How to Build a Fast Sand Filter for Irrigation

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How to Use These Instructions

- These instructions were written with the focus of using a plastic 55 gallon (208 L) drum as the container for the fast sand filter. If a different sized container is used, the measurements will need to be adjusted accordingly.
  - However, the height of the base will not change. The base needs to be at least ½ m off the ground so a 5 gallon (19 L) bucket can be placed underneath to collect the filtered greywater.
- Pictures are included as a visual aid for the written specification and details.
- It is suggested you read through the instructions before starting to gain a clear understanding of how all the parts will come together in the end.
How to Use These Instructions

- Be careful with the units and lengths, do not mistakenly use cm when the specification calls for mm.
- The dimensions have been converted from Imperial units to metric units. This may lead to some confusion if that specific part cannot be found locally. For example, a 5 gallon bucket is very common in the US and it converts to 19 L. However, a 5 gallon bucket in America may be known as a 20 L bucket in the country the filter is being deployed in. The point is to not get hung up trying to find a 19 L bucket when 20 L buckets are more common. Building the filter may require a bit of creativity and engineering. For the best results, try to come as close to the specifications mentioned in the instructions.
Fast Sand Filter Capabilities and Information

- The filter will remove sediments from greywater
- The filter does not:
  - Kill Pathogens
  - Reduce Salt Levels
  - Remove Chemicals
- Water is NOT DRINKABLE after filtering
- Prepares water for use in Drip Irrigation System
Required Materials

● Mortar/Masonry sand
● Pebbles or gravel of approximately 6.35-25.4 mm in diameter
● 25.4 mm diameter PVC Pipe
  ○ 100 mm length of PVC pipe
● Wood to build frame
  ○ 38 x 89 mm lumber of length
● Large Barrel - Preferably a 55 gallon (208 L) drum
  ○ A steel barrel would rust over time while plastic will not. This is why plastic is chosen.
● Very fine mesh
● Tube of Silicone
● Drill
  ○ 4.75 mm drill bit or thereabout
  ○ Wood screws
Sample Pictures of Required Materials

The mortar/masonry sand. The reference coin in the picture is 24.26 mm in diameter

25.4 mm diameter PVC pipe
Sample Pictures of Required Materials

Nylon mesh used to separate the sand and pebbles

PVC glue/cement used to keep the pipes joined together
Sample Pictures of Required Materials

Silicone Sealant

55 gallon rain barrel
Cleaning gravel and sand

- Use clean water to clean the different materials.
- This is done by rinsing the materials repeatedly until the water used looks clear.
- Be sure to stir the gravel and sand in the water to loosen all trapped particles.
- This is done to remove an excess dirt and dust off the materials. They could potentially clog the filter.
Constructing the Base

1. Cut 2 pieces of the 38x89 mm wood to a length of 60 cm
2. Cut 6 pieces of the 38x89 mm wood to a length of 56 cm
3. Place the 60 cm pieces parallel to each other
4. Place the 56 cm pieces between the two parallel 60 cm pieces
5. The 56 cm pieces should be spaced evenly (approximately 10 cm apart)
6. Use wood screws to join the 60 cm pieces to the 56 cm pieces

This will create a base for the barrel to sit on
Sketch of the Base
Constructing the Frame

1. Cut 4 pieces of the 38x89 mm wood to a length of 1 m
2. Use wood screws to attach the base to the 1 m pieces at a distance of ½ m from the bottom.
3. Use wood screws to attach L-shaped brackets or blocks of wood in the corner made between the base and the 1 m piece for extra support.

The base should be attached halfway at a distance of ½ m. Place the 1 m pieces at the corners of the base. You may need another person to help hold the base or you could flip the frame on its side. It is suggested that L-shaped brackets or blocks of wood are screwed in under the base for extra support. The filter will be very heavy.
Constructing the Frame Continued

1. Measure the distance from the top corner of the frame to the opposite corner on the bottom of the frame. (The length should be around 116.61 cm)
2. Cut 4 pieces to the measured length (around 116.61 cm)
3. Use wood screws to attach these pieces of wood on the diagonal of the frame. There should be one board per side of the frame (4 sides, 4 boards)
4. Use wood screws to attach the diagonal boards to the base where they intersect (This is very important or else the frame could wobble and break)
Sketches of the Frame
Constructing the Barrel

1. Take the 10 cm long piece of PVC pipe and mark the halfway distance.
2. Drill multiple holes (12+) in only one half of the pipe using the 4.75 mm drill bit.
3. Drill or cut out a hole large enough to fit the 10 cm long PVC pipe in the center of the bottom of the barrel. The hole should be slightly smaller than the diameter of the pipe to ensure a snug fit.
4. Push the PVC pipe through the bottom of the barrel so the end with the holes is on the inside of the barrel and the end without the holes is on the outside.
5. Apply the silicone sealant around the entire pipe both inside and outside of the barrel. This will create a watertight seal so there are no leaks.
6. Let the sealant sit to dry according to its instructions.
7. As the sealant is drying, use a tape measure to make a mark 10 cm and 56 cm from the bottom on the inside of the barrel. Make sure they are large and easy to see.
Sketch of the Barrel

Top

Bottom

Holes on the inside

No holes on the outside

45 cm

10 cm

Sand

Pebbles
Constructing the Filter

1. Place the barrel on top of the base with the PVC pipe fitting through a gap in the base.
2. Pour gravel/pebbles to the 10 cm marking inside the barrel.
3. Cover the gravel in the fine mesh (This mesh is used to separate the layers)
4. Pour sand to the 56 cm marking inside the barrel.

More sand may need to be added when water is added to the sand. You will notice the sand compact. Add more sand to the 56 cm marking inside the barrel.
Sketch of Final Filter
Constructing the Distribution System

1. Cut a piece of the 38x89 mm wood to a length of 1.5 m
2. Cut two pieces of the 38x89 mm wood to a length of 60 cm
3. Use wood screws to join the two 60 cm pieces together at a 90 degree angle. Both pieces should be joined in the middle (halfway) so they resemble an “X”. Place the 1.5 m piece in one of the corners of the “X” and use wood screws to secure. The “X” should be 30 cm from the bottom of the 1.5 m piece.
4. Drill holes in the bottom of the bucket for the drip lines (You will need to measure the diameter of the drip lines and choose the size of the drill bit. It is suggest the holes in the bucket are slightly smaller than the diameter of the hoses for a tighter fit).
5. Apply sealant around the drip lines in the bucket.

6. Use screws to attach the bucket to the 38x89 mm piece of wood.

7. Dig a small hole 30 cm deep to fit the end of the 1.5m piece of wood.

8. Put the wood in the hole and fill in with dirt. Make sure the entire system is stable and will not tip over.

9. Distribute the irrigation lines around the garden.
Sketches of the Distribution System
Operating Instructions

1. Place a clean bucket under the PVC pipe that is sticking out of the bottom of the barrel and through the base. The filtered greywater will drain into this bucket.

2. Take greywater and pour it through a piece of mesh and into another bucket.

3. Take the bucket with the partially filtered greywater and pour it into the top of the barrel. Make sure to evenly distribute the greywater across all of the sand for more thorough filtering.

4. The filtered greywater will drain out of the PVC pipe in the bottom of the barrel and into the bucket.

5. Take the bucket of filtered greywater and distribute to the funnels around the garden for irrigation.
Maintenance

- The top 15 cm or so of sand will need to be changed periodically. Start with 1 month and if the sand looks relatively clean, extend the time period. If the sand does not look clean before 1 month possibly because of especially dirty greywater, change the sand.
- If you notice slower filtering, this might be a sign that the top layer needs to be cleaned.
Potential Modifications

● The height of the barrel can be cut down to a minimum of 0.7+ m for compactness. If you chose to cut off part of the barrel, make sure it is tall enough to hold 10 cm of pebbles, 45 cm of sand, and 7.5-10 cm of greywater on top of the sand.

● For extra stability of the frame, the 1 m long pieces can be cut longer with the excess being buried in the ground or concrete.

● Dirt, gravel, or concrete can be poured around the base of the bucket distribution system for more stabilization
References


