Alternative Marine Aquarium Nitrate Removal

An alternative for saltwater aquarium nitrate removal.

By Randy Donowitz

This is a recent picture of the center of author's 135-gallon reef tank after treatment with AZ-NO3.
Photo by Terry Siegel.You can imagine how I felt when I unpacked my new test kit and measured my aquarium water's nitrate level — it was 60 parts per million NO3! I had ignored some of the early warning signs and now I found that my aquarium was near crisis. In this article I will explore how I arrived at this point, the measures I took to deal with the problem and how you can avoid this stressful situation.
By all accounts my 125-gallon reef system was thriving (see Aquarium Frontiers On-Line, "Featured Aquarium," July 1997 for specifications of my system). My corals showed great polyp extension, there was a lush growth of pink and purple coralline algae throughout the tank and my fish were healthy and active. Things were so good that I began to get a bit lazy. The water changes became less frequent and the carbon was changed irregularly. Testing for anything other than pH, calcium and alkalinity was rare. There wasn't a speck of hair algae to be seen, no red slime or brown sand sludge. No need to worry...right? Wrong. Very slowly, things in my system had begun to degrade.

In retrospect, the signals were there for me to read. I chose not to believe that the seemingly isolated occurrences of tissue and coralline recession and the marginal alkalinity readings (2.5 to 2.8 milliequivalents per liter; mEq/L) were related. My tank still looked fine and all those blemishes seemed to heal. What my system was telling me, however, was that dissolved organics were building up.

When the cyanobacteria took hold, I began to take notice. Out came the test kits, which was my next "I really did know better" error. Despite the fact that I knew the reagents were probably "a little old," I happily accepted the phosphate (0 parts per million; ppm) and nitrate (less than 10 ppm) readings as "accurate enough." I performed a water change, changed my carbon and my skimmer airstones, removed cyanobacteria manually and returned to all the sound husbandry practices I knew were required for successful reef aquaria. It wasn't enough. The cyanobacteria persisted and spread. I became more concerned.

About this time, I purchased an Aqua Controller from Neptune Systems and was able to measure the oxidation reduction potential (ORP) of my system for the first time. I know ORP values are highly variable from system to system and not necessarily the ultimate indicator of a healthy aquarium, but my reading of 290 to 300 millivolts (mV) didn't compare favorably with the other beautiful reef aquaria I had seen (380 to 450 mV).

A few days later, my new test kits arrived. Interestingly, the phosphate level was still near 0, measured with a Salifert test kit (later confirmed at 0.02 ppm with a Hach test kit), but the nitrate (NO3) was at an astounding 60 ppm! It really was quite remarkable that most of the organisms in my tank still looked good and were in fact growing. My reef is heavily stocked with 14 fish, and I insist on feeding them what they need in order to thrive. Apparently, the anaerobic denitrifying capabilities of my system are not sufficient, and I suspect the skimmer is marginal for the bioload it is asked to handle. Need I say more? The question then became what to do about the nitrates.

Two bottles of AZ-NO3. Photo by Terry Siegel.The first step was a series of three large water changes (25 gallons each) over a one-week period. I didn't want to place excessive stress on the system, but I was confident that if I could bring down the nitrates to a reasonable level (say, less than 10 ppm, quickly), extremely diligent husbandry and a skimmer upgrade would prevail. The next nitrate test showed a significant 10 ppm reduction, but this was far from sufficient. I was going to have to change a lot of water over a long period of time to really make the kind of difference I was looking for, and this seemed to be neither an efficient nor a wise way to proceed.

I had read Greg Schiemer's "Product Review" on nitrate reduction media article (Aquarium Frontiers, Fall 1995) and had little faith in their ability to effectively reduce nitrates. Short of dismantling my reef and installing a live sand/plenum system, I was left with few alternatives. I was getting a bit desperate, as the cyanobacteria continued to spread to new areas of my tank.

I remembered an advertisement I had seen for a new product claiming to use new bio-technology to eliminate nitrates. I've been around the aquarium hobby long enough to be extremely skeptical about the claims of new miracle cures, and I'm

fully aware of all the snake oil that is sold in the industry. For some reason, I was drawn (perhaps by my desperation!) to this new product, and my rudimentary understanding of what “AZNO3” (Absolute Zero Nitrate) claimed to do further piqued my interest. Monolith Marine Monsters (M3), which distributes the product, has a good reputation on the web, and I knew a few friends who had had positive experiences with the company before. Still, I was skeptical. I gathered whatever information I had, most of it downloaded from the M3 web site, and asked Craig Bingman to take a look and comment on the theoretical soundness of the science behind the product. A few days later he replied that though he was unsatisfied with the company’s explanation of the chemical mechanisms at work, he felt reasonably convinced that, “theoretically,” the product should work. That was enough for me.

What follows is a documentation of my experience using AZ-NO3. This is clearly an anecdotal account, and as I had no intention of writing this article at the time, I didn’t run as many tests or keep as accurate records of daily occurrences as I might have otherwise. I cannot claim a science background and will limit my discussion to my observations only.

AZ-NO3 is advertised as “a thirty day nitrate remover and all natural oxidation/reduction enzyme catalyst.” It claims to work by “cellular respiration on the target nitrate molecule, which is then removed by the protein skimmer.” As best as I can work out, AZ-NO3 provides a form of carbohydrate that acts as food for a bacterial bloom. The bacteria then use an enzyme, which is also provided, to biologically assimilate the nitrate molecule. The rest is left to your skimmer.

Although the accompanying product literature is often confusing and not well written (sorry, I’m an English professor by day!), it does provide a fair amount of detail regarding product use and potential long-term and short-term effects. The suggested dosage is ¼ ounce daily for each 50 to 60 gallons of water in your system. The idea is to maintain this dosage until the nitrates reach 0, and then slowly wean the system off the product entirely. It is noted that a small maintenance dosage may be necessary for some systems, and that all systems vary in their needs and responses.

When my supply of AZ-NO3 arrived, I generously estimated the volume of my system at 150 gallons and decided to follow the recommendations on the label for the “safe-start method,” which calls for a gradual daily doubling of the additive over the course of the first week. For my aquarium, this meant six drops on day one, 12 drops on day two, 24 on day three and so on, until the full dosage of ¾ ounce daily was reached on day seven.

By day three of the “safe-start” period there were some noticeable changes. There was a slight cloudiness to the water, which was indicative of a bacterial bloom, and many small bubbles were visible throughout the tank, presumably carbon dioxide byproducts of the reactions taking place. Most significantly, my nitrates had already dropped 10 ppm down to 40 ppm. The cloudiness and bubbles are consistent with the side effects mentioned in the instructions, as was the negative reaction exhibited by a few organisms.

After the second day of the full-strength dosage, my skimmer was foaming at an incredible rate and nitrates measured a remarkable 10 ppm. From here, readings showed a swift decline to 0 ppm NO3 after two more days. Many organisms, notably my Blastomussa wellsi, Fungia and several, but not all, species of soft and leather corals, looked very bad. The polyps were all closed and shrunken causing me many anxious moments. However, none of my fish, small-polyped scleractinan corals, clams, crustaceans or many long-polyped sclearactinian corals showed any effects at all. In fact, I could find no obvious correlation between the species that were affected and those that were not. Again, these negative reactions are indicated as both common and temporary in the product literature.

What I did find was an extreme fluctuation in my ORP readings that is of potential concern for anyone who is considering using this product. The series of water changes I carried out prior to treatment with AZ-NO3 had raised the ORP to a constant reading over 400 mV. Throughout the start-up period, these readings remained stable. However, after the first full dosage, the ORP dropped to less than 250 mV at around 2:00 a.m. By 8:00 a.m., levels had returned to nearly 400 mV. I noticed this pattern throughout the ensuing week of treatment. Roughly three hours after I added the daily dosage, the ORP plummeted at least 100 mV and returned to normal several hours later. The concern here is that at very low ORP levels the dissolved oxygen in the system can reach dangerously low levels. If you do not have the capability to monitor your system’s ORP, I would pay careful attention to your fishes’ rate of respiration, as they are the most likely to be affected if oxygen levels begin to drop too low. It might even be wise to increase the aeration in your system via an airstone just to be safe.

In my case the fish never showed any signs of distress, and by the end of the week ORP levels were consistently over 400 mV once again. Because the appearance of several organisms was concerning me and the nitrate level had been reduced to 0 so quickly, I decided to try to rapidly wean my system off the AZ-NO3. I dosed ½ ounce the next day and ¼ ounce the day after. I was able to detect a slight reading of 0.1 ppm NO3 after I skipped a day and resumed 1/8-ounce daily treatments for the next several days. Throughout the treatment my skimmer continued to produce copious quantities of thick, foul-smelling scum. Slowly, the negatively affected organisms began to recover and I was able to maintain nitrates

at 0 with a 1/8-ounce addition of AZ-NO3 every other day.

About four weeks after the initial start-up period all the organisms in my system were fully recovered. In fact, some looked better than ever. Currently, improved husbandry techniques and a maintenance dosage of 1/8-ounce AZ-NO3 three times a week have allowed me to hold nitrate levels at 0 (measured with a Salifert test kit and confirmed with a Seachem test kit). When my new skimmer arrives, I anticipate weaning the tank completely. Meanwhile, my reef system has regained its former glory and the inhabitants show no apparent aftereffects.

It is now seven weeks after the beginning of the AZ-NO3 treatment cycle and my cyanobacteria problem has slowly disappeared completely. Because I attacked the problem in so many different ways (raising alkalinity levels, changing light bulbs, manual removal, etc.), I cannot say that the AZ-NO3 directly cured the outbreak, nor do the manufacturers make such a claim. What I can say is that AZ-NO3 did perform almost exactly as the instructions said it would. In my case, the nitrate level of my system was impressively reduced by 50 ppm in under two weeks. Presumably, many other dissolved organics were removed in the process, and this must have contributed to the steady decline of the cyanobacteria.

My experience with AZ-NO3 raises many questions. Proprietary concerns aside, I encourage others to ask for, and the makers of this product to provide, clearer explanations of the chemical reactions taking place. It would also be nice to know what causes some organisms to react so negatively at first. Is it possible to eliminate or at least minimize these effects? An analysis of the skimmate produced during treatment might also provide some insight into exactly what, besides bacteria, is being removed. I suspect that, in part, some corals are responding to increased levels of light resulting from the drastic reduction in dissolved organics in the water. Many of the most seriously affected organisms exhibited the emission of the long brown strands of mucus characteristic of the readjustment by corals of their populations of symbiotic zooxanthellae.

At $23 an 8-ounce bottle, AZ-NO3 is not cheap, nor is it prohibitively expensive. My system had a strong and rapid response to the treatment that enabled me to use far less of the product than I had anticipated. I do not know what the experiences of others have shown in this regard and I suspect each system varies significantly.

Additives, no matter how effective, should not become a substitute for sound husbandry practices. I urge you all to avoid getting yourselves into the predicament I found myself in. If, however, you do find you have high nitrate levels, AZ-NO3 seems to offer an efficient and safe way to reduce those levels quickly. I think this product holds particular potential for hobbyists with fish-only systems, where nitrate levels are typically high and there are no invertebrates to distress. Remember, you must have a protein skimmer for this product to work. Is AZ-NO3 the miracle cure for all our nitrate problems? I'm not prepared to go that far, but occasionally there are new products using new technology that can be of benefit. Based upon my experience, AZ-NO3 appears to offer such promise. Much more needs to be examined to fully understand this approach to nitrate reduction and its effects on our captive marine systems. I hope others more qualified for the task take my observations as a place to begin this inquiry.