

Water Circulation System

by Dr_DBW

Who hates having powerheads located somewhere in your reef aquarium?
Trying to attach them to the sides of the tank so they point towards the reef structure where the current is required, and then taking up visual space?
Or attempting to hide them behind rocks somewhere around the back but then lose the amount of current the corals feel?
Plus then have a large hassle to remove the pump or maintenance?
Well, here is an idea that might help to minimise all of these problems using external circulation pumps.

Initially when I set up OZ REEF the in tank water circulation consisted dominantly of two Eheim 1060s mounted on top of the tank.
The inlets were Hagen Aquaclear Quickfilter Attachments on the end of PVC piping, while the outlet was vinyl tubing ending in barbed elbows.
The outlets were held to the glass by heater suction cups along the left and right ends of the tank.
And it worked very well, not taking up much visual space, very little space in the tank, and the current was going where it is needed.
But I was not entirely happy with it, especially those heater suction cups which just do not go the distance.
Eventually they would lose their strength, letting go at will and messing up the water movement or blowing the sand around as it drops down.
Cleaning them helped to lengthen their lifetime, but not for all that much longer.
What you are going to see here is what I have updated this to, in what I believe is one of the best ways to circulate water in an aquarium using pumps, solving all of the last major problems.
And so far things are working very well.

This new system follows the same principles of that of the original, but with some very important improvements.
Below is a diagram showing how it works and the arrangement of the various components.
The diagram shows the approximate layout of the left hand circulation pump, and it is repeated for the right hand side.

Water circulation system diagram, the horizontal blue line represents the water surface.

Lets start with the prefilter, which consists of a Hagen Aquaclear Quickfilter Attachment.
These are perfect as a pump prefilter, after the sponge has been removed.
The water flow is distributed over a large area and the slits are narrow enough so that any "large" organisms can't be sucked into the pump, and wide enough so they do not become clogged.
The original prefilters are still in use and over the last 2 years have become heavily encrusted in coralline algae, to no detriment to the flow through it.
They also make the perfect home for vermitid snails, those the live in tubes cemented to the surface and feed via a mucus net.
This is glued to some 25mm PVC piping, the ends of which have to be filed down to fit into the prefilter, but can be quite easily removed if there is a need via a very simply to use twist locking system in the prefilter.
On the end of the pipe is two 45o elbows to change the pipe direction from vertical to horizontal.
Two 45o bends are used as there is less pressure drop across them compared to one 90o and it gives a chance for the piping to avoid the lighting hood that is hanging over the top of the tank.
If it went straight up and out of the tank, then through a 90o elbow the pipe would hit the hood.
Then there is a 90o elbow, something that would have been good to avoid but space is limiting to change the pipes direction in.

The challenge with having external circulation loops like this is the fact that if the lines are full of air then they have to be primed with water before the pumps will operate.
Until now I have done this by linking the outlet from another pump to the outlet of the circulation loop and forcing enough air out to start the pumps operating.

It is not difficult to do in itself, but there is a much easier way to do it and it can be a bit fiddly. Simply place some airtight into the intake side of the pump and use a check valve that only allows air to be withdrawn. All it then entails to prime the pump is to suck the air out of the intake side through the airline until some water starts to come out the airline. Once that is done the pump can be started and air does not return through the pump due to the check valve. And if you are worried about what happens when the power goes off, well nothing happens, both ends of the loop are under water so no air enters and it does not require repriming.

Next a union joint is used to make it very easy to pull apart and ensure that there is no undue stress placed on the pump inlet while aligning and attaching the piping. Then comes the pipe reducer to the pump inlet thread size. Note that both the inlet and outlet sides of the pump were increased to the next size piping to reduce the frictional losses, which will then in turn mean there will be a higher flowrate out of the pump. So the inlet went from 19mm at the pump to 25mm, and the outlet from 13mm to 19mm piping. See the following photograph showing the PVC fittings used on inlet side and the outlet assembly.

Center bottom is the outlet consisting of two male to female 19mm PVC elbows. Across the frame is the inlet to the pump minus the prefilter, with the union joint to the left. Emanating from the 90° elbow is the air line with check valve.

Now the outlet side starts with a 19mm barb to 13mm thread from the pump, aiming directly upwards, with a short length of about 60cm of 19mm vinyl tubing. Vinyl tubing is used so that there is a gradual curve between the pump and the rigid final outlet section, flexibility allowing the outlet pipe to be twisted and raised up and down as required. The outlet line is then converted to 19mm PVC piping, which is now horizontal. To get the piping vertical and down into the tank, two 45° elbows are used, once again to reduce frictional losses. The pipe is now vertical, and the length used allows the pipe to go down to about 2/3rds of the depth of the tank.

The pipe is then held to the tank canopy by a simple clamping bracket. It consists of a horizontal length of wood that has three holes large enough for the 19mm pipe to fit through drilled in it. The reason for the three holes is so that front to back location of the outlet can be adjusted with some degree. A simple clamp then holds the pipe in place so that it does not move or vibrate.

View under the lighting hood of the inlet for two circulation pumps, have changed it so two Eheim 1060s draw through the same inlet.

Top view of the three circulation pumps that are now part of the circulation system, 1 x PM-4200 and 2 x Eheim 1060.

And now for the most important and flexible part of the entire setup, the outlet. This consists of two 90° PVC elbows that are male to female, which means one slips on the end of the piping, then the next one on to the first forming a double joint. If they are not glued into place then it is possible to rotate each through 180°, giving total control over the direction the water flows in.

The outlet consists of two male to female 19mm PVC elbows on the end of 19mm PVC piping. They are not glued on so can be rotated 360° in the vertical and horizontal planes. (note image is slightly distorted due to angle through the glass)

Righthand outlet after several years in the aquarium, covered with vermetid snails and coralline algae.

This is how the outlets are mounted in the tank, right hand side. The vinyl tubing from the pump is up upper left, into the two 45o elbows. The clamp holding the piping in place is 1/3 of the way down from the top of the frame, with two "eyes" that are the bolts used to tighten the clamp. Piping below the water level is showing coralline algae growth, the dark blotches.

And that is all that is to it, very simply.

Pumps do not take up space inside the display tank, heat from the pump is reduced, ease of positioning of the outlet and full directional control over the outlet.

The following is a list of the parts used in this instance roughly in order from the inlet to outlet, note this list is for 2 systems.

2 x Hagen Aquaclear Quickfilter Attachment

These are the prefilters for the pump inlets, sponges removed.

50cm x 25mm PVC Pipe

For the inlet side of the pumps to run between the various fittings from the prefilter to the pump.

4 x 25mm 45o PVC Elbows

For the inlet side of the pumps, used to keep out of the way of the lighting hood and minimise the pressure drop.

2 x 25mm 90 PVC Elbows

For the inlet side of the pumps, to align the piping with the pump inlet.

2 x Airline Joiners

To be glued into the inlet line to allow priming of the pumps.

2 x Air Check Valves

Stop air from being sucked back into the inlet line and through the pump.

50cm x Airline

Long enough so that can be reached easily to prime the pumps.

2 x 25mm PVC Union Joints

Allow easy disconnection of the pumps and reduce stress on the pump inlet lock.

2 x 25mm Slip to 19mm Threaded PVC Joint

Reduce the inlet pipe to the Eheim 1060 pump inlet size.

2 x 13mm Threaded to 19mm Barb

Allow connection of the pumps to vinyl tubing.

1m x 19mm Vinyl Tubing

Run the pump outlet to the outlet PVC pipes.

2 x 19mm Threaded to 19mm Barb

Connect the vinyl tubing to PVC pipe.

2 x 19mm Threaded to Slip Joint

Connect barb to PVC piping

2m x 19mm PVC Piping

To extend the outlet down into the water and connect the other various joints together.

4 x 19mm 45o PVC Joints

Change the angle of the piping to vertical and minimise the amount of pressure drop

4 x 19mm 90o Male to Female Slip Joints

The directing head of the outlet, these are not glued into place but left free so that the outlet direction can be changed with ease.