# A Philosophical Overview of Water Quality Test Kits

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I have been avoiding writing this because I couldn't figure out how to phrase it without it sounding like I was endorsing one particular manufacturer over another. So, let me start out by saying that of all the test kits I have used, I haven't found a single one that did not properly measure whatever it is supposed to measure within acceptable limits. There are some I personally find more convenient to use and some easier to obtain and some that cost less than others. I have run across inaccurate test kits that various pond keepers have. This is usually because they bought them in 1987 and seems to have developed some sentimental attachment to them. Would you keep and use a prescription medicine considerably past its expiration date? Date your test kits when you purchase them even though you may not know how long they have been on the dealer's shelf. Few manufacturers date their test kits with an apparent expiration date (Aquarium Pharmaceuticals being a pleasant exception), although most have some sort of batch number coding. As a general rule I recommend that test kits using sealed individual test packets should be discarded and replaced after two years. Other types should be replaced after one year. There are exceptions. Most total alkalinity and pH test reagent lifetimes can be doubled over those guidelines. Any test kit that has been left out in the hot sun for a day or two may be ready for immediate replacement.

Which type of test kit is best? There isn't an exact answer to that question as it depends on what it is being used for. Someone who is making multiple daily tests might select a different type of kit than someone who is just doing routine monthly testing. For the average pond keeper, I recommend the Aquarium Pharmaceuticals Dry Tab Master Pond Test Kit. This kit contains twenty tests each of wide range pH, ammonia (salicylate), nitrite, and nitrate. Note that if our average pond keeper is running a full set of tests each month, he would be ready for refills after 20 months, about two years. A test kit that will run a hundred tests isn't necessarily a good buy if you only run 12 tests in a year and then should replace the test kit.

How accurate do we need a particular test kit to be? Actually, not very. We are usually more concerned about the presence or absence of something or a general range than the actual quantitative reading (within limits). We would like the readings to be repeatable; i.e. running two successive tests should give essentially the same results. Do we really need to know whether the pH is 7.80 or 7.82 and does that tell us anything? We are probably more interested in knowing if it is approximately 7.0, 7.5, or 8.0 for general pond maintenance.

This brings us to the electronic probe test devices. Like a calculator with a ten-digit readout, the resulting readings may be misleading as to their actual accuracy. An electronic pH meter is only as accurate as the calibration and should usually be calibrated before each daily use. Then, how accurate are the calibration solutions? The shelf life of the calibration solutions is the same or often less than other test kit reagents. We also have the hassle of cleaning the probe periodically with an appropriate cleaner solution and storing it in a proper storage solution.

The electronic salinity meter is a great device as its accuracy depends primarily on the physical construction (and sometimes battery condition). But with it, one must realize that it is not actually measuring the amount of salt in the water but the conductivity of the water and then assuming that all the conductivity is due to salt. This can be misleading, particularly at very low readings where other components in the water may be providing a significant portion of the conductivity. Of course, we probably aren't concerned whether a 0.05 ppt reading is really 0.03 ppt salt and 0.02 ppt other stuff.

Several ion specific electronic test kits are available as well as those that use colorimeters to determine the readings. These are quite expensive and definitely overkill for our needs. They are some neat toys to play with. The colorimeters can be useful to someone who is colorblind.

The dissolved oxygen electronic test is also a bit temperamental about contamination of a thin membrane that is part of the probe and can be easily contaminated with the organics in our ponds. If properly maintained and frequently calibrated, they can provide accurate readings. Built in calibration of most of these units rely on the amount of oxygen in the air (about 20%). One quick check we can make is to drop an airstone and a thermometer into a clean container of distilled water. Let it aerate heavily for a while, then remove the airstone and run the DO test. Result should be right at saturation for that temperature (adjust appropriately if not at sea level).

The quick check of ammonia, nitrite, nitrate, chlorine, chloramine, and total alkalinity tests can be made on distilled water to ensure they show a proper zero reading. (Remember that this doesn't apply to a pH or DO test.) This doesn't necessary mean they will show a proper reading when there really is something there for them to measure.

Now, about using our test kits. Remember we are usually trying to measure the concentration of something in the parts per million range and we are, with most test kits, using a 5 milliliter sample. One part per million in our 5 ml sample is just 0.000005 grams. Not much more than a speck of dust. If your equipment is not clean, your test results are suspect. Did you remove the dry tab tablet from its pouch with your fingers? Did you try to save some time by mixing the reagents with the test sample by holding your finger over the end of the test tube instead of properly capping it?

A pond keeper friend was having problems with his new cement pond. The pH was extremely high although he had dutifully acid cured it prior to startup. I went over and ran a test and found the pH to be about 7.5. He ran his set of tests again and when he got to the pH, it was over 9.0. No, his test kit was not a problem; it was how he was running the test that was the problem. He first ran the ammonia test and then using the same vial, poured out the ammonia test sample, refilled the vial with pond water, and ran the pH test. The first thing that almost all the ammonia tests do is add a strong base to the test sample (often sodium hydroxide) to raise the pH very high and make sure all the ammonia is in the deionized form. The residual from the ammonia test caused the subsequent pH test to be in error.

I try and keep the test vials separate and to use the same vial for the same type test each time. In addition, I rinse the vial (and cap) with the water being tested three times before taking the sample. (Do not pour the rinse water or the tested solution back in the pond!) Every so often it is time to clean the vials thoroughly. Glass ones can be run through the dishwasher or any of them can be hand washed in warm water with a little dishwashing detergent and perhaps a small bottlebrush. Then we have to make sure we get rid of any residual detergent with a good set of rinses and perhaps a final rinse or two with distilled water.

When doing the comparisons between what color a test developed and the reference standard colors, it is important to compare the hue, not the intensity. I prefer using a test kit where the standard colors are looked at through a semi-transparent medium rather than being printed on a piece of paper. That way both the light through the sample and the light through the color standard are the same.

Some tests may give inaccurate readings depending on what else is in the water. The classic example of this is the Nessler reagent ammonia test when an ammonia binder is in the water. The Nessler reagents react with the aldehyde from the ammonia binder and you may end up with a color that doesn't resemble anything on the color chart. At low levels of the ammonia

binder, the results can appear to be a positive ammonia reading even though there is actually no measurable ammonia in the test sample (bound or otherwise). Many dissolved oxygen liquid tests use a sodium thiosulphate standard solution as the final titrating reagent. If the water sample has some residual "de-chlor" in it, the results will be in error.

I am not going to give you a shopping list and tell you to go out and buy these particular test kits. I will discuss the test kits I use and don't use, and in some cases why, but that does not mean you should necessarily go out and duplicate what I have. Other types or brands may be more convenient for you to use, less expensive, or easier to obtain. I do not use test strips, as I don't like the small area that must be compared with the color chart and I have experienced shelf life problems with some of them. Some pond keepers really like them. I do not like the "pillow" packets of reagents as I have difficulty opening them and often spill more than I get into the test vial. However, those manufactured by Hach (same ones as sold by Kordon) are very accurate and high quality test kits.

The KHA should probably have a couple more tests available than the average pond keeper. As such, would recommend their kit has all of those listed below except Iron, Phosphate, and hardness.

**pH** - Around my pond and on pond visits, I use the LaMotte 2120 wide range pH test kit. I like the "octal" comparator that is used instead of a color chart printed on a piece of paper. I also have Oakton (relatively low cost) pH meters that I use at koi shows where I may be making many readings during a day. (along with pH standards of 7.0 and 10.0 to calibrate them, and probe cleaner and storage solutions to keep them working) These units are also waterproof and float which has been of particular benefit a few times.

**Ammonia** - LaMotte 3304 all liquid, salicylate. I also have the LaMotte 4795 Nessler kit but don't use it very often. I also sometimes use the Aquarium Pharmaceuticals dry tab salicylate test on pond visits but not at a koi show where I am running lots of tests.

**Nitrite** - Aquarium Pharmaceuticals dry tab. I have a La Motte 7421 nitrite test kit but don't use it unless I am looking for extremely accurate results during controlled experiments as it is a bit awkward to use in comparison to the dry tabs. Aquarium Pharmaceuticals also markets an excellent liquid reagent nitrite test kit.

**Nitrate** - Aquarium Pharmaceuticals dry tab. Also have the La Motte 3110 but same applies as for the nitrite kit.

**Temperature** - a fast reacting photography thermometer is great for multiple readings. For a specific pond, a spa thermometer floating in the filter, or one of the Radio Shack indoor/outdoor electronic thermometers are nice to have if protected from the elements. Do not use one of the small glass floating aquarium thermometers, koi have been known to swallow them.

**Total Alkalinity** - LaMotte 4491 This is a very accurate titration type test that I just enjoy using.

**Salinity** - Koi Medic electronic meter (accurate and very fast). La Motte 7459 with a modified test procedure to cover the ranges we most often are dealing with (very accurate). Aquarium Pharmaceuticals salinity test kit. Inexpensive and accurate but a bit awkward to use. Also the

range is not quite the range we normally are concerned with so to save reagents and time, usually better to dilute the test sample 50:50 with distilled water and then multiply the results by two. A hydrometer based test is not appropriate for the ranges we are concerned with. They are acceptable for marine (salt water) aquariums but just don't provide the accuracy we need for the lower amounts of salt. This also applies to the very expensive reflectometers although they can do the measurement fairly well.

**Dissolved Oxygen** - PinPoint DO electronic meter. Relatively inexpensive but calibration tends to drift off fairly quickly. LaMotte 7414, a high grade laboratory type test but uses sodium thiosulphate as final titration agent. Tetra used to, and may still, offer a DO test kit that did not use the sodium thiosulphate. Unfortunately, the color change was from a light pink at around 4 ppm to a slightly darker pink to indicate10 ppm. I was never able to accurately use the subtle color change it provided.

**Chlorine / Chloramine** - LaMotte 6817, actually the LaMotte 680 Chlorine test with the 6817 refill (to save a few $$). The DPD-2 tablets that come with the model 680 show total chlorine (unbound and bound, i.e. chloramine). The DPD-1 and DPD-3 tablets from the model 6817 refill kit show unbound and bound chlorine respectively using the same color chart as the model 680. The DPD-1 and DPD-2 tests are also good for detecting any residual ozone levels if that is of interest.

**Copper** - I am using a Mydor copper test kit since it is inexpensive. Would prefer having the LaMotte 6616 which costs considerably more but since I don't run copper tests very often, purchasing a refill kit each year would end up at a very high cost on a per test basis.

**Iron** - I have a LaMotte 7787 but I don't think any of us need an iron test kit unless we are doing some specific experimentation. Iron precipitates out of aerated water fairly quickly and unless the test is run immediately after adding water (probably from a well) to the pond, it will always read zero anyway.

**Phosphate** - I once had a LaMotte phosphate kit that I used during some green water experiments but never got a reading with it from any pond. It did show the minute amounts that I added into the experimental containers. Like the iron test kit, I don't think we need one of these.

**Hardness** - I do have an old hardness test kit (sentimental attachment I guess) but never use it as I haven't figured out what useful information hardness provides. The hardness test was developed to help determine how much soap one should use in commercial laundries. Since I don't add soap to my pond, hardness is not of much importance to me. There appears to be some confusion between hardness and total alkalinity. They are often related but it is the total alkalinity test that provides the information we need.