San Francisco Bay Area Koi Club
September 2009 Volume 15 Issue 9

"News From Around The Pond"

"Pond"er This!

Five plants are the most common plants in water gardening and fish love them:

1. Azolla (Azolla Caroliniana)
2. Common Duckweed (Lemna Minor)
3. Anacharis (Elodea)
4. Water llyacinth (Eichhomia Crassipes)
5. Water Cress (Nasturtium Officinale)

(paraphrased from the article "Beneficial Water Plants" By David Sorenson. One of hundreds of articles available to registered members of the AKCA at: http://www.akca.org/joomla/index.php . All subscribers to Koi USA are eligible to register!)

If undeliverable please return to:
Bill Edwards
686 Canterbury Place
Milpitas, Ca 95035

HTTP://WWW.SFBAKC.ORG

Inside this issue:

Meeting Schedule

Please join us at the next get-together on 26 September, 2009 at:

The home of
Harley Carothers
17473 Via Susana
San Lorenzo, Ca 94580

(See directions on page 7)

Board meeting Starts at 11:00 AM

Social hour starts at 12:00 Noon - Please bring munchies & finger food!

General meeting 1 PM

Topic of speaker: Winter care

Note:
Meetings are always the 4th Saturday of every month - unless otherwise changed by prior notification (rare).

The SFBAKC is a non-profit EDUCATIONAL club for koi enthusiasts. Anyone who requires help or advice should feel free to request it from our membership.

We encourage anyone interested in koi or currently involved with koi to become a member.

Guests are always welcome to come and check us out at our monthly general meetings.

The KHA is cadre of highly trained Koi club members who have graduated from the KHA Academy. They are trained in all aspects of Koi keeping, including pond building, water quality, koi health and disease prevention. If you need help you can download a questionnaire from our website.
Your answers will help them evaluate the situation.

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President's Corner

(ed. There is no message from Rich this month. Instead there is a very informative article about chloramines and ammonia that Rich has submitted. Enjoy!)

"Living with Chlorine, Chloramine and Ammonia in Your Tap Water."

By R. Little

Introduction

A recent string on an online forum raised a common misconception about chloramines and effective dechlorination products.
Several off the shelf products state they contain the only dechlorination ingredient that will remove chloramines.
That's a true statement, but what does it mean?
There is confusion, throughout the hobby, relating to the impact of the ammonia component of chloramine once released from the chlorine molecule.

CHLORINE

<u>Measurement:</u>

Chlorine (Cl), measured in ppm, is a gas, which has been added to tap water to control harmful bacteria. City provided tap water is normally found to have 0.5 - 3.0 ppm but higher surges are sometimes observed. Some city water supplies can still be found that either do not require chlorination or may have the chlorine removed before the water is distributed. This would not be of concern to those who take their tap water directly from a private well. Droplet and pill test kits are available. Recommended test kit range 0 - 4 ppm. *Acceptable concentration 0.*

<u>Effects:</u>

Chlorine is a quick killer in fairly low concentrations (less than 0.5 ppm). Even in very small concentrations, it burns the edges of the gills. It also can be deadly to the bio-converter bacteria.

<u>Treatment:</u>

In an open container, water will release about 1/4 of the chlorine concentration per day to the air. Water that has set in an open container for a week or just for a couple days if aerated is normally safe to use or better yet, pretreat tap water with one of the commercial chemical products. Follow the manufacturer's directions (Or make your own dechlorinator).

(continued on page 4)

Treasurer's Report

September 2009
Submitted by Greg Bequette

Beginning balance, August 1, 2009			**$5,252.01**
Income			
Dues			$72.50
Sale of inventory			54.96
Total Income			$127.46
Expenses			
Koi USA collections less payments	$20.00	-$60.00	-$40.00
Newsletter expenses for past several months			-$300.46
Purchase of two books			-$278.75
Koi Fair profit sharing payment			-$315.83
Total Expenses			-$935.04
Ending balance, August 31, 2009			**$4,444.43**

Just a reminder - Our August, 2009 meeting was our annual picnic. It was a big success!

(Living With Chlorine … continued from page 3)

Homemade Chlorine Neutralizer

Make a solution consisting of 4 ounces (1/4 lb) Sodium Thiosulfate crystals (technical grade) dissolved in 1 gallon of distilled or de-mineralized water. Use 5 ml (1 teaspoon) of the solution for each 10 gallons of makeup water to neutralize up to 3.75 ppm chlorine. One cup can be used for each 500 gallons. (The entire one gallon of solution will treat about 7500 gallons of tap water.) This will serve to neutralize the chlorine in chloramines in the same way.

The shelf life of the solution is about six months when stored in a cool, dark location. The crystals will keep for several years if kept dry.

When pretreating replacement water, the dosage is for the quantity of water being replaced, not the total pond capacity!

Although it would be better to treat all tap water being added, small amounts of replacement water without dechlorination treatment are often added without noticeable effects to the fish. It is recommended that any time water is added, it be treated. Do not use chlorinated tap water to clean your bio converter (filter) media unless you are actually trying to sterilize it. Water from the pond is a much better choice for this task.

Use timer with injection

CHLORAMINE

Why Chloramination?

Let's begin with a brief discussion of chlorine, chloramines and their purpose in tap water. Chlorine has been used as a disinfectant for decades. (continued on page 5)

(Living With Chlorine … continued from page 4)

Through its use, the water most of us drink is relatively free of disease and many lives are saved each year because of it. The EPA monitored it's effectiveness over the years and found that the residual components of chlorine oxidation produce unhealthy by-products. They decided the illness created by Trihalomethane (TH M) levels were unacceptable and have directed water producers to reduce the level of chlorine in drinking water.

Local municipalities have been mandated by the Environmental Protection Agency (EPA) to eliminate or reduce Trihalomethanes from public water supplies to 0.1ppm, or 100 parts per billion. The EPA set a new MCL of .05 ppm. Chloramination will reduce the chlorine levels needed and therefore lower possibility of future occurrences of Trihalomethanes.

What are Trihalomethanes?

THMs are volatile organic chemicals (VOC) which are produced when chlorine interacts with organic material in the water (dead leaves, sediment, etc.) Various THMs have been classified by the EPA as either probable or possible human carcinogens, and have been associated with bladder and rectal cancer.

Standards

Chloramines are regulated to 4ppm but most water districts aim for an average of 1 – 2ppm but may show up in heavier doses in the same way chlorine did.

That's not high enough to deal with bacteria in many old systems with minute cracks and scale deposits so water companies often send a heavy slug of straight chlorine down the line to deal with those colonies. It usually happens in the middle of the night and is cleared early in the morning.

Another time chlorine is used in a large dose is with newly installed lines and facilities to clean up new installations. These doses are lethal and normally neutralized before the system goes into service but can be released without warning.

Functioning

Chloramine is a compound of chlorine and ammonia that is added to tap water to control bacteria. It can also be formed by adding water containing free chlorine to a pond containing ammonia. If any ammonia is present in a pond, be sure and treat it before adding any tap water containing chlorine as they bind easily and the chlorine you expected to evaporate will actually be around much longer. To determine if chloramine is in your tap water, fill a 5 gallon bucket with tap water, add the proper amount of chlorine neutralizer, and then test the water for ammonia using your ammonia test kit.

Chloramine is present if a positive indication of ammonia is found. Chloramine is difficult to measure quantitatively in low concentrations, and particularly when a combination of chlorine and chloramine is present.

Acceptable concentration 0

Chloramine does not decrease concentration nearly as fast as chlorine when exposed to air. It produces the same general effects as chlorine but is usually found in concentrations that won't dissipate by oxidizing organics (gills) as readily as chlorine. Chloramine can cross the gills to enter the bloodstream. It binds to iron in red blood cell hemoglobin, causing reduced cell capacity to carry oxygen resulting in long term damage to the fish rather than the gill damage and obvious harm caused by chlorine alone. The same treatment actions as for chlorine apply except that the ammonia remains after neutralization. A "healthy" bio-converter will take care of the ammonia or a chemical treatment may be used. Some commercial products incorporate treatment to both neutralize the chlorine and bind the ammonia components at the same time. Check the manufacturer's directions.

Chlorimine or chlorine can be removed by:

- Chemical agents (for chlorine) and Biological filter (for ammonia)
- Chemical agents that remove both ammonia and chlorine
- high quality activated carbon filtration and reverse osmosis remove chloramine, but are expensive and must be closely monitored to ensure their effectiveness.

Water districts often use a combination of chlorine and chloramine so a reading of total chlorine won't necessarily show the amount of chloramine and therefore the amount of ammonia may be less.

Since chlorine is a volatile gas, it readily evaporates out of solutions and the levels necessary to assure proper sterilization at the extremities of providers lines would be so low as to provide an opportunity for bacterial colonies to flourish. Chloramines reduce the tendency to off gas as long as the chlorine was bound to another molecule. Ammonia was selected to modify the off gassing as long as the chlorine was bound to it.

How Does Chlorine and Chloramines Kill Bacteria?

Chlorine does its job of killing bacteria by bonding with and oxidizing organic compounds in the water in a free radical process. Oxidation can occur with the proteins and organic matter inside and outside our bodies as well, and has been associated with cell damage and reduced cell vitality by many nutritionists. Chloramination will actually reduce the amount of chlorine needed in distribution lines, however little is known about the long term health effects of chloramines. Chloramines are less potent than chlorine, but do their job of killing bacteria by breaking down or rupturing cell walls.

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(Living With Chlorine … continued from page 5)

Because chloramines in high doses have been found to cause blood damage and liver damage in laboratory animals at 50ppm, the EPA has capped the allowable usage of chloramines at 4 ppm. Most municipal water districts will stay below that, adding about 1-2 ppm with a maximum of 2 ppm. Chloramine content will diminish slightly as it travels further from the source.

I'm going to use Sodium Thiosulphate as the chlorine removal agent. Sodium thiosulphate ($Na_2S_2O_3$) is a reducing agent that reacts with Oxidizing agents, specifically, hypochlorous acid (Hock). I won't bore you with the chemical reaction.

The end interaction/reaction of sodium thiosulphate with chloramine in water leaves ammonia. As you know, the sodium thiosulphate/chlorine/chloramine interaction is instantaneous. In addition, the dosing rates of sodium thiosulphate recommended to COMPLETELY remove all chlorine in the water is 7.4mg of sodium thiosulphate for each 1.0 mg of chlorine Therefore, whatever the amount of TOTAL RESIDUAL CHLORINE is in the water will require the recommended amount of sodium thiosulphate to completely remove the chlorine. The end-product from the sodium thiosulphate/chlorine reaction leaves ammonia.

How does one measure Total Residual Chlorine (TRC)? There are at least eight different methods to measure TRC. The method I use is the DPD colorimetric method. Most portable test kits one can purchase use this method. Again I won't bore you with the process, but most importantly, when one decides to measure chlorine – once the sample is taken – the test must be performed immediately. Chlorine in a solution is quite unstable and agitation and/or measurement in strong light will accelerate the reduction of chlorine and give a false reading.

Another factor is the amount of a water change one is doing. The reason this is important is because of the ammonia by product of the chlorine/sodium thiosulphate chemical reaction. There are some that suggest the use of sodium thiosulphate can increase the ammonia levels to unacceptable levels. This is not true. Let's assume that the way Chlorine is being added to the pond is via a water source, which contains CL2 in some form (a municipal water source). For this exercise lets assume one is changing 20% of the water in the pond and the water contains 1PPM of Chloramines. 1 PPM chloramine neutralized with sodium thiosulphate becomes 0.2 (20% water exchange) times 17/51.5 (molecular weight of ammonia divided by molecular weight chloramine) = 0.06 PPM total ammonia produced as the end-product of the chemical reaction. . This level is quite low and most test kits will not even measure this level. Most test kits measure at the lowest level 0.25 PPM. Now if your filtration system and water quality is resulting in water with high levels of ammonia, even then the use of sodium thiosulphate is quite insignificant. However, be aware that levels of ammonia, in a total ammonia reading, recommended as a maximum for long term exposure to chlorine is 0.002 PPM – so keeping the ammonia level down is quite important. As we shall see later, the level of harmful ammonia is a portion of the total ammonia and is determined by pH and, to a lesser extent temperature.

The bottom line – whatever the TRC level is – that is the amount of sodium thiosulphate I'd use to completely remove all of the chlorine. By the way, sodium thiosulphate can be in water at up to 100 times the required dosage without harm to koi – although I would never recommend this.

Thoughts from a simple koi keeper…

Thom……

Ammonia

The ammonia in chloramines can be bound chemically when the chlorine is being removed or can be left to be converted by the bio-filter. This is where a lot of misinformation is centered.

As mentioned earlier, the chloramine removal folks state that their product contains the only chemical capable of removing chloramine. What they don't say is there are other chemicals that will make the chloramines just as ineffective. They just don't happen to remove the ammonia portion and allow the bio-filter to remove it.

I left the water hose on in my pond recently, by accident of course. 4 hours of chlormine tap water (Our water utility reports 2-5.5ppm chlormines reported, 3.3ppm chlormines max system average). Our Ammonia only only tested at .25pmm after what should have amounted to a 50% water change. I use ST and Chloram-x after that if water temps are low or high (bio weak) or if it's an abnormally larger change.

There is no Material Safety Data Sheet (MSDS) for chloramine. Customers can obtain MSDS for the components (hypochlorite/chlorine and ammonia) from their water utility. SFPUC currently adds about 2.3 mg/L of chlorine and 0.5 mg/L of ammonia to produce our target chloramine residual of 2.3 mg/L. To put the MSDS information in its proper context, the maximum levels for these chemicals in our system will likely not exceed 4 mg/L for chorine and 1 mg/L for ammonia.

The concentration of chlorine at delivery is about 13% or 163,000 mg/L, and for ammonia is about 19.0% or 176,000 mg/L.

Legend:
mg/L Milligram per liter; 1 in 1,000,000
ppb Parts per billion, 1 in 1,000,000,000
ppm Parts per million; 1 in 1,000,000
ppt Parts per trillion; 1 in 1,000,000,000,000
mg/L Milligram per liter; 1 in 1,000,000 = 2.3

There is some literature that suggests that the use of sodium thiosulphate can increase the ammonia levels

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Driving Directions to Harley Carothers' home at:
17473 VIA SUSANA
SAN LORENZO
94580
650-738-1935

For brevity, take whatever route necessary to get to I-880 (N or S).

From the *South* (South Bay) of I-580/I-238 in San Lorenzo -

- Take I-880N,
- Take exit #29/A STREET/SAN LORENZO - go 0.20.3 mi,
- Turn Left on W A ST - go 0.60.9 mi,
- Turn Right on HESPERIAN BLVD - go 0.50.8 mi,
- Turn Left on BOCKMAN RD - go 0.50.9 mi,
- Turn Left on VIA ALAMITOS
- Turn Right on VIA HONDA
- Turn Left on VIA ESTRELLA - go 0.10.2 mi
- Turn Right on VIA CORALLA - go < 0.10.2 mi
- Turn Left on VIA SAN ARDO - go 0.20.3 mi
- Turn Right on VIA BUENA VIS - go 0.20.3 mi
- Turn Left on VIA SUSANA - go 0.10.2 mi
- Arrive at 17473 VIA SUSANA, SAN LORENZO, on the Right

From the *North* (North Bay), Get SOUTH of I-238 in San Lorenzo -

- Take I-880S
- Take the LEWELLING BLVD/SAN LORENZO exit - go 0.20.2 mi
- Turn Right on LEWELLING BLVD - go 0.30.5 mi
- Turn Left on WASHINGTON AVE - go 0.50.8 mi
- Continue on VIA ALAMITOS - go 0.50.8 mi
- Turn Right on VIA MANZANAS - go 0.30.5 mi
- Turn Left on CHANNEL ST
- Turn Right on BANDONI AVE - go 0.10.2 mi
- Turn Left on VIA MELINA - go 0.20.3 mi
- Turn Left on VIA MESA - go < 0.10.2 mi
- Turn Right on VIA SUSANA - go 0.20.4 mi
- Arrive at 17473 VIA SUSANA, SAN LORENZO, on the Right

The Mission Statement of the SFBAKC -

"The San Francisco Bay Area Koi Club wants people to do it right the first time, helping to create a dream instead of a nightmare"

To encourage, promote, and educate others in the art of keeping Koi and building ponds through quality guidance and care for show, breeding, aesthetics, sales, or just for pleasure.

To build a "Koi keeping" network among the members.

Projects:

Sponsor Koi shows and pond tours.
Study and research all areas of Nishikigoi, including
pond and water garden design, construction, development, and support.

Encourage and promote the development and presentation of show Koi.

(Living With Chlorine … continued from page 6)

to unacceptable levels. This is not true. I'll illustrate. Let's assume that the way Chlorine is being added to the pond is via a water source, which contains CL2 in some form (a municipal water source). For this exercise lets assume one is changing 20% of the water in the pond and the water contains 1PPM of Chloramines. 1 PPM chloramine neutralized with sodium thiosulphate becomes 0.2 (20% water exchange) times 17/51.5 (molecular weight of ammonia divided by molecular weight chloramine) = 0.06 PPM of ammonia produced as the end-product of the chemical reaction. . This level is quite low and most test kits will not even measure this level. Most test kits measure at the lowest level 0.25 PPM. Now if your filtration system and water quality is resulting in water with high levels of ammonia, even then the use of sodium thiosulphate is quite insignificant. However, be aware that levels of ammonia recommended as a maximum for long term exposure to chlorine is 0.002 PPM – so keeping the ammonia level down is quite important.

That doesn't mean the ammonia level is entirely safe for koi. At conditions of high pH and high temperature it can become a health problem even at low ammonia levels.

Ammonia exists in two forms: as toxic ammonia (NH3, un-ionized), and as the nontoxic ammonium ion (MH4+, ionized). At any given time, the amount of each form is primarily dependent on pH and, to a lesser extent, temperature. The NH3 rises and the ammonia becomes more toxic at higher ph levels and temperatures.

Un-ionized ammonia (NH_3) begins to be a problem at 0.002ppm. The amount of ionization is determined by Ph and temperature. That's why the test kits we use have differing acceptable levels for differing pH & temperatures.

pH refers to the power of hydrogen and is a measure of the amount of hydrogen ions present in your system. The pH scale runs from 0.0 to 14.0. A pH of 7 indicates there are as many hydroxide ions (OH-) as there are hydrogen ions (H+) Values less than 7 are termed acidic, 7 is neutral and values greater than 7 are called basic.

As a side note, high ammonia readings at low pH levels (A crashed bio..) can be very harmful if a buffer is added to raise the pH without first binding the ammonia or changing the water to dilute the ammonia to safe levels first. Particularly since the bio nitrifying bacteria is probably killed off and unable to sustain a nitrogen cycle.

At a 3ppm chloramine level the 0.18ppm total ammonia will have 0.068 ppm un-ionized ammonia at 9pH, many times the 0.002ppm considered safe so water changes can be a concern unless the ammonia is bound. A similar temperature with a pH of 8.4 will have a level of 0.024pppm and a pH of 7.5 will contain less than 0.002ppm NH3, a safe level to do a 100% water change.

There are different approaches to dealing with the ammonia. At low pH (mid 7s) don't worry. At higher levels, deal with the ammonia using binding agents or do partial water changes. The above example of a pH of 8.4, a 10% water change will have no impact at all while a pond with a pH of 9 won't tolerate a chloramine level of 3ppm. If your tap water chloramine level is lower, the ammonia levels will also be lower and therefore proportionally safer.

A friend out here filled his new 3500 gallon pond and used ST to de-chlorinate. He was left with 0.25ppm ammonia. His pH was in the high 7s so the ammonia wasn't even harmful from his tap.

0.03% ammonia is no more stressful than feeding koi.

Roddy Conrad *The Koiphen Chemist*	*Join Date: May 2004* *Location: Charleston, WV, USA* *Posts: 1,818*

Ammonia readings interpretation

There seems to be a strong culture in the koi hobby that any detectable reading on an ammonia test kit is big trouble for a koi pond. I see many folks do a lot of water exchanges and pay big money for lots of ammonia binder because of detectable ammonia readings.

We sometimes need to remember to balance detectable ammonia readings on a test kit with other possibilities. Most ammonia test kits will measure positive ammonia when an ammonia binder is present, since the ammonia binder itself reads as ammonia on the test kit.

Then there are all those OTHER things that may be in the water which read as ammonia. Let me give you an example of a set of phone calls this morning from a friend who was worried about ammonia readings in the 0.5 ppm to 1 ppm range for several weeks. These readings were on an 8000 gallon koi pond with a light load and ultra good biofiltration design, and which had all summer to reach biofilter maturity. KH was over 200 ppm, GH was at 180 ppm, no detectable nitrite, largest available Sacramento bead filter, large shower filter, turnover of the pond through the filters every 30 minutes. So what was the issue? An ammonia binder had been added a few weeks ago, one possibility was the ammonia binder was giving the reading, so some of the ammonia binder was put in the

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(Living With Chlorine … continued from page 8)

source water, and the same ammonia reading as the pond resulted. Then the source water was tested by itself, same 1 ppm ammonia reading as the source water. This is from source water from a well that is 300 feet deep with the nearest neighbor a half mile away, and the location is many miles from any town or industry. Then the ponder tested the big fishing lake a half mile away, same 1 ppm ammonia reading as the source water and both his ponds.

Conclusion: Something in the local source water reads as ammonia on the test kit. If it was actually ammonia, the biofilter would have converted it!

My own test kit lists the following chemicals to give positive ammonia readings:

- Iron
- Sulfide
- Any alcohol (methanol, ethanol, isopropyl alcohol, etc)
- Any ketone (acetone, ketone based solvents)
-Any amine - ammonia, chloramine, aliphatic amines, aromatic amines
- Glycine

The ponder friend and I concluded if the large fishing lake, stocked with all kinds of fish for the last 40 years, has the same 1 ppm ammonia measurement, whatever it is must not be very harmful to koi and just forget it, there is no ammonia despite the 1 ppm reading.

On that general note, a friend of mine started a koi pond last summer (2005) with a new bead filter on a 5000 gallon koi pond with a medium koi load. The ammonia reading was in the 4 to 6 ppm range, and REAL, for about two months. No koi got sick, no koi died, none got ulcers, etc. No ammonia binder was used.

One of the government aquatic toxicity web sites has a 1993 reference where fingerling carp were kept at 4 ppm ammonia for 31 days then all their body functions were compared to controls in water without ammonia. No detectable differences were found, the carp fingerlings were doing fine after 31 days in the 4 ppm ammonia levels.

So if you have a low level ammonia reading, here is my advice:

First, make sure it is actually ammonia by the kind of troubleshooting my friend and did with his readings this morning.

Second, if the readings are real, and the pond is less than two month old, maybe the best thing to do is to wait another few weeks to see if it goes away.

Third, if it doesn't go away, then spend your time and energy working on improving your biofiltration rather than wasting your time and energy on water exchanges and ammonia binders.

If the ammonia reading is above 2 ppm, is real, and stays at that level for a week or more, I agree an ammonia binder is a good investment while you decide how to improve biofiltration.

Unfortunately, EPA has mandated, in addition to chloramine, which many older municipalities must add enough alkalis or base chemicals to their system to bring pH up to around 8 or 9 to retard etching of lead and copper from older pipes. This is mostly a problem in areas with naturally occurring soft, acid water, and depends a lot on what they use. If it truly raises alkalinity, it buffers, and makes for a problem with chloramine as we shall see.

Between the "all dead the same day" incidents and the relatively harmless situation lays a nebulous continuum of conditions that can be aggravated by the burst of ammonia without killing everyone off. Symptoms can be vague and often delayed for some time.

Baby fish get clubbing of the finer gill filaments and become permanently stunted. Adult fish are temporarily, and sometimes permanently, sterilized. Respiration can become labored as the gills are seared. General health can be reduced, making diseases more common. [Ammonia exposure is a known precursor of most bacterial gill diseases.] None are easy to spot, but these are all things we do *not* want to do to our fish.

OK. One may well ask how much of the total ammonium/ammonia is in the damaging un-ionized ammonia form? The equilibrium between ammonium and ammonia changes smoothly between almost no ammonia well below pH=7 to quite a lot at 8 and a whole lot at 9 (if we are concerned with only 0.006ppm).

For example, at those three pH levels and at 20C, the percent of the combination as ammonia is only 0.5% at pH=7, but rises to almost ten times that, 4.7%, at pH=8. It is 35.8% at pH=9 or over 70 times as much as at 7! (See ammonia toxicity chart)

Essentially, more available hydrogens (H+) mean more NH_4^+ ions and less un-ionized NH_3. Makes some sense. Since the number of available hydrogens drops 10X for each pH point of increase, we might expect the equilibrium to somewhat follow that pattern, and it does pretty much that.

Since we already know that 0.006ppm of ammonia is measurably harmful, we want to stay well below that level. That means that the *total* measured ammonium/ammonia, per your test kit, must be well below 0.128ppm to be safe at pH=8 and 20C. Unfortunately, that level of combined ammoniums isn't even detectable on most test kits, but can harm your fish, anyway. Babies could be permanently damaged but older fish only temporarily stressed.

At pH of 7, it would take a reading of 1.2ppm to reach that same ammonia level (0.5% of 1.2ppm= 0.006ppm). That, BTW, isn't very far from what some domestic-water chloramine doses release when treated with sodium thiosulfate.

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(Living With Chlorine … continued from page 9)

The situation gets even worse at higher temperatures as the ionization constant of water drops and the dissociation constant of ammonium increases. It is further made worse by poor oxygenation and other factors that can combine with ammonia to increase damage. The damage is sometimes recoverable in older fish, but often permanent in small babies (where we are more likely to do 100% changes, too).

A test kit with the correct active agent for ammonia can be helpful for monitoring. Two basic kits are available, and should be selectively used:
- Nessler reagent. This kit will give a faster reading, but will also give a false reading if ammonia binders have been used.
- Salicylate reagent. This kit provides a correct reading when ammonia binders have been used.

The following graph allows the free ammonia to be evaluated. Care should be taken when feeding and when changing very large amounts of water if the pH is above 8 particularly during the summer.

Table of Free Ammonia for Total Ammonia of 1 ppm

Temperature		PH > > >														
		Table of Free Ammonia for Total Ammonia of 1 ppm														
C	F	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.2
10.0	50	0.000	0.001	0.001	0.002	0.003	0.005	0.007	0.012	0.018	0.029	0.045	0.069	0.105	0.157	0.228
11.1	52	0.001	0.001	0.001	0.002	0.003	0.005	0.008	0.013	0.020	0.031	0.049	0.075	0.114	0.169	0.243
12.2	54	0.001	0.001	0.001	0.002	0.003	0.006	0.009	0.014	0.022	0.034	0.053	0.081	0.123	0.181	0.260
13.3	56	0.001	0.001	0.002	0.002	0.004	0.006	0.010	0.015	0.024	0.037	0.057	0.088	0.132	0.194	0.276
14.4	58	0.001	0.001	0.002	0.003	0.004	0.007	0.010	0.016	0.026	0.040	0.062	0.095	0.142	0.208	0.294
15.6	60	0.001	0.001	0.002	0.003	0.005	0.007	0.011	0.018	0.028	0.043	0.067	0.102	0.153	0.222	0.311
16.7	62	0.001	0.001	0.002	0.003	0.005	0.008	0.012	0.019	0.030	0.047	0.072	0.110	0.164	0.237	0.330
17.8	64	0.001	0.001	0.002	0.003	0.005	0.008	0.013	0.021	0.033	0.051	0.078	0.118	0.175	0.252	0.348
18.9	66	0.001	0.001	0.002	0.004	0.006	0.009	0.014	0.023	0.035	0.055	0.084	0.127	0.188	0.268	0.367
20.0	68	0.001	0.002	0.002	0.004	0.006	0.010	0.016	0.024	0.038	0.059	0.091	0.136	0.200	0.284	0.386
21.1	70	0.001	0.002	0.003	0.004	0.007	0.011	0.017	0.026	0.041	0.064	0.098	0.146	0.214	0.301	0.406
22.2	72	0.001	0.002	0.003	0.005	0.007	0.012	0.018	0.029	0.045	0.069	0.105	0.157	0.227	0.318	0.425
23.3	74	0.001	0.002	0.003	0.005	0.008	0.013	0.020	0.031	0.048	0.074	0.113	0.167	0.242	0.336	0.445
24.4	76	0.001	0.002	0.003	0.005	0.009	0.014	0.021	0.033	0.052	0.080	0.121	0.179	0.256	0.353	0.464
25.6	78	0.001	0.002	0.004	0.006	0.009	0.015	0.023	0.036	0.056	0.086	0.129	0.191	0.272	0.372	0.484
26.7	80	0.002	0.003	0.004	0.006	0.010	0.016	0.025	0.039	0.060	0.092	0.138	0.203	0.287	0.390	0.503
27.8	82	0.002	0.003	0.004	0.007	0.011	0.017	0.027	0.042	0.065	0.099	0.148	0.216	0.304	0.409	0.523
28.9	84	0.002	0.003	0.005	0.007	0.012	0.018	0.029	0.045	0.069	0.106	0.158	0.229	0.320	0.427	0.542
30.0	86	0.002	0.003	0.005	0.008	0.013	0.020	0.031	0.048	0.075	0.113	0.168	0.243	0.337	0.446	0.561
31.1	88	0.002	0.003	0.005	0.009	0.014	0.021	0.033	0.052	0.080	0.121	0.179	0.257	0.354	0.465	0.579
32.2	90	0.002	0.004	0.006	0.009	0.015	0.023	0.036	0.056	0.086	0.129	0.190	0.272	0.371	0.484	0.597

After factoring from above your NH3 level can be compared to the zones below:

	0.0 is ideal. Values up to 0.019 might be tolerated for extended periods
	0.020 - 0.049 may be tolerated, but will cause long term harm
	0.050 - .0.199 May be tolerated for a few days, harmful
	0.200 - 0.499 May be tolerated for a day or two, very harmful
	>0.500 Extremely Toxic, remove fish

(continued on page 11)

What is 'free' versus 'ionized' ammonia?	Free ammonia (NH3-N) and ionized-ammonia (NH4+-N) represent two forms of reduced inorganic nitrogen which exist in equilibrium depending upon the pH and temperature of the waters in which they are found. Of the two, the free ammonia form is considerably more toxic to fish and, therefore, we pay considerable attention to the relative concentration of this particular contaminant. Existence of these chemical species are generally viewed as indicators that a given water has been contaminated, usually in relation to the direct discharge of an ammonia-bearing waste (e.g., fish waste, uneaten food, rotting leaves, something dead in system, etc.).

This chart can be found as an active chart at http://www.makc.com/

Bibliography:
The Koi Shack:
http://www.koishack.com/forum/index.php/topic,2752.0.html
Aquascience Research Group Product Info:
http://www.aquascienceresearch.com/Products.htm

ClorAm-X fact sheet:
http://www.aquascienceresearch.com/PDFs/ClorAm-XPDS.PDF

Amquel fact sheet:
http://www.aquascienceresearch.com/ProductInfo/AmQuel.htm

ST product detail:
http://www.aquaticeco.com/index.cfm/fuseaction/product.detail/iid/5688/cid/1598
Roddy Conrad: Chlorination
http://water.me.vccs.edu/courses/ENV149/chlorinationb.htm

Arlington, VA Dept. of Environmental Services:
http://www.arlingtonva.us/departments/environmentalservices/uepd/wquality/EnvironmentalServicesFish.aspx

San Francisco PUC – Chloramine Conversion Project:
http://facilities.stanford.edu/environment/Stanford_Fish_E.pdf
KoiPhen:
http://www.koiphen.com/forums/

3. Applicable literature:

AKCA, Pond Water Chemistry, by Norm Meck
http://www.akca.org/kht/H2oQual.pdf

Chlorination
http://water.me.vccs.edu/courses/ENV149/chlorinationb.htm

How many dogs does it take to change a pond filter?
- Border Collie: Just me. I'll also upgrade your filter and put in new plumbing.
- Golden Retriever: The sun is shining, the day is young, we've got our whole lives ahead of us, and you want me to clean a pond filter?
- Basset Hound: Did you say something?
- Poodle: I'll just blow in the border collie's ear, and he'll do it. By the time he finishes with the plumbing, my grooming will be complete.
- Shih Tzu: (Fails to respond, continues to bark at squirrels.)
- German Shepherd: Five. One to hold the filter in place, one to turn the plumbing valves, one to remove the filter, one to clean the filter, and one to bark orders.

Rottweiler: Make me.

Bumper Stickers -

- Help starve a feeding bureaucrat.
- Gravity- It's not just a good idea, it's the LAW!
- The Schizophrenic: An Unauthorized Autobiography
- Stop repeat offenders. Don't re-elect them!
- I used to have an open mind but my brains kept falling out
- Black holes are where God divided by zero.
- Why do psychics have to ask you for your name?
- Madness takes its toll. Please have exact change.

Q: Why did the turtle cross the road?
A: To get to the Shell station!

Q: Why do seagulls live near the sea?
A: Because if they lived near the bay, they would be called bagels.

Q: Where do dogs go when they lose their tails?
A: To the retail store. (Roll your eyes - it's okay!)

If a turtle doesn't have a shell, is it naked or homeless ?

A Horse goes into a bar and the bartender says
"Hey buddy, Why the Long Face"

There are 2 cowboys in the kitchen. Which one is the real cowboy?
The one on the range.

Short article from the AKCA website: http://www.akca.org/library/akcamed8.htm

Nutrition

Proteins ***& Amino Acids***

25% to 56% of a Koi's diet should be protein. Younger fish need more protein. Primarily, protein is a source of building material and secondly a source of energy. There are 10 essential amino acids: Arginine, Histidine, Isolcucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan and Valine. Fats & Lipids 12 % of the Koi's diet should be fats and lipids. Unsaturated fats are easily digested by fish, but sucrose, lactose and starch are poorly digested. Excessive carbohydrates can increase the blood sugar and liver mass to potentially pathogenic levels. Fats and lipids are a major source of energy and they are necessary to carry fat soluble vitamins - A D E K. They are essential for the health, growth and normal appearance of the fish.

Carbohydrates

Less than 20% of the diet should be carbohydrates. Fish metabolize carbohydrates at a lower level than higher animals. As the chief source of energy, carbohydrates are very important to the fish's diet. Many fats require carbohydrates for their breakdown. but sucrose, lactose and starch are poorly digested. Excessive carbohydrates can increase the blood sugar and liver mass to potentially pathogenic levels. Excess carbohydrates are converted into fat.

Fiber

A dietary requirement for fiber in the diet of fishes has not been investigated extensively. Fiber has been demonstrated to be nonessestial in the diet of channel catfish and trout. Other data indicate it should not exceed 4% for salmonoids. Fiber is the part of the food that is not digested, but it is necessary for the normal functioning of the intestine. Excessive amounts of fiber can reduce the nutrient intake and impair digestibility.

Vitamins

..... mg/kg of diet ....remarks
Vitamin C.....100..... not stored , used rapidly under stress
B12.....02..... stored in liver, heart, blood & brain
Biotin.....1.....stored in kidney, liver, & brain
Choline.....3,000.....destroyed by high temp & sun light
Folic Acid.....5.....destroyed by high temp & sun light
Inositol.....400.....destroyed by high temp & sin light
Niacin (B3).....150.....stored in liver, destroyed by sun
Pantothenic.....40.....not stored, destroyed by high temp
Riboflavine.....20.....not stored, destroyed by high temp
Thiamin .....10 ..... not stored, destroyed by high temp
Vit A ..... 2,500IU..... ....stored in liver, fat soluble
Vit E..... 30IU..... stored in liver, fat soluble
Vit K .....10IU..... stored in liver, fat soluble
Vit D.....2,400IU .....stored in liver, fat soluble

Minerals

..... mg/kg of diet ..... remarks
Aluminum .....2..... must be supplied by diet
Calcium .....3,800 .....naturally in water
Chloride .....1,060 .....naturally in water
Cobalt 16
Copper .....12.5..... must be supplied by diet
Iodine..... 5 .....naturally in water
Magnesium .....1,095 .....must be supplied by diet
Iron ..... 220 .....must be supplied by diet
Manganese 15
Phosphorous.....5,170..... naturally in water
Potassium .....5,300 .....naturally in water
Sodium .....1,280 .....naturally in water
Sulfur..... 1,500
Zinc .....14 ..... must be supplied by diet