

Japan Aquaponics DIY Aquaponics Guides

Plumbing Part 1

Plumbing your aquaponics system will require a careful consideration of many different factors and will depend on your own design and situation. Nevertheless we will try to outline several important things to be aware of to help you. Plumbing is an integral part of your aquaponics system and so should be considered right from the very beginning - don't wait until you have the fish tank and the growbeds in place before you start to think about how to actually connect it all together!

Before we talk about how to put the plumbing together we should look at what is most commonly used for the plumbing - and the easy answer to that is PVC Pipe. You will sometimes see debate about whether PVC pipe is safe to use, but there is very little evidence to suggest that it is in anyway harmful - and it has been certified as safe for use in drinking water plumbing, by agencies the world over. Because of this, it is almost universally used for aquaponics as it has several beneficial features:



PVC Pipe is almost universally available
PVC Pipe is usually extremely cost effective (read cheap!)
PVC Pipe comes in standard sizes worldwide
PVC Pipe has a wide range of adapters and connectors available

PVC Pipe is easy to use, cut and adapt
PVC Pipe is durable and long lasting

For the purpose of this guide we will be assuming the use of standard PVC piping in your aquaponics system. It is worth noting that whilst other piping could be used (such as agricultural pipe, flexi-pipe, bamboo, hosepipe etc.), you must make certain that it is safe for use in a system that grows produce for human consumption - and also consider whether it will be toxic for your fish or plants. As an example you should steer clear of metal piping - especially copper piping, as it can be highly toxic to your fish. If in doubt, I would probably not use it, and instead settle for standard PVC pipe.

Plumbing Fluid Dynamics

Just briefly it is worth noting how a fluid actually flows through a pipe - there are a couple of small things to consider that will influence how you plumb your system. The pipe itself provides friction to the smooth movement of the water, and so you actually find that as water flow through the pipe, the water in the very middle of the pipe goes just a little faster than the water that is touching the sides of the pipe. The difference is tiny - but it exists nonetheless. Similarly if you look at the flow rate through a straight length of PVC pipe, and through a pipe with a series of bends - the water flows more quickly through the straight pipe, as you would imagine. There are some complicated equations to work out exact flow rates - but for the purpose of this guide it is enough to just recognise that there will be some factors that will determine the flow rate through your aquaponics plumbing, and which will influence your decision as to what size diameter piping you should use. Simply put, in a given amount of time you can move a greater volume of water through a big pipe than you can

through a small pipe - and this fact can be exploited when you plumb your system.

Another thing to consider is gravity. Gravity (in a simplified explanation) will exert a constant downward pressure on the water in our aquaponics system - so if you are using a pump to move water up, then you need to be aware that gravity will be fighting against that movement. This means that when you are working out how to move the water, and the rate that the water is flowing through your system, you need take into consideration difference in height between the different components of your system - basically, how high do you need to pump the water. We can also use gravity to our advantage and use it to move water around for us with the minimal of mechanical intervention. If we have a fish tank that is higher than a growbed then we can have the water overflow out of the tank and flow down to the growbed - purely by gravity and a well designed system.

So where do we start?

We can start by working out how much water is going to be in our system in total - how many growbeds do you have and what is their volume? What will be the volume of your fish tank and / or sump tank? Put it all together and now you have an idea of the amount of water that needs to be moved around your aquaponics system. As a general rule of thumb you want to move the entire of your fish tank volume each and every hour in order to maintain good water quality for your fish. You also need to work out the 'head' of your system - that is, how high do you need to pump the water? Finally, we need to consider whether you will be running your pump continuously, or whether you will have a timed flood and drain system. All of these factors together will give you an idea of how much water needs to be moved around; how much time we have to move it, and therefore how we need to configure our plumbing.

If we take an example starting point of a 1000 litre fish tank, with 2, 500 litre growbeds positioned above the fish tank. Water will be pumped from the fish tank 50cms up to the growbeds, and will then directly return to the fish tank via the outflow pipes in the growbeds. Assuming that we are running the pump constantly then it needs to be powerful enough to move at least a 1000 litres of water 50cms high in 1 hour. However, if you are planning to run a timed flood and drain system, then you need to allow for the fact that the pump may only be on for 15 minutes every hour. If this is the case the pump needs to still move the entire volume of the fish tank - but it needs to do it in only 15 minutes... and so you will need to use a much more powerful pump to allow for this. In our example above, the pump would need to be able to move at least 4000 litres of water to a height of 50cms in 1 hour.

The pipes need to be big enough to also handle this volume of water and we need to have various controls and safety measures in place just in case there is any problem.

The Pump



The pump is quite literally the beating heart of your aquaponics system and it something that you should not buy cheaply - it is well worth paying for a high quality pump as it will pay you back in the long run. A quality pump will not break, it will not leak any chemicals into your system, and it will often use less electricity than a cheaper, less well designed and manufactured pump. Don't scrimp on this component of your system!

You need to check two things with your pump... its flow rate and its Head pressure. The flow rate tells you how much water the pump can move in litres per minute or per hour. The Head pressure then adjusts this measurement based on how high the water is being pumped. Every pump will have a chart similar to the one here. Check this carefully to see if it is capable of moving the amount of water that you need. It is better to UP-size your pump as you can always adjust the flow if it is too high... but you cannot increase the flow if it is too small. A slightly bigger pump will also allow you to increase the size of your system if you want to expand it at a later date.

The Pipes

There are two types to consider – those delivering water to the growbeds – and those removing it from the growbeds, and as a general rule of thumb the pipes removing water from the growbeds may be larger than those taking the water to them in order to ensure that the beds can drain properly and not overflow, or at least able to adequately handle the volume of water being delivered to the growbeds.

Which size pipe diameter to use will depend on your circumstances but once again, as a general rule you should aim to use a larger diameter than strictly necessary. If you have a 1000 litre aquaponics system then you should probably use 20mm piping as a minimum, and anything up to 40mm or 50mm would be fine. There are a number of engineering type calculators online that can help you work out the ideal pipe diameter to use and we recommend taking a look at one of these in advance. Flow rate also decreases as the length of pipe increases, so if you need to consider this when you work out your flow rates.

Bear in mind that over time debris may build up on the inside of the pipes and this will affect the rate of flow in the pipes. Pipes may need to be cleaned every few months in order to ensure a constant and unimpeded flow of water. The necessity to clean some sections of your plumbing should also influence your decision as to whether you need to glue your pipes together... in our opinion this may not be necessary for most aquaponics systems as the water pressure is not so high, and the piping can be pushed together firmly enough to avoid the need for PVC glue.

Also note that joints, and bends in your plumbing will decrease the flow rate of the water. If you have lots of right angle connections in your design then you will need to confirm the final flow rate once you have laid everything out. Every bend is the equivalent to an additional length of pipe (and consequent reduction in water flow). For

example, in a 20mm diameter pipe a 90-degree elbow fitting is the equivalent of an additional 0.5m of pipe – a 90-degree Tee fitting is the equivalent of an additional 1.4m of pipe. In a large system this may have a significant impact on your overall flow rate.

The Connectors

There are several commonly used types of connectors in aquaponics and we work with both threaded connectors and slip connectors. Threaded connectors are ones that screw into one another and are designated as male and female. Slip connectors as the name suggests, just slip into one another. In order to preserve pipe diameter you will find that most connectors are female, and the male pipe



simply fits directly into it. Examples of connectors are:

- 90° elbows
- 45° elbows
- 90° Tee fittings
- Ball Valves
- Bulkheads
- Reducers
- Couplings

Fitting Pipes through the growbeds



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When we need to put a pipe through a growbed or a fish tank then we will usually use either a Bulkhead fitting, or something like a Uniseal. The bulkhead can either be a purposely-designed adapter or it could be a fairly standard male and female adapter with some rubber washers. Bulkheads come in a very wide variety of sizes and shapes, but can be easily assembled from parts readily available in any homestore. The bulkhead is a good, sturdy option for plumbing through the bottom of the growbed when you are using a standpipe



The uniseals are rubber rings that fit into the holes that have been drilled into the tank. They clamp around the hole making a watertight connection and then the PVC pipe can be slotted into the seal. The seals usually allow the pipe to be installed in only one direction, thus providing a watertight seal between the pipe and the connector. Uniseals are a cheap and easy method of putting a pipe through a tank, and they can also be used with rounded surfaces thus making them particularly useful for plumbing into barrels and other such rounded containers.

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