The Nitrogen Cycle - The Holy Grail of Fishkeeping - PART II - Nitrite & Nitrate

March 31, 2013 at 8:25am

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Ok... so your tank is full of milky whiteness but we know now why. It's ammonia. We threw our fish in and they started producing urea/waste from Day 1, cheeky little buggers! This turned into ammonia, the tank went white, and now the fish are looking uncomfortable. We have got the filter running but there has simply not been enough time to let all those beneficial bacteria colonies move in yet, so ammonia is rising... and rising... and...

If you haven't read Part I, I suggest you do so. There might be some weird words in this one and it is better to have a good grounding in the first part before I bore you with the second part. This is where a bit more of the science kicks in but I'll try and keep it interesting.

Bacteria reduce water changes!...Hold on... That really doesn't sound like it makes sense... oh well, let's crack on...Yep, they sure do. Most of us should be changing their water once a week at least. Most of us know that already. But if I were to ask you WHY do you change your tank water, what would you say?

Because the fish like clean water? Sure, of course they do. But what is clean water? You might say you change water to dilute toxins that have built up over time? Again you would be correct, but WHAT toxins? Or maybe you just change the water because you know what?... Google said so, so there! Again... juusss fine. I don't really care why you change your water. So long as it gets changed. The reason for this is NITRATE buildup within your tank. Awesome! Ammonia...Nitrate! Fantastic. Let's just add it to the list of 'crap' (see what I did there?) we have to deal with from our fish. But don't worry too much because you can't have one without the other and they are inextricably intertwined. But to get ammonia to manifest as nitrate to the point where we have to remove it through water changes a couple of processes need to happen.

Let me take it back one step first. We know now that fish produce urea (Part I) and this in turn becomes ammonia. This in turn is toxic to fish and will kill them. Enter the aquarium superheroes! Bacteria will find a nice home within your filter and begin to 'eat' the ammonia in your tank. Remember that milky whiteness? MAGIC!!

You wake up one morning and the water is crystal clear! This really DOES happen, guys and is amazing to see. The bacteria are in your filter, the ammonia filled water has been passed across your bacteria colony, and as it does they are literally sucking out the ammonia from the water. Woohoo, clean water, right?

Wrong

Now we need some more bacteria. There is plenty of room for everyone so don't stress, but that first type of ammonia (let's call them Nitro-ammonia) only really does half a job. Kind of like me on Sunday, Monday or... anyway, the point is that there is no AMMONIA in your tank anymore,

but they have converted it into NITRITE (Notice the difference in spelling from NITRITE to NITRATE and be aware of this difference EVERY time you see these words. This is important) As I mentioned the bacteria have converted all the ammonia into nitrite (NO2).

POINTS TO NOTE

We perform water changes to reduce levels of nitrate (NO3)

Urea is used by the fish to expel nitrogen waste

Ammonia (NH3) comes from fish waste/urea

Bacteria (Nitro-ammonia) convert ammonia (NH3) into nitrite (NO2)

Nitrite is then converted into nitrate (NO3) by....

You guessed it! Bacteria.

The last phase of this cycle is the conversion of nitrite (NO2) into nitrate (NO3). Nitrate is the least harmful of the nitrogen compounds to your fish however will become toxic in high enough amounts. To give you an idea of comparison, test kits work on a ppm (parts per million) scale, usually. And you can buy one that will test your levels of ammonia, nitrite AND nitrate. So what levels should there be? Here is a rough guide:-

Ammonia - Should never be more than 0.5 ppm and really should stay at 0 for almost the whole time. The bacteria that breaks ammonia down are tireless and will never take a break. They will constantly convert ammonia into nitrite so you should never be able to detect any. The only exception to this rule is when you decide to add ONE or TWO new fish, at MOST, and the bacteria colony MAY let a little bit of ammonia through as the colony grows to suit the new fish waste load.

Nitrite - Should always be 0 - I want you to consider why. If the bacteria are constantly converting ammonia to nitrite, then it is reasonable to assume that they are also constantly converting it from nitrite to nitrate. In which case, you should not have any detectable nitrite spike in your system. As previously mentioned, when adding new fish, the science follows that if you are going to get a small ammonia spike, then you MUST get a small nitrite spike (I hope everyone understands why this is) but you are going to be really lucky to catch it at the time that it spikes. The bacteria are very efficient and will catch up quickly! So let's say 0.

Nitrate - This is the reason we perform water changes remember? Unfortunately, for all intents and purposes, in most aquaria, there is nothing to break down this final stage of nitrogen or nitrogenous waste as we call it. And so it accumulates... and accumulates.. and you get the idea. It will rise to a level that is toxic to fish slowly but surely.

AT A GLANCE

Ammonia - 0 parts per million
Nitrite - 0 parts per million
Nitrate - up to 150 parts per million (freshwater only) (marine practically 0 as well)

You can easily see how fish handle nitrate FAR better than they handle nitrite or ammonia. But if we don't change our water that nitrate number will continue to climb forever. It will reach toxic levels and one fish will die. Dead fish also create ammonia spikes, just the same as fish waste, so now you have nitrate AND ammonia, and very unhappy fish. This can lead to a 'roll on' effect essentially ending in a tank crash and all your fish gone.

Long story short... Change your water guys. Clean water is the most wonderful, magical, beautful thing in the world to fish, and they will absolutely LOVE you for it. Your fish will be happier, they will swim more, they will show their colours FAR brighter for you, they will grow faster, they will eat better, they will breed more effectively, they will live longer, they will grow larger... they will....

N.B - NEVER EVER EVER wash your filter under chlorinated tap water.. Chlorine is toxic to bacteria, and these guys are the HOLY GRAIL, remember? Treat them with respect. Only ever wash your old filter sponge in old tank water or a seperate bucket of neutralised tapwater. Or else you will have to go right back to PART I and start all over again. Again, remember that only 10 per cent of your filters job is to catch sediment, so just give it a swish to get all that stuff out, maintain the bacteria (you won't see it) and shove it back in the filter.