# Water Treatment

**Many killifish species live in very pure water. That is it contains few minerals. As a result, they are adapted to this water. With mineral laden water such as found in a lake, or water obtained from a well in a limestone substrate, the "hardness" is greatly increased due to dissolving the surrounding minerals and concentrating the mineral content by evaporation. Most Aphyosemions and many of the South American annuals will survive nicely in hard water, but may not be able to fertilize eggs. It is my understanding that the egg membrane quickly hardens once the egg enters the water and the sperm cannot penetrate the hardened membrane. This is probably much simplified, but for water treatment purposes is close enough.**
**There are three methods of removing minerals from water. Distillation, mixed bed ion exchange, and reverse osmosis (RO). A home water softener does not remove minerals. It replaces calcium ions with sodium ions. Same for the little water softening "pillows" sold in aquarium shops. I will not say these are of no use, however when I used them they did not help much. Distilled water is not cheap, but is available commercially. This is *Distilled*, not bottled spring or drinking water. To distill water it must be converted to steam and then the steam condensed. Costs $ to boil water! Usually distilled water sells for about a dollar a gallon.**
**This leaves us with two alternatives; mixed bed ion exchange columns, or a reverse osmosis unit. A mixed bed is a once thru system. It cannot be recharged easily in the home. The two resins must be separated and rinsed; One in hydrochloric acid and the other in caustic soda for regeneration. A mixed bed column can be purchased at many local aquarium shops and is not a bad deal if you wish to treat a small amount of water. A new column costs around $20. It will treat about 100 gal of water depending on the mineral concentration of the water. If you have only a few small aquariums you wish to soften water for, this may be the most cost effective way to go. All the water entering the unit is demineralized and no water is wasted. Additionally, if you have low water pressure (less than about 50 psi) the alternative RO unit may require a pump to boost pressure to function with decent efficiency.**

**Reverse Osmosis Unit**

**For a larger supply of water (assuming sufficient water pressure that the purchase of a pump ($175) is not required), a reverse osmosis unit is probably more cost effective. A RO unit capable of producing between 20 and 80 gallons of demineralized water every 24 hours costs about $120. This includes a "three stage"**

**unit. The first two stages are a sediment filter and a charcoal filter. These prevent clogging and destruction of the RO membrane, which is the third stage. Units come with a garden hose fitting on the inlet and two 1/8 inch nylon tubes on the outlet. One tube is the water passing through the membrane; the second is from in front of the membrane and servs to prevent build up of minerals and sediment on the inlet side of the RO membrane. This "constant flush" is about 4 to 5 times the demineralized water volume exiting the other nylon tube. The water is of excellent quality on both sides of the membrane since it has all passed through the filter and carbon filter. The "flush" water has about 20% higher mineral content than the water supply line. This waste water is fine for most uses, including aquarium water for other tropical fish not requiring extremely soft water.**

**It is not possible to easily "re introduce" this water to the house water supply since it is at a much lower pressure than the house water supply (it went through the filters resulting in a pressure drop)and a high pressure pump would be needed.**

**Now, about that $120. There are a few accessories that, although not essential, are very desirable and worth the money.**

**First, it would be nice to shut off the RO water before the RO reservoir overflows. (As a low cost reservoir, a 30 gal Rubbermaid garbage can serves the purpose quite well.) A small float valve (available from RO unit dealers at a cost of about $15) can be used to shut off the supply to the Rubbermaid garbage can. This does not shut off the rinse water though, but if sent to a drain, at least will not flood the fish room. An alternative at a cost of $80 is an electronic shut off that will turn off the entrance water supply when the reservoir is filled. More cost up front, but it can be a water bill savings if you are forgetful like me.**

**Another nicety is for the RO unit to come with clear filter canisters. Nice, but a better solution is a small pressure gage (about $15) to monitor the pressure on the RO membrane. As the pressure drops due to need for a filter change, flow through the RO membrane decreases. Simply changing filters when you think it is time can be costly as the sediment filter plus the carbon block filter costs about $30 to replace.**

**There is no problem replacing them, but just buying the new cartridges can run up the cost if done needlessly. Again just put out the $15 and be happy you did. This is actually cheaper than see thru cartridge holders and more useful. A visual check can tell you the sediment cartridge is picking up dirt, but cannot tell you if it is really slowing the flow like a pressure gage. Some manufacturers offer a four stage RO unit. The 4$^{th}$ stage is a mixed resin bed ion exchange column. Nice for laboratory use, but in my opinion a complete waste of money for most aquarium use. Some prefer such a unit for raising salt water species, but for killies it is a waste of money.**

**A small test meter to determine the conductivity of the RO water is most useful. There are meters calibrated in microseimens (one microseimens is one micro MHO, which is the inverse of resistance in micro ohms). Other meters are calibrated in parts per million Total Dissolved Solids (TDS). Both measure the resistance of the water to electrical current. Pure water is not a good conductor; it is the dissolved minerals in the form of ions that carry the current. Thus a measure of the resistance of the water can provide a measure of the mineral content. A standard is**

**used to set the calibration of the meter if extremely accurate results are desired. For aquarium measurements, the setting on the as received meter is more than adequate.**

**The RO water is far too pure for fish. They do need a mineral content to buffer the aquarium water. With no mineral content massive pH swings are not prevented (no mineral buffering present) due to waste buildup. In the wild, water of near 1 ppm mineral content can be the habitat of many of our killifish. The pH does not swing since the water is constantly being changed (killi means stream, remember) and there is no buildup of waste products.**

**To put some mineral content back into the RO water to bring the TDS up to a reasonable value (most killies do fine at 40 to 150 ppm depending on species) you can re-mix some of the waste water into the RO reservoir or, like I do, buy some chemical buffer like "RO Right", a Kent product. I have no affiliation with them, but I have found the RO systems offered by Spetrapure and Kent to be competitive in price and reliable. A search for Spectrapure on the web will provide a website with additional information on RO unit function, supplies and ordering information.**

**I once tried to raise killifish when I had only well water and rain water collected from my rain gutter from the roof. Most species did not do well. Now with a reverse osmosis unit, even difficult species like Diapteron do just fine. If you are raising killies and get mostly white (infertile) eggs, an RO unit may be the answer.**