THE FILTER

Tampa Bay Aquarium Society
St. Pete/Tampa Florida

GloBarb from 5D

May 2021
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An "OLDIES" but "GOODIES" ISSUE!!!

TBAS . . . Since 1992

Mike Jacobs photo 2021

TAMPA BAY AQUARIUM SOCIETY

ST. PETE/TAMPA FLORIDA

TAMPA BAY AQUARIUM SOCIETY

"THE FILTER"

Tampa/St. Pete, Florida

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Sometimes I REALLY enjoy looking through old tropical fish articles!!! That's why every now and then I do a whole issue of "oldies". THANK YOU for putting up with my "problem" . . . :

The Clarion Inn has been an "ok" venue for us to have our meetings but I so long to get back to our OLD MEETING PLACE!!!! We should know about the May meeting shortly and we will let you know about that on our website!!

In the meantime, please will you and your family stay safe with the ending of this "COVID-STUFF"!!!

See you all soon,

Mike

Mike Jacobs, Editor

Thorichthys meeki
Firemouth Cichlid
Photo by Mike Jacobs 2018

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From March 2014

I'll have to go back a few years to tell this tale. The year was actually 1972. My wife, at the time, and I were living in Manassas, Virginia. Back then it was a small, historic, town about thirty miles outside of Washington DC.

There was no fish club in the area then, but a good size group of us made the rounds, visiting one another's homes. We'd check out the progress of breeding this and that fish and whoever had excess fish were always eager to share. That's how I got into trouble.

We lived in a large two-bedroom apartment with about twenty fish tanks. Thank goodness my wife was understanding. She enjoyed watching the Oscar's, Jack Dempseys, and other Cichlids in the bigger tanks. So, she never questioned the comings and goings of other fish.

I hate to say it but even those of us that have understanding spouses, I'd dare to say that the majority of them do not have any idea of what kinds of fish we really have nor how much time and money goes into them. (Thank goodness) That was the case with my wife, for the most part.

One day while visiting a fish friend nearby, he showed me a number of Walking Catfish he had recently acquired. Back then in that area of the country anyway, they were a big fad. Besides he had gotten a "real deal" on a bunch of them.

So, I end up coming home with two Albino Walking Catfish. The first was about twenty inches long, nice and fat, with huge, long whiskers. The second was smaller, only about twelve inches long and much less lazy.

The only tank I had open at that time was the bottom 55 gallon on a two-tank rack. It should fit them perfectly, in a quiet location near the dining room, dimmer light and, besides, what problem could they be to anyone?

It was the next day, just about lunch time as I recall, I received a phone call at work. When I answered the phone, it's my wife, screaming for me to come home immediately there is some kind of monster in the apartment, and she and her friend Cathy locked themselves in the bathroom to escape it. I was unable to ask any questions of her, but it sounded like I had better get home and see

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what's the matter.

A seemingly long car ride home and I enter the apartment through the backdoor. All was quiet. No one greeted me, I was thinking this would be some false alarm and I'd walk in to find my wife laughing apologetically. But no. Not even the cat was in sight.

What I did see is the cord of the telephone stretched down the hall and under the bathroom door. So, I walk to the bathroom, knock and call to my wife. She jerked the door open, grabbed me and both of the women, still, frantically insisted there's a monster of some kind in the apartment. So, I told them I'd go check. But before she would let go of my now fingernail gouged arm, both women told me the story, together, of what happened.

My wife had invited her good friend Cathy over for lunch, as she often does, and they catch up on the local gossip. While they were chatting and enjoying their lunch, suddenly our pet cat, Cesare, leaps down from sunning himself in the window. For reasons unknown, at that time, he hurries over to the corner of the doorway past where the ladies are having lunch. There he bristles up, lets out a loud growling hiss and runs as fast as he can go to the back bedrooms. Well, need I say, this got the women's attention. They, too, jumped up, hurried to the doorway and look in the direction the cat had been looking. There they both saw it and they too, both screamed and ran for the bathroom. My wife grabbing the phone on her way to call me for help.

Finally getting my arm back, I tell the bug-eyed women to stay there. I start walking thru the rooms and that's when I spot it. Doing a double take, there **IS** a monster in the living room. There in the middle of the floor is a twenty inch long, white, Walking Catfish gyrating back and forth as it makes its way across the room.

"Oh no!" I groan to myself.

With tuffs of grey lint and cat hair stuck all over the fish, I have to admit it was a strange looking sight, to say the least. I pick some of the lint from the poor fish as I make my way with him back to put him in the aquarium. That's when I see the twelve inch one is also gone. I find him in the kitchen. He had evidently been under the kitchen stove and had all kinds of things stuck to him. But once back into the water neither fish was any worse for wear.

Heading back to face my wife once again, I'm frantically thinking "Where can I get a cover for that tank right away", believing this will be what she asks me. Entering the bathroom doorway, I give the, now a bit calmer woman, a brief explanation of what the monster was and attempt to laugh it off. I'll just say that was the wrong approach on my part. I was told, in part, something like . . . fish have their place and it's not walking around my home". She held the phone for me while I made the call. Thus, ending my keeping of the **"Walking Catfish"**.

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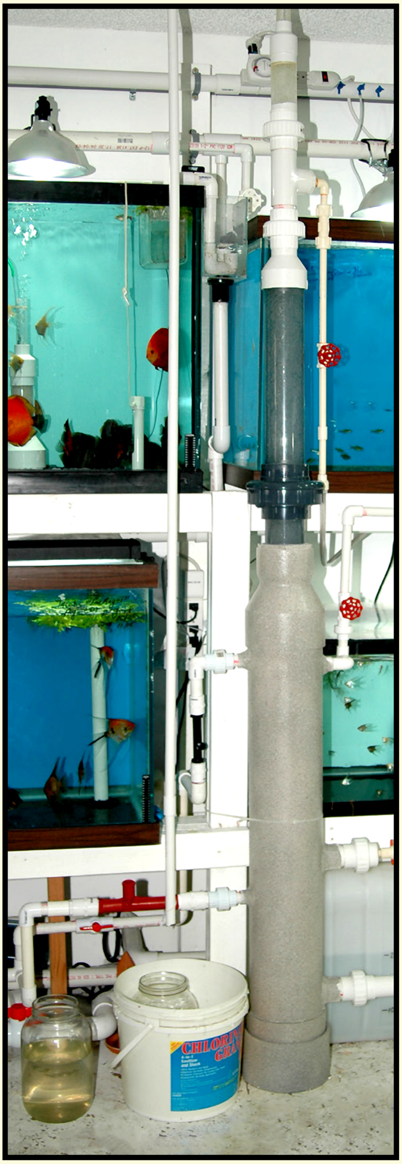
BUBBLING YOUR WAY TO CLEAN WATER WITH "Foam Fractionation"

. . . incorrectly called protein skimming

aquaresearchcenter.com

by Joe Gargas

From July 2016



Lately, there has been an awful lot of talk in the aquarium industry about protein skimmers. There has also been a good deal of misinformation and misunderstanding about this increasingly popular technology.

Fish keepers, who gather their information from hobbyist magazines and word-of-mouth, may often pick up and pass on this misinformation. The end result could be a loss of livestock because of the incorrect application of protein skimming technology.

For retailers this means lost sales and angry customers. Therefore, it is the retailer's responsibility to break the chain of disinformation by providing customers with the proper data. In this article we'll go into some of the general chemical principles and pragmatic uses of protein skimming, and I will share with you my firsthand experiences at my hatchery.

Let's begin by making sure we use the proper vocabulary for this important method of improving the water quality of aquariums. A protein skimmer is a device, such as an overflow tube, a weir or a surface suction extractor that actually skims the surface of aquariums. When people mention protein skimming, they are really speaking about a well-known wastewater treatment process called Foam Fractionation. Any discussion of foam fractionation would be negligent if it did not also talk about Ozonation,

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because the ozonation process is normally used in conjunction with foam fractionation.

Those Fine Bubbles

The process of foam fractionation begins with bubbles. When fine bubbles are blown into water, the proteins present will coat the surface of the air bubbles and produce a foam.

This protein foam carries with it a lot of colloidal material (an extremely fine particulate with an approximate particle size less than 0.2 microns which will not settle on standing and can only be removed through flocculation) as it rises to the surface on the backs of the bubbles.

Since proteins will rapidly break down to ammonia, as much protein as possible must be removed from recirculating water. Fats do not “foam out” as well as proteins do. Recently, foaming agents have been introduced on the market which can be used in either fresh or salt water, thus allowing foaming without the presence of protein (Sterba 1983).

Using foaming agents, turbidity caused by bacteria and algae can be removed at any time if desired.

One of the biggest misconceptions in foam fractionation is that the process cannot be used in freshwater systems. This is far from the truth, although it is easier to foam fractionate in salt water due to the higher density of salt water which yields smaller bubbles and greater surface area.

In fresh water, you cannot produce a small bubble when air is injected. To circumvent this, you must think in terms of turbulence. You can go to any freshwater stream or lake and see the foam in various areas where there is turbulence.

In my foam fractionator, I increase my flow rate of water through the unit. This exceeds the manufacturer’s recommended flow rate by at least twice the amount.

I then use a number of small-pore ceramic diffusers that are normally used in the application of pure oxygen and/ or ozone. I inject air from a linear compressor, which produces a pressure of five pounds per square inch. This greatly increases the number of fine bubbles so that a reasonable amount of foaming can be attained in fresh water.

Every week I would remove approximately one gallon of a light brown liquid with a very oily consistency. In waste water treatment, foam fractionation is used to eliminate ammonia. This is successfully done at a pH between 8.5 and 10. I have also discovered that better foaming occurs at a higher pH. This would make the use of a foam fractionator practical and efficient for those who keep various species of African cichlids.

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Three Fractionators

There are currently three types of foam fractionators:

1) The Concurrent Fractionator. In this design air and water both enter at the bottom and flow together up the column where the foam spills over at the top.

2) The Countercurrent Fractionator. In this design water enters at the top and flows downward, while the air enters at the bottom and flows upward. This produces a greater turbulence and longer contacts time. I employ this type of foam fractionators on my large trickle bed nitrification system.

3) The Centrifugal Fractionator. In this design, water under high pressure enters the fractionator from an inlet jet mounted tangentially to the cylinder wall. This results in a vortex in the fractionator cylinder. Air is sucked into the water ahead of the tangential inlet jet by venturi suction, and so it gets the name venturi fractionator.

The mixture of air and water in the Vortex produces a foam which is spun out to the sides of the fractionators by centrifugal force of the spinning water.

Fractionator at Work

I use the countercurrent foam fractionators on my large trickle-bed filtering system. My foam fractionator is approximately 5 ft. tall and 8 in. wide. At the bottom, three diffusers are situated: These are 3 in. long, 1.5 in. wide and weigh 0.39 lbs (which is heavy enough to prevent them from floating to the surface).
Air at approximately 5lbs. per square inch is injected into the diffuser. The manufacturer recommends a flow of approximately 250 gallons of water downward through the fractionator. I have found that this flow was not sufficient to produce the turbulence necessary for foam production in fresh water, even with ozone being injected. I raised the flow to 500 gallons per hour, which greatly prolonged the ascent of the air bubbles.

At this flow an oily brown liquid began to float to the top of the cylinder and spill over into the collecting compartment. This liquid did not look at all like the foam produced in saltwater fractionation.
I ran a permanganate demand test on the liquid and noted an immediate color change. I averaged approximately two gallons of this oily liquid in a 10 day period. This oily liquid is sometimes a cloudy white instead of brown, but it never separates into two layers after standing and again the permanganate demand is high on this substance. The amount of liquid produced seems to correlate with the amount of food that I feed.

Ozone the Oxidant

Ozone has been in use for drinking water purification since its introduction in 1906 in the French city of Nice, where it was used to disinfect the municipal water supply.

Although ozone is an excellent disinfectant, even surpassing chlorine in its speed of sterilization in a given amount of time, its real value in water treatment lies in its abilities as a powerful chemical oxidant which leaves no toxic byproducts in the water.

I have been operating a large discus operation with several hundred fish, and I turned to ozone and foam fractionation (along with trickle bed filtration) to reduce my need for water changes. I had a very large system with an approximate volume of 1,000 gallons of recirculating Lake Michigan water.

Generating Ozone

Ozone is generated by passing a high AC voltage across a discharge gap in the presence of oxygen. Only about 10 percent of the energy supplied is used to make ozone, while the rest produces heat.

The discharge from an ozonator contains one percent ozone when air is used as the feedgas.

By comparison, ultraviolet lamps do not produce enough ozone to oxidize any significant quantities of organic compounds in an aquatic system.
If the air temperature to an ozonator exceeds 40 deg. Centigrade (104 deg. Fahrenheit), the ozone will begin to decompose. Therefore it is best if the air feeding an ozonizer is dry and has a temperature of less than 30 deg. Centigrade.

Industrial ozone generators will always have an air cooler and dryer ahead of them to maximize their efficiency.

I constructed an air dryer from a 4 ft. length of 4 in. diameter PVC pipe. I filled the dryer with calcium chloride, which can be inexpensively purchased in 50 lb. bags from any ready mix concrete yard.

After the calcium chloride dryer is another small tube filled with a drying indicating agent which changes color when the calcium chloride is exhausted and needs to be discarded. These drying tubes can be purchased on the market.

Ozone Contactors

To maximize the gas efficiency of ozonation, it is necessary to maximize the gas exchange across the gas/ water interface. This is accomplished by dispersing the ozonized air into the bubbles as it mixes into the water, while maintaining relative motion between the bubbles and the water. This can be achieved by using a deep countercurrent foam fractionators which will allow for the long available contact time between air and water.

Effects on Humans

The odor-detection limits of ozone in the air are 0.02 to 0.05 ppm. Concentrations of 1.0 for periods longer than 30 minutes can produce headaches. The public health service has set a level of 0.1 ppm by volume as the maximum safe concentration for working conditions (Evans 1972).

Basically, if you can smell the ozone, you've already gone too far. Ozone has a smell similar to that of chlorine, although those with experience can distinguish between the two. You can sometimes smell ozone after a thunderstorm, when ozone is produced by the electrical discharge of lightning.

To prevent ozone from escaping into the room, I use a charcoal-filled tube as a vent on top of my foam fractionator.

Chemistry of Ozone

Ozone is one of the strongest of all oxidants; its chemical oxidation potential is 2.07 volts, which is stronger than either permanganate at 1.68 volts or hypochlorous acid (household bleach) at 1.5 volts.

Hydrogen peroxide, by contrast, is a very weak oxidant, with an oxidation potential of only 0.68 volts (Snoeyink, et. al., 1980). For this reason hydrogen peroxide is of little value as an oxidant in aqueous systems and is virtually useless as a disinfectant.

Ozone, $\mathbf{O_3}$, is an allotropic form of the oxygen molecule, wherein there are three oxygen atoms bonded together instead of the two atoms in the more common diatomic oxygen molecule, $\mathbf{O_2}$.

The unstable ozone triplet decomposes into the stable diatomic oxygen molecule $\mathbf{O_2}$ and a free oxygen atom which is highly reactive and non-selective in its attack upon organic compounds.

In water, ozone decomposes faster at a high pH, so its reactions are more rapid and less selective since free oxygen atoms are being generated faster at high pH values.

By contrast, the ozone molecule itself reacts more slowly with organic compounds. Ozone will attack almost any organic compound to produce an oxygenated product.

In theory, with enough ozone and enough time, you could oxidize the organics completely down to their ultimate oxidation products of carbon dioxide and water.

This, however, is never achieved in practice because the individual organic compounds have already been attacked, and the resulting oxidized products are slower to react with more of the same oxidant than the original compounds were.

What this means is that the overall rate of oxidation will begin to slow down as ozonation proceeds. This imposes practical limits on the efficiency of ozonation.

It is reported that ozonation is faster at high pH and dependent upon the square root of the ozone concentration. Square root dependence means that a fourfold increase in capacity of the ozone generator is required to bring about a doubling of the ozonation rate. From this it is easy to see that the point of diminishing returns is rapidly reached as the ozonation is increased.

Ozone has a half life of about 15 minutes in aqueous systems (Evans, 1972). Half-life is the time required for half of a substance to decompose. A 15-minute half-life means that 1/2 of the ozone will decompose in 15 minutes; 3/4 in 30 minutes, and 7/8 in 45 minutes at 20 deg. Centigrade (Rice, et. al., 1985).

Intermediate oxidation products of ozonation include ozonides, organic peroxides and hydrogen peroxide (Bailey, 1975). These oxidized compounds are non-toxic and are more readily metabolized by bacteria than the original organic compounds (Rice, et. al., 1985).

Ozone readily oxidizes organic compounds containing sulfur, which are often toxic products of anaerobic decomposition (Evans, 1972).

Ozonation therefore increases the biodegradability of harmful organic compounds. Several kinds of amino acids and alcohols are oxidized by ozone in a short time (Ikehata, 1975).

The major products of the ozonation of amino acids present in tank water are aldehydes, ammonia and hydrogen peroxide (Evans 1972).

Aldehydes oxidize readily to carboxylic acids. Ozone does not react with ammonia, except at high pH values of 9 or more (Rice, et. al., 1985).

However, ozone rapidly oxidizes nitrite to nitrate. I can get an indication of how the ozonation process in my system is working by doing a simple permanganate demand test. In this test, the longer the purple color lasts the higher my water quality is.

Powers of Disinfection

Ozone's powers of disinfection are well known. But just because a significant ozone concentration exists in the water does not insure sterility. Ozone concentrations of 0.5 ppm to 4 ppm are usually used in water disinfection applications (Evans, 1972).

There appears to be a threshold dose of ozone which must be exceeded, prior to which there is a rapid kill. Dissolved organic material will react with the

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ozone before it has time to destroy the microorganisms. Hence the presence of organics in the water constitutes an ozone demand that must be satisfied before the destruction of microorganisms can be accomplished.

Laboratory studies on the destruction of bacteria and viruses that report a certain concentration of ozone for a specified period of time as being sufficient to disinfect the water are not often duplicated in aquatic systems, where pathogens do not always exist as discrete units.

Furthermore, the pathogenic organisms may be embedded in particulate matter, where the ozone cannot penetrate far enough to reach them. Some viruses, for instance, are often clumped together in such a manner that those in the middle of the clump survive because the ozone does not diffuse inward to reach them. Except for this clumping defense, viruses are more vulnerable to ozone than the larger pathogens are.

The mechanism of ozone destruction of pathogens is one of simple oxidation of the cell wall, followed by the collapse of the cell. Obviously, the larger organism with a stronger cell wall will be more resistant to ozone. Good filtration can remove the larger particulates and clumps that can shield organisms from ozone, greatly improving the disinfection rate of the oxidant.

Ozonation in Aquariums

The foam fractionator in which the ozone will be injected should be followed by a charcoal filter to neutralize any excess ozone before it reaches the aquarium. I have heard of many saltwater aquarists that killed both fish and invertebrates with excess ozone.

Ozone can react with chlorides, which in saltwater are present in very high concentrations, and oxidize them into hypochlorite, OCl (the basic component of household bleach). Hypochlorite is very stable at the high pH of saltwater, and will eventually reach a level toxic to fish and invertebrates.

Normally, ozonation will increase the amount of foaming. The problem that I experienced was too great a drop through the ozonator I used, and this restricted the ozonated air flow into the foam fractionator.

However, I still produced enough bubbles for adequate foam. After using ozone the clarity of my water increased. The odor in my aquariums was slightly reminiscent of a freshwater stream.

Ozonation does not reduce the Biological Oxygen Demand of the water if the trickle bed filter is properly running. What ozone will do, however, is reduce the Chemical Oxygen Demand by oxidizing those organic compounds that the bacteria in the filter cannot metabolize. It is the buildup of these resistant organics that necessitate the need for frequent water changes.

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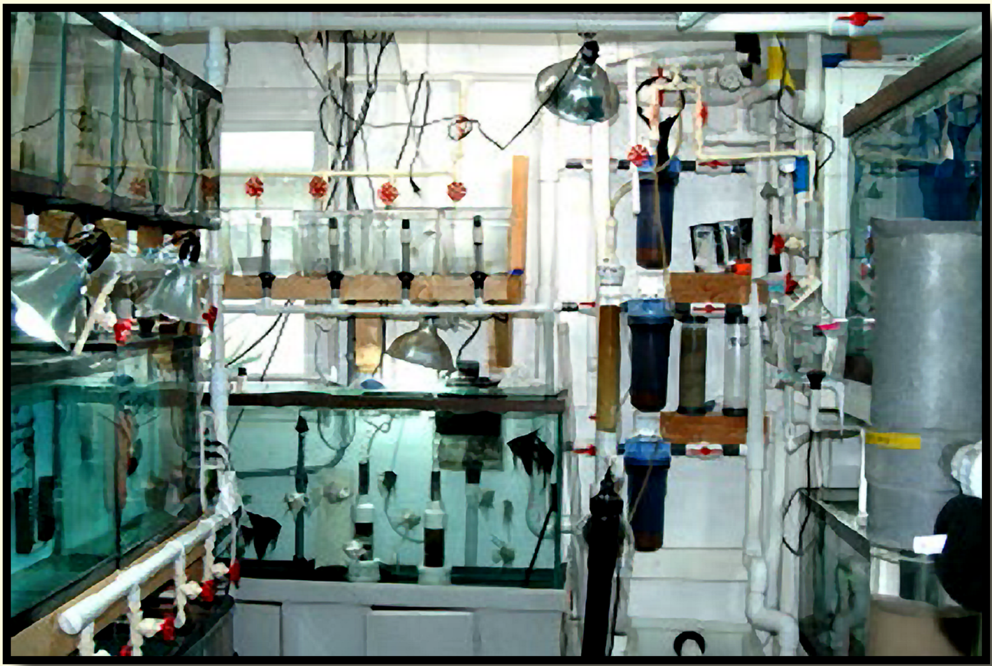
Foam fraction will remove anything smaller than 40 microns. The width of a human hair is 50 microns and its the only water treatment process that removes the waste completely out of the active water column.

Savings Abound

The utilization of a foam fractionator, along with ozone, has reduced my need for large water changes in my hatchery, which has given me a considerable amount of savings over time along with changing the microbial flora to something more similar to what exists in the wild. I have also reduced the stress factor of captive fish by providing them with optimum water quality.

References:

Bailey, P.S. 1975 Reactivity of Ozone. The first International Symposium on water for waste water treatment.
Evans, F. 1972 Ozone In Waste Water Treatment
Gargas J.E. 1988 TFH – Fresh Water 0zonation and Foam Fractionation in a Discus Hatchery
Ikehata, A. 1975 Treatment of Municiple Waste Water By The Use of Ozone.
Renner, R. 1985 Uses of Ozone in Drinking Water Treatment and Application
Rice, R. 1985 Uses of Ozone in Drinking Water Treatment
Snoeyink V. L. & D. Jenkins 1980 Water Chemistry - John Wiley & Sons, New York
Sterba, G. 1983 The Aquarists Encyclopedia



Another photo of Joe Gargas's fishroom.

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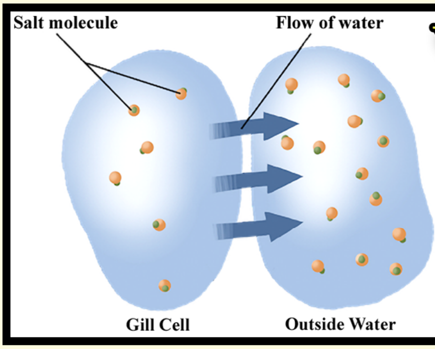

Wives' Tale: pH Shock!!!

by Mike Jacobs

From November 2018

Remember guys . . . I have been keeping tropical fish since I was about 5years old (1950)! My mom introduced me to the hobby and boy was she ever sorry about that . . . inside of 1-2 years I had 6-8 tanks in my bedroom and spawning fish and I was only 6-7 years old!!!!

Anyway . . . in all of the years of keeping fish I have heard about 10000000 wives' tales. Most people don't intentionally tell "lies" . . . they just repeat what they have been told and accept it as fact . . . they REALLY think they are helping people, really!!!!!

Well, one of the old "Wives' Tales" I had heard since about the late 1950's was that when you put "new" fish into your aquarium and within 1-12 days they die, then it's "pH Shock"!!!! I bought the story. I mean at that time I was 8-9-10 years old and who was I gonna argue with?

Well folks . . . that "wives' tale" is not true. I don't think I have ever seen a TRUE case of "pH shock". It's not generally pH shock and let's rule that out!!! Generally, maybe 98% of the time, it has to do with OSMOREGULATION! Generally the fish are coming from a conductivity problem (hardness . . . we'll talk about that and Joe Gargas is now really mad at me for saying the 2 are the same . . . ☺☺!!). Generally the fish that died is coming from a higher conductivity than your water and that presents a problem . . . sometimes a DEADLY one!!!

Let me try to explain what is going on with fish when that situation presents itself to the fish you just got somewhere.

A fish's body does so many things it's amazing . . . but let's just talk about this problem and the fish's reaction to THIS problem. A fish's body needs to be in "equilibrium" with the surrounding water . . . that's just NATURE . . . the amount of "salts" in the water has to be equal to the amount of "salts" in the fish's body. If it is not, then the fish has a problem and begins to self-correct its body, since it cannot correct the outside water and the salt on the outside. To do this the fish can either take water in or release water from its body to make the proper

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compensation. That's the problem!!! (salts & minerals: I use them as the same)

Ok . . . remember, the fish cannot change the "salts" in water outside of it's body!! So let's assume you are given (buy) a fish and just plop it into your tank. Let's assume the water the fish was in had a MUCH higher "salts" content that your water. What's going to happen? The fish is going to try to REGULATE it's fluids to match the outside water . . . that's all it can do!!! Well, remember, the outside water contains MORE "salts" that the body contains so water from the fish's fluids must exit the fish's body. WHERE DOES THAT HAPPEN . . . **THROUGH THE GILLS**!!!! If the "salts" on the outside are just a little bit more concentrated then that's not a problem . . . the fish will allow water to **exit** through its GILLS and everyone is happy. The problem is if the water contains a way higher concentration of "salts" . . . now the **exit** of was is happening **BIG TIME** through the gills AND THEY CAN'T TAKE IT!!!!! What happens is the gill cells will burst and burst and burst and burst until the fish can no longer breathe and that's the classic symptom of the OLD "Wives' Tale - pH Shock" . . . the fish will go to the top of the water and try breathing like a betta does and they gulp and gulp and gulp air, unsuccessfully, until they eventually die!!

The process of dying can start within minutes if the outside concentration of "salts" is **WAY** higher than what the fish was in up to 10-12-14 days in some cases and you won't even notice what the heck is going. That last case would happen if the amount of "salts" they were in is not a tremendous difference between your water.

Ok . . . trust me folks . . . this is a matter of the water from within the fish's body trying to get out of the fish's body and it happens through the gill cells and the gill cells will burst if the difference is too much . . . literally.

Ok . . . that's the problem . . . what are the parameters within which you can get fish from people and stores and be safe? Well, first you have to have some way to check the water. Answer: a **CONDUCTIVITY METER** (right). They are smallish (6-7 inches long and 1 inch wide by ½ inch deep . . . or so. If you don't know the conductivity of the water they are coming from then you MUST at least have a conductivity meter at home and measure the water they are in. My St. Petersburg, Florida water is about 550uS (uS – symbol for Microsiemens the units used by a conductivity meter) and that is kinda normal for West Coast Florida city water. If you get a fish from a store and the bag shows 4000+uS . . . that fish will likely be dead in 4-6-8 days or so. If you are getting the fish from a friend and they know what they are doing then you probably aren't going to have a problem. This problem is a relative problem usually with fish from a fish store. Be very careful with them . . . I am **NOT SAYING DON'T BUY FROM THEM** but if you have the fish home and your conductivity meter shows 4-5 times the conductivity reading then TAKE YOUR TIME acclimating your fish to your water.

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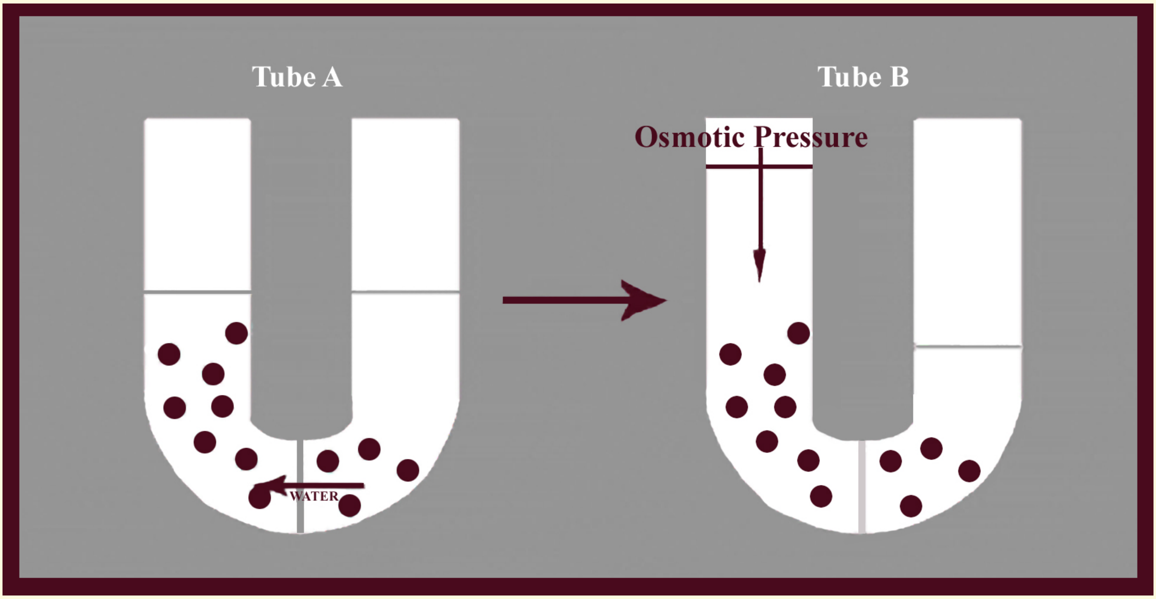
Put them in a 1-2 gallon plastic tank and put 1/3 of the total water in every ½ - 1 hour for a day or 2 depending on the difference in the meter reading and all will be fine!

Lastly, how about going the other way with the conductivity . . . lower “salts” level to higher “salts” concentration. That’s not even close to the problem of going the other way. What happens then the fish is going from higher concentrations to lower concentrations . . . **the gill cells burst from too much water trying to escape too quickly** . . . going the other way the cells just accept the INFLUX of water through the gill cells kinda normally . . . who am I to argue with Mother Nature!!

The following diagram is from Steve Rybici’s website “Angles Plus” showing the water flowing from a lesser concentration (fish’s body) to a higher concentration (outside water):



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Geophagus argyrostictus **- Blue-Lipped Cichlid**
photo: Mike Jacobs 2021

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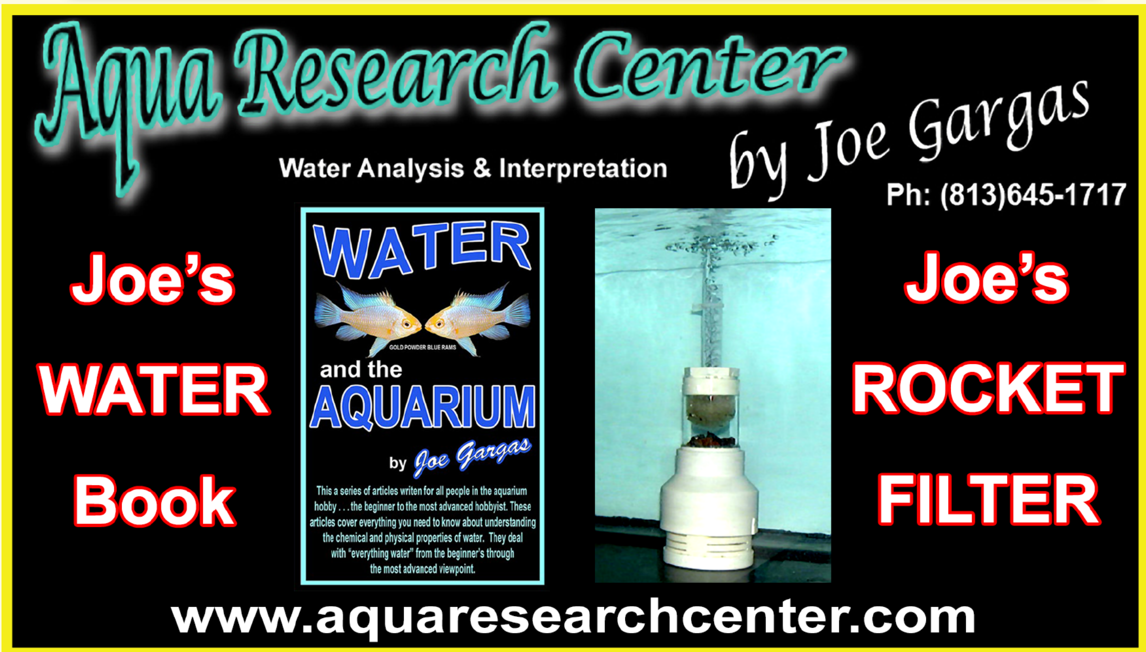

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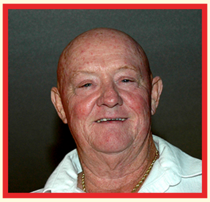

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