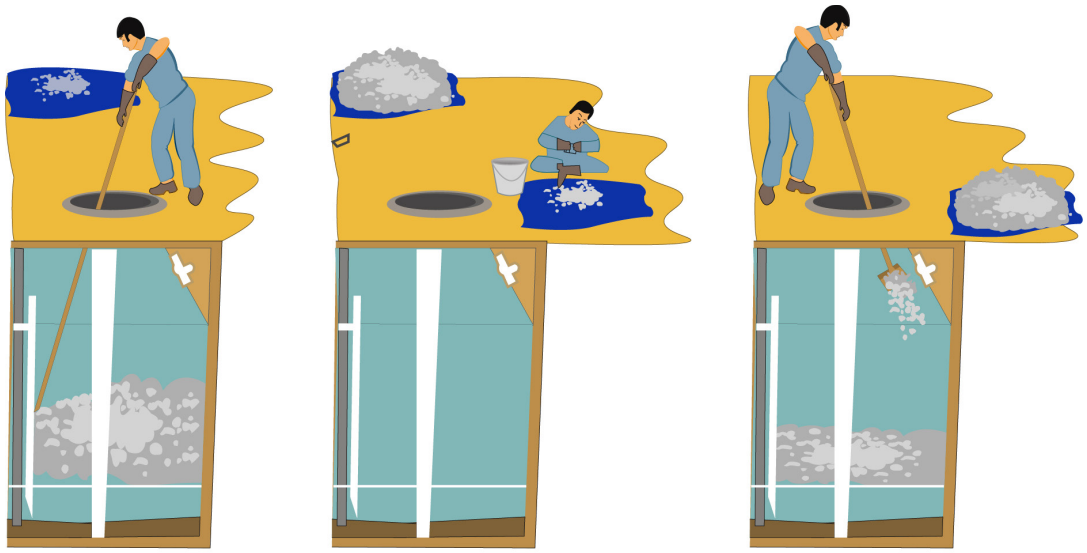
ii. Dislodge all wastewater from the chambers

iii. Remove all the filter material from the chambers

iv. Wash the filter materials

v. Put back the filter materials in the chamber

vi. Place back the manhole covers properly.



1 2 3

4.4. O&M Activities for Planted Gravel Filter (PGF)

Planted gravel filter (PGF) is made of planted filter bodies consisting of graded gravel. The bottom slope is 1% and the flow direction is mainly horizontal. The main plants used in this filter bed are Canas indica, Reed juncus, Papyrus, Phragmites and Arunda donax.

Maintenance

1. Cutting of PGF plants and collecting of Dead Leaves on surface of PGF once in 30 days to avoid clogging of the system and maintain the cleanliness

2. Cleaning washing of PGF Filter Materials will be required once in 6-10 year or when the filter material clogged, to retaliate the design treatment efficiency in the effluent quality and to avoid clogging of wastewater through the treatment system.
The process of cleaning and washing the filter materials of PGF is as follows;

i. Disconnect the wastewater flow to PGF

ii. Remove the plants properly from the PGF

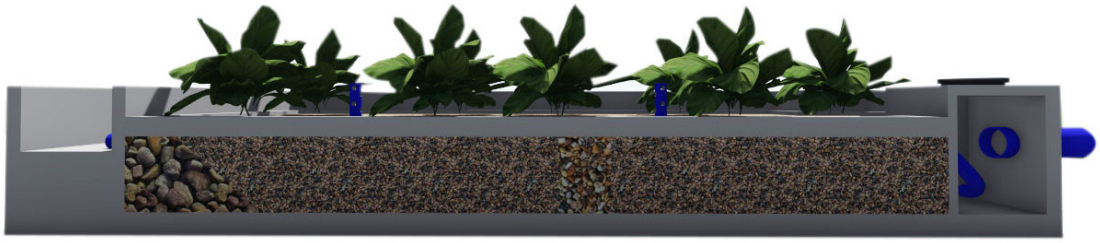
iii. Remove all the filter material from PGF

iv. Wash the filter materials

v. Place back the filter materials in the PGF basin

vi. Place back to plants

vii. Connect the wastewater flow



4.5. O&M activities for Collection Tank and Pump check

Some of the system are having Collection Tank at the end of DEWATS to collect treated wastewater for irrigation or discharging to Drainage.
All pumps get damaged if they run dry or not maintained properly!
Non automatic pumps must be attended manually: switch off the pumps if water level is reduced by 20 cm in the collection tank.

Maintenance

1. Check the submersible pump on weekly basis and see if they are properly working

2. Check power cord and make sure the cord is connected to power

3. Removal of Algae and other floating material from Collection tank

1 2 3 4

5. General Operation and Maintenance performance in DEWATS

i. Check that Manhole covers are suitably covered

ii. Ensure free wastewater flow

The free wastewater flow needs to be checked at least every month! To avoid and identify possible obstructions in pipes and channels, a free flow of wastewater is required for the system to fully function. Damages or leakages can be identified.

Maintenance

a) Open manhole cover of inspection chamber and Inlet and Outlet of all DEWATS modules. Check for obstructions like solid material and deposition at all the points. Check if the wastewater has its usual flow. If required remove obstruction with an appropriate tool (e.g. shovel, stick). Once in 30 days

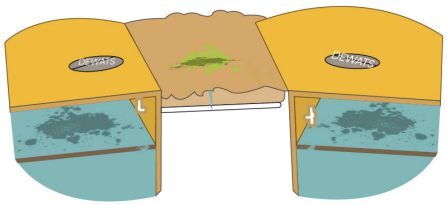
b) Also you can check the flow of wastewater in sewer lines by using of color, open all inspection chamber, mix the color powder with water and flush the water in to the closet and then check the flow in each inspection chamber until DEWATS if you see the color than there is flow if you don't see than there is blockage.

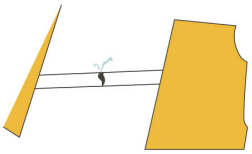
iii. Repair of leaking pipes

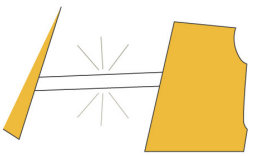
Step 1: Check for leakage of water from pipes. (Dripping dark depositions below pipes, wet spots on the nearby surroundings).

Step 2: If any leakages are found, contact a plumber to fix the leaked pipe.

These steps should be done once in a month to be insure that pipe are not leaked or block.







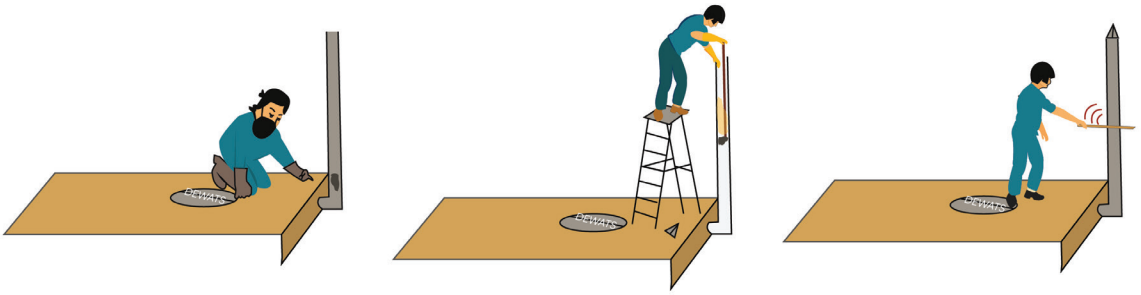
iv. Ensuring the functionality of vent pipe

Step 1: Look for damages on the outside of the vent pipe.

Step 2: Check for blockages in the vent pipe by either looking through it, tapping it with a stick and judging if it is free from the emanating sound or through other suitable methods

Step 3: Remove any blockages found using an L-brush. If you notice any damage, please contact your service provider for replacement.

These steps must do once in a month to avoid bad odour around the system.



6. Common problems and their reason in DEWATS Systems

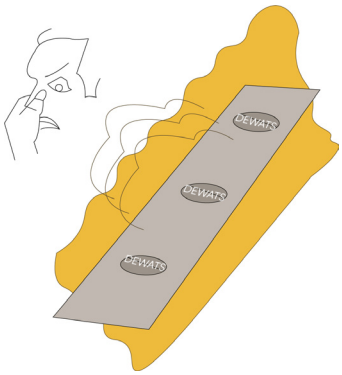
1. Foul Smell

a. Manhole is left open

b. Desludging needs to be done

c. Broken Sewer pipes/vent pipes/blocked pipes

d. Stagnant water (PGF/Percolation Pond)



2. Water stagnant in the PGF

a. Clogging of Filter Materials/Outlet Pipe

b. Position of Swivel Pipe

3. Pour Quality of Treated wastewater

a. Intrusion of Solid Waste

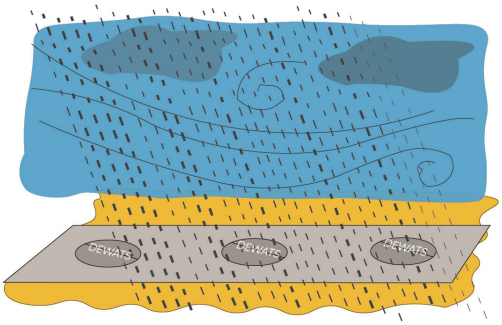
b. Clogging of filter materials in PGF

c. Desludging needs to be done

4. No discharge of wastewater from DEWATS

a. Clogging of Pipes/Filter Materials

b. Leakage in pipes



5. Sludge washout into latter ABR chambers

a. Desludging needs to be done

b. Rainwater intrusion into the DEWATS due to damaged sewer lines

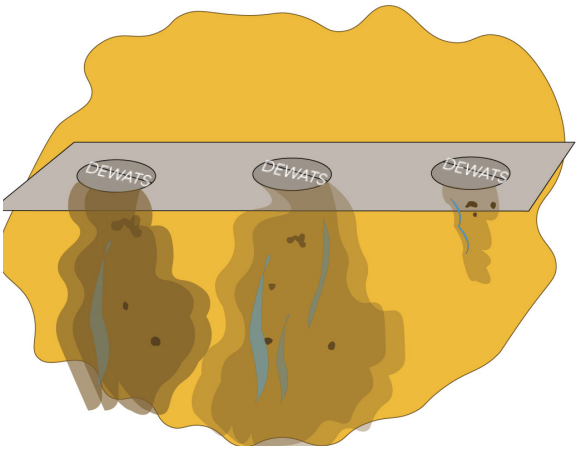
c. Chamber filled with sludge

6. Back flow of wastewater

a. Clogging

7. Mosquitoes

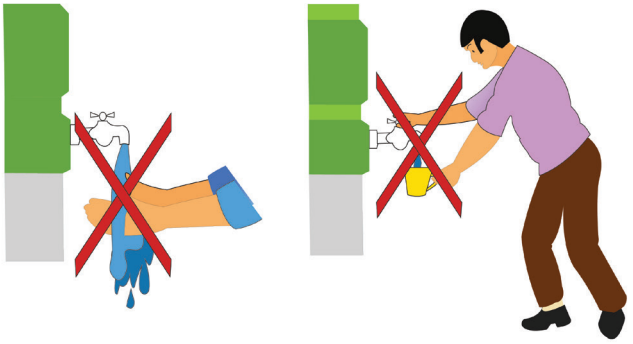
b. Manholes are open



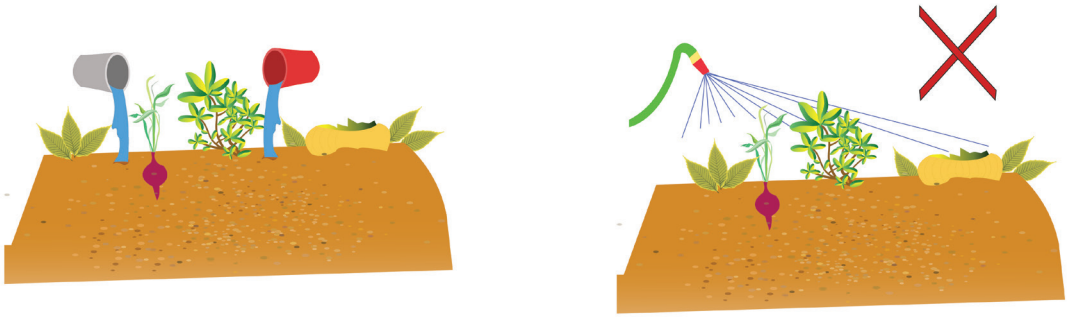
7. Rules for reuse of treated wastewater (recycling water) in food gardens

Use recycled water to save water and to fertilize your crops. Follow the rule below because recycled water is not as clean as tap water. If you use recycled water, as suggested, your profit will be great

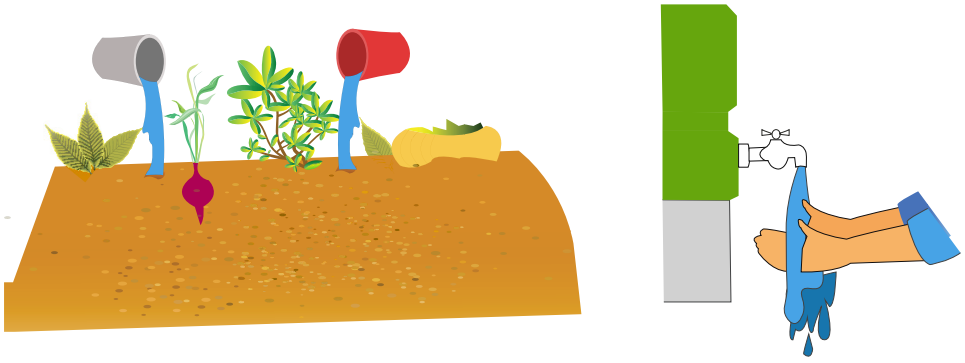
1. Do not drink and not wash your hands with recycling water!



2. Do not pour recycling water over any vegetables. Water always the roots only



3. Wash your hands after irrigating with recycled water



4. Do not tip any oil or chemicals into the toilet or the basin! Everything you tip in the toilet or basin influence the recycled water and the growing of the vegetables.

5. Your system works purely biologically, so NO chemicals, NO plastics or metal, NO sanitary pads, tampon or nappies should be disposed into toilets or any basin. NO colouring toilet liquid put into the toilet cistern. Those stuff might clog or kill the biological process and might harm your crops through watering with the final effluent!

Recycled water is still wastewater and it might still contain germs. If you follow the rules your crops will gain, and you stay healthy.

Bremen Overseas Research and Development Association (BORDA)
www.borda-wesca.org/afghanistan