How To Build A Personal Reverse Osmosis Waterworks

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Introduction

Without pure water carnivorous plants slowly die. This is because their root systems—not used to mineral-rich water—wither away. Since I mist my orchids daily, water them on the weekend, and top off my carnivorous plant trays as necessary, I use about 95 liters (25 gallons) of water per week. There are different ways to get pure water for your plants. You can buy it from the store, have it delivered, or process tapwater in your home by distillation or Reverse Osmosis (RO). For my rate of water consumption, it made sense to construct a home system.

Distillation is the only way to get 100% pure water, but a good quality RO system with pre-filters gets pretty close (certainly close enough for carnivorous plant cultivation!). Distillers have drawbacks and advantages. A distiller requires gas or electricity to boil and then cool its water. Furthermore, the solutes (dissolved solids) cake the inside of the boiling chamber and must be cleaned out periodically. On the other hand, it wastes very little water.

RO systems also have their bad and good sides. A typical RO system can waste up to 3/4 of the water put through it, dumping it overboard, and occasionally needs to have its filters replaced. On the beneficial side, they operate solely on tap water pressure, and needs no gas or electrical power. They are also less expensive. I decided to purchase an RO system, instead of a distiller, when I found one on sale for only US$169. It came with three pre-filters (one sediment and two carbon), a 68 liter/day (18 gallon/day) RO membrane, an eleven-liter (three-gallon) pressurized storage tank, a carbon post-filter, and a spigot. This unit takes about 2-1/4 hours to fill the storage tank.

RO System Components

Osmosis is the tendency for water to cross a selectively permeable membrane, exiting a less concentrated solution of impurities and entering a more concentrated solution. In Reverse Osmosis filtration this flow direction is reversed. Water is forced under pressure towards the membrane. The small water molecules pass through the membrane to a lower pressure zone. The larger impurity molecules cannot pass through the membrane. The pressure on the output side of the membrane is much less than the pressure on the input side. (If you already have a home RO system for drinking water, you know the flow is much less than from the regular tap.)

The water purified by the system is routed into one of two types of storage tanks—either a pressurized storage tank or an unpressurized (also known as "atmospheric") storage tank. A pressurized storage tank holds the water in a balloon-like sack inside a metal tank which has been pre-pressurized with compressed air. When you turn on the tap, the balloon (which is being squeezed by the compressed air trapped in the tank with it) expels its contents through the tap. To send water from an atmospheric storage tank to a tap, you need a kind of "booster pump" called a "demand pump." Only the most expensive demand pumps approach the water delivery rate you get from a normal household tap.

While convenient, pressurized storage tanks can be wasteful of water. This is because as you get closer to filling the tank its pressure rises. As a result, fewer and fewer molecules will cross the RO membrane, and instead are expelled as wastewater. This increases the amount of water wasted. It is better if you can dump the water purified by the RO system into an atmospheric tank. You could use the wastewater on plants that are insensitive to (or thrive on) concentrated minerals. A good RO system should shut off automatically when the storage tank is full to minimize wasting water.

RO systems are equipped with prefilters: charcoal for chlorine, and mechanical for bacteria. The RO membrane can be damaged by chlorine, so this filter must not be removed if your water is chlorinated. Since these filters are not perfect, there will always be some bacteria in the water purified by the system. Without chlorine present, the bacteria can explode in population, especially in an unsealed, easily contaminated atmospheric tank. As a result, water in atmospheric tanks may not be suitable for drinking. To deal with this issue, some expensive RO systems run the purified water through an ultraviolet sterilizer.

A Custom-Built RO System

I built a system that dumps the output of the RO system into a 150 liter (40 gallon) atmospheric tank then uses an inexpensive, low-flow booster pump to move it into a 140 liter (36 gallon) pressurized tank.

Tapwater purified by the RO system is deposited into an atmospheric storage tank. Wastewater from the RO system exits into a second atmospheric storage tank where it is used to water plants which are not bothered by mineralized water. The pump draws RO water from the atmospheric storage tank and pumps it into the pressure tank.

As water is drawn from the pressure tank, the booster pump turns on to replenish it from the atmospheric tank. Because the flow rate of the booster pump is very low, only the volume of water in the pressure tank can be used before waiting for the tank to recharge. You must size the pressure tank larger than the volume of water you intend to use at one time and the atmospheric tank should be larger than this so that the pump does not run dry. Note that a pressurized tank holds about one third water and two thirds air; thus a 140-liter pressurized tank holds less than 57 liters of water.

If you would like to see detailed building instructions on how to construct a home RO system, as I did, contact me.

Some other useful web sites are:
http://www.softwater.com/faq.html (Water quality and purification systems)
http://www.premierh2o.com/ (RO Systems)
http://rosystems.com/ (RO Systems)
http://www.wellmate.com/catalog/eseries.html (Pressure Tanks)

(Editor's Note: The casual plant grower may also consider renting an RO unit. High quality units can be rented inexpensively, and as Ron describes in his article, the output can be directed into pressurized or atmospheric tank—BAMR)