DIY Automatic Aquarium Water Filler

(Or – Hydraulic Engineering; Including What Works, Doesn't and Why!)
(Some minor welding is used as a construction tool)

Keeping more difficult to maintain fish like Discus or those living in Salt Water requires more attention than goldfish in a bowl! The higher temperature that Discus require evaporates more water than a gold fish bowl as well. If you're going away for perhaps a two plus week vacation what to do? You can trust your fish to a friend or you can automate the evaporation make-up water and feeding functions. Water make-up can be accomplished without electric switches or pumps employing a simple mechanical approach. It uses a principle developed in the mid 1600reds!

This "Picture Book" outlines how to build a water make-up system that works that has no moving parts. In addition - and as important - what we tried that didn't work! Also included are other items employed to make ongoing aquarium maintenance easier.

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Making an Automatic Water Make-up System

What worked and what didn't.

The first attempt was simple an inexpensive. Use a toilet bowl float valve and a 5 gallon plastic pail of water set above the tank. Sounded like a simple idea. **A visit to Lowes found the parts needed; or so I thought! The float selected was combined with a valve. This model took the least amount of room and was only $9.00. Bought a 3/8 inch threaded Nylon Barb for the pail and a threaded pipe fitting to act as a retainer nut.**	
Next step was to bend a 2x7x1/16 inch Stainless Steel sheet to hold the float/valve. **Clamped in a vice and made the two bends to form a "U" that would slip over the top of the aquarium.** **Drilled holes for the Nylon 1/4x20 screws that would be used to secure the bracket to the aquarium top. Also drilled holes for Nylon screws and plastic pipe clamps to hold the combo valve/float**	
Inserted stainless nuts into the holes in the bracket using screws to temporarily hold and center them. Tack welded with 2 small tack welds each to secure the nuts to the bracket. Used stainless welding wire but plain carbon steel wire would work for this application. The nuts are outside the aquarium so corrosion is not an issue. The weld made with carbon steel may also be brittle but it is not a large load so should work fine. Long Nylon bolts in picture were cut short. **The small tack welds can be seen in the inset picture.**	

Drilled a hole in a 5 gallon plastic pail and inserted the Barb. Threaded the pipe fitting on the inside and sealed with Aquarium Silicon. A 3/8 inch hose went from the Barb to the plastic pipe on the valve/float. Unfortunately the valve never shut off the water completely! Could have been a bad valve or it could have needed higher inlet pressure to seal. Not sure, it was a sealed system and couldn't check.	
Decided another approach would be better and I would not have to worry about overfilling because of a leaking valve! **Used a hydraulic principle that has been known for centuries! A sealed container can allow a partial vacuum to form to hold water in the container.** **Found this 5 gallon poultry feeder at the local Ag Store. It had an "O" Ring cap. Used a male 1/4x20 threaded pipe fitting to tap the opening at the bottom. Threaded the 3/8 Hose Barb x 20 threads/inch fitting into the hole and used aquarium silicon to assure a seal. There can be not be even a very small air leak or this system won't work!**	
Had confidence this system would work having used the principle when changing the bottom heating element in an electric water heater! A plumber told me; "No need to drain the tank; just shut all lines, opened the drain valve, couple ounces drained into the pan then - no water! A vacuum formed in the tank preventing water from coming out!" I knew the scientific principle but was still nervous since the water heater was directly above our living room! But it worked. Unscrewed the lower element and it was a weird sight! A 2 inch diameter vertical wall of water just sitting there quivering! No more than a few ounces leaked out into the drain pan as I screwed in the new element!	 **That is not an actual photo of what I did with a tank full of water but it does show what was done.**

Had the Stainless bracket built, so used it to properly position the hose end in the tank. When water was above the hose end air can not go back into the tank and the vacuum formed prevents water from leaving the tank. Keeping the tank vertical- I tested the system. It worked so well that even with the tube exposed to the air- no water flowed! Tried several attempts at putting a small hose inside the tank opening- no help. This was the 2nd failure!	
Air was not getting into the tank. Even tried a small hose inside the 3/8 inch hose to bring air to the low pressure in top of the tank. That didn't work either. The water didn't budge! Surface tension may have been blocking air movement. **So built a fixture to hold the tank horizontal so the outlet was pointing down. It worked!**	
This is the final set-up. The tank outlet is 20 inches above the water level in the aquarium. The hose does not dip down, it is always pointing up to the opening so air can move up into the tank when the hose end is exposed to atmospheric pressure air. **Tested it for two days with the hose below the water surface. About 1/8 inch of water left the tank. I attribute that to the air bubbles caused by the very active water movement generated by the filters. Some very small bubbles were seen in the hose. The water that left was probably not enough to make up for evaporation. When lowering the water level to test filling ability, an air pocket about 2 inches long would "slug" up the tube and water would come down from the tank. That was repeated until the water rose above the tube end- then it stopped. Works great. Bottom picture is a close-up of the tube and bracket in aquarium.**	 

Math Related to Gas Pressures

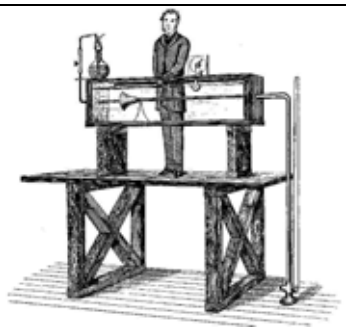
It is interesting that folks in 1600, 1700 and 1800 developed the math and physics knowledge to describe the phenomena they saw around them.

Daniel Bernoulli (1700-1782) understood and defined the relationship between gas flow and gas pressure. That defines why airplanes fly!

Osborn Reynolds (1842-1912) is shown in a sketch below Bernoulli with his test apparatus. He defined the rules that define when gas flow becomes turbulent (very important in gas shielding in MIG and TIG welding.)

Daniel Bernoulli

The bottom sketch on this page is Evangelista Torricelli (1608 - 1648) who was a secretary to Galileo in the last months of his life. Torricelli was a professor of mathematics in the Florentine Academy. He tested many materials defining the liquid column height that remained in a tube when inverted in a dish of that liquid. He noted a mercury column was 76 cm and predicted that water would go up 10 m (33.8 feet- see note right) on the basis of the ratio of the liquid densities.



Using mercury he developed the first barometer. He described why wind exists from this work. For his early efforts one unit of pressure measurement is named after him-Torr.

What happens in our Automatic Water Level Control is as water leaves the tank and the hose is submerged in aquarium water a partial vacuum forms and atmospheric pressure at the hose end prevents gravity causing water to flow out. Until air enters the hose/tank no water flows.

Using his data we can calculate the air pressure in the top of our container required to prevent water from flowing out of the hose. The height of water in our system is ~24 inches. In a tube with atmospheric pressure (14.7 psi) on one end and a total vacuum on the other water would be 33.8 feet high. Or 14.7psi/33.8 feet = 0.44 psi/foot. Or for 2 feet the pressure would be 14.7 psi -2 x 0.44 psi = 13.8 psi or a vacuum of less than 1 psi.

Perhaps he was not quoted accurately but based on density difference 76 cm = 10.29 m of water so actual height = 33.75 feet! Not the direct 10 m = 32.8 feet! We'll give the scientist credit – not the Internet!

Discuss by Mail – Appendix A

Wanting to try Discus in my 55 gallon tank decided the best way to buy quality fish at a reasonable price was by mail. Had been purchasing aquarium supplies from www.PetSolutions.com so looked at their offerings. They had the range of colors the size (3 inches) desired. Their prices and shipping charges were very reasonable.	
A box was delivered by UPS Next Day Air. It arrived @ 10AM. Each of the 6 Discus was in a separate double wall bag. Put all six in a bucket with a plastic bag liner. Slowly added aquarium water that had been operating for a month with a Bristlenose Cat and 4 Green Cory's. Tank water measured 0 Ammonia; 0 Nitrite and 20 Nitrate. PH was 6.7 and TDS 200. **Purchased 10 Rummynose Tetra as well as "Dither Fish." This would supposedly make the Discus less timid.**	
The fish loved the tank. For the first few days the Rummynose Tetra "Dither Fish" did their job. The school of ten cruised the tank. They seamed to make the Discus less nervous. **However within two days the Discus became aggressive. They came to the front of the tank when I went into the room. They wanted to be feed! The Rummynose went into hiding in the plastic plants! Even the Cory's are only seen on occasion. After a month things haven't changed, All are doing well. Only see the Rummynose when food drops in the tank!**	

Tank Set-Up - Appendix B

The 55 gallon tank has a grass/wood picture background and plastic plants. There is one small piece Mopani wood from Africa in the tank. It extends the wood pictured in the background to the front of the tank. The Bristlenose reportedly likes to chew on it – to each his own! The Bristlenose Cat manages all the algae. Really can't see any in the tank. Used 15 inch high plastic plants that look great.	
Two Emperor filters are in the back. The 400 has two Bio-Wheels and the 280 has one. These sustain the aerobic bacteria needed to help manage Ammonia and Nitrite. The flow rate is high but the fish are not jostled around. Although lights are on the top cover they are not used. There is a skylight within a few feet of the tank that provides plenty of diffused light.	
The Bio-Wheels are seen in this picture. Water flows over these as it exits the filter. This turns the wheels and keeps the large corrugated surface area exposed to air.	
The picture right shows the Cascade ceramic Bio-Rings used in the filter. They come in a plastic mesh bag. The Bio-Rings provide a large surface for the growth of bacteria needed to produce the proper balance in the aquarium. The bag is placed behind the mechanical media in the filters. Currently using polyester batting pillow stuffing material from Wal-Mart as the mechanical media. It is placed in the container that comes with the Emperor filter. The container Is modified with a Dremel tool to remove the baffles from one side.	

Discus are from the Amazon where temperatures are 82 to 88 degrees F. Our tank at kept in that range. **The higher temperature keeps the 200W and 100W heaters working in the winter. To reduce heat losses and electrical costs the bottom and back of the tank are insulated. Some left over Street Rod insulation was glued under the tank. The back piece of insulation is held with some clips over the aquarium top and some clear tape seals the edges. The same tape was used to attach the plastic background picture edges. This insulates two of the three large glass areas.**	 
What to do if the power is interrupted? Probably only have 2 to 3 hours before the fish will be in distress. This PENN-PLAX Model B11 costs less than $20. It used two "D" batteries and can supply air for about 72 hours. It plugs into a 110 volt line strictly to tell when it is off! Then it turns on the air pump and generates enough air to create a bubble stream to aerate the tank! Use two in the 55 gallon.	
Have used this Lifeguard feeder for 30 years. It has 14 chambers and can feed 1, 2 or 3 times per day. I feed once per day and the fish gather when it's time! It also comes with a plastic top that can feed for 30 days of more. I like to vary what I put in each section with some food for the catfish mixed in (algae pellets.) Although hard to see, I use a piece of clear tape, partially folded over around about 1/3 of the top to provide a backstop so food can be placed on the top and pushed into each bucket. **Picture on bottom shows larger food holder installed.**	 

Changing Water Weekly – Appendix C

This Aqueon Water Changer is well worth the $25. It uses a Venturi principle (name after Giovanni Venturi 1746–1822.) The flow of a liquid or gas though a small passage creates a vacuum. In this case the vacuum is used to pull the tank water out and into a sink. Then reverse the valves with a flip of the lever and the tank fills. I change 20 gallons in under 10 minutes.

The device comes with a faucet adapter but it did not fit my small faucet spicket. Fortunately the local Ace Hardware had just what I needed. It's shown on the left in photo. Cost was only about $2.00.

Here the unit is installed. To keep splashing in the sink I cut the top and bottom from a quart plastic bottle and inserted the "Water Changer" through the top hole.

Photo bottom left shows the other end in the tank. Purchased an optional 18 inch long pickup tube. These are about 2 inches in diameter and pick the gravel about 3 to 4 inches and pull all debris into the sink.

When its time to fill, since the make-up water is coming directly from the tap, I use this inexpensive digital thermometer to match the water temp to the tank. I also use a capful of "Prime" to handle a full 50 gallon dose of Chloramines. That is what they recommend when you can't add it just to the make-up water. $7.50 of Prime handles 1250 gallons or 25 water changes.

40 Years of Fish Keeping – Appendix D

The current tank held Lake Malawi Cichlids for about 5 years. Note rocks and rock background that provided plenty of hiding places. Had a similar 75 gallon tank some years ago where the Malawi Cichlids bread. Some young were able to hide and grow in the rocks until they got large enough not to be eaten! These fish are mouth brooders.	
Kept salt water fish for several years 30 years ago. That was a challenge since I traveled and did not want to be changing 25% of the water each week! I also decided I would use small tanks (against recommendations) a 20 and 10 gallon! This was well before folks talked about live rock etc. The 20 gallon had only a Panther Grouper and a Volitan Lionfish. Kept them about 4 years. They ate mostly Bay Scallops, about once or at most twice a week. Put scallops on a string and bobbed in the tank! **Both tanks had lots of algae with lights on a timer. The local aquarium store would harvest some for their tanks! I recall writing a "How To..." about the 10 gallon system for the local aquarium club. Seldom changed water in it - that was the challenge! Looking back and reading modern salt water books suggest my tube worms and growing lots of algae were probably what made this tank successful.**	 
Keeping fish started when daughter and I bread Betas in the basement 40 years ago! We had lots of jars filled with babies and were raising brine shrimp for food. **She still has fish as do the grandchildren. Great hobby.** **With some of these tips keeping fish can be easy even when you go on vacation! Suggest reading all you can and buy a few good books. That is what I have done over the years.**	

Advertisement for Our Gas Saver System

If you found the information about making an aquarium easier to manage useful and you have MIG (Wire) Welder you'll enjoy the following.

If you don't have a MIG welder but have a friend with one or with a Fabrication Shop do them a big favor and have them review these three pages and the Shielding Gas Saving information on our Web Site: www.NetWelding.com

If You Have a Home Shop - Have You Run Out of Shielding Gas on a Saturday or Sunday? We Have a Solution:

How Much Gas Can Be Saved??

The best way to show the savings is with an example from one of our industrial customers who tested the system then bought them for all 35 of his MIG welders.

A Texas Truck Box manufacturer evaluated the system on a repetitive job, welding doors. With their standard gas delivery hose they welded ***236 doors*** with a full cylinder of shielding gas. Just substituting their gas hose with our patented ***GSS*** maintaining the same flow settings they welded ***632 doors***! That's a 63% reduction in shielding gas use.

Weld Performance Improvement

A small shop owner provided this feedback after he purchased a 3 foot ***GSS*** for his small MIG welder. Al Hackethal reported these findings:

"Well, I can't believe it. I never thought a hose could make that much of a difference. I had a small job that's been waiting for a while. The weld quality, and even penetration is considerable better. Almost no spatter! The weld seemed to be hotter and I turned my MIG down a notch.

Initially thought that my imagination had kicked in, but then realized that the gas I'm buying is actually working the way it's supposed to. Glad I found your website. This is one of the few things that really works better than any info could suggest. I understood the theory, though in practice I understood much better after the first couple of welds. Now I have better looking welds and almost no spatter, which means less grinding and finish work! In addition, the tip was cleaner after the job I just did.

This will provide savings in time, labor and maybe even consumables too. As a one man shop there's never enough time for anything.

Oh, the leather wrap for my TIG hoses worked very well and fits perfectly. I'd just replaced the hoses and was looking for something to protect them that was better than the nylon wrap that's available around here. Now I'm "TIGing" again too, and much safer. It's good to know the coolant hoses are well protected. Much better than using a 300 amp TIG and then realizing that I was standing in a puddle of coolant, which is what recently happened.

Thanks for making products affordable".

Another Home Shop Writes About GSS System

Perry Thomasson has a very well equipped home shop. He uses a 175 amp MIG welder. However the small welder cart only held a medium size shielding gas cylinder and Perry wanted to reduce the number of times he had to have it filled.

He purchased the largest cylinder his distributor offered for sale and chained it to a wall in his shop. He needed a much longer gas delivery hose so he added a 50 foot conventional 1/4 inch ID hose. He found he was using a lot of gas.

He purchased a 50 foot long ***GSS*** and saved a significant amount of shielding gas while improving his weld starts by reducing the starting gas surge. Since his regulator/flowgauge had a hose barb on the output, we supplied Perry with a splice connection on the supply end of the ***GSS***. He simply cut the existing gas delivery hose close to the regulator and spliced in the ***GSS*** hose. The welder end uses a standard CGA fitting that is supplied with the system.

Perry emailed a picture and said;

" The system works great. Thanks for the professional service and a great product."

A Professional Street Rod Builder Had This to Say About the GSS*:*

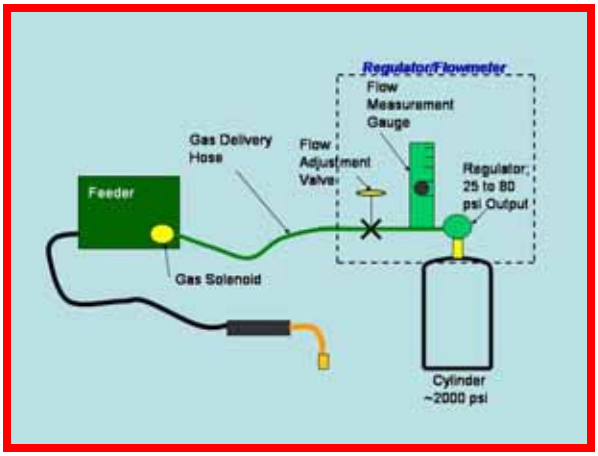
They use a 250 amp MIG welder with built in feeder and a 6 foot gas delivery hose. With their standard gas delivery hose the peak shielding flow at weld start was measured at 150 CFH, far more than needed and enough to pull air into the shielding stream. Air is then sucked into the gas stream causing poor weld starts and possibly weld porosity.

With the ***GSS*** replacing their existing hose, the peak flow surge at the weld start was about 50 CFH and it quickly reduced to the 25 CFH setting. With the many short welds made and frequent inching of the wire, they used less than half the gas and had better starts.

Kyle Bond, President, indicated a big benefit is the reduced time and effort changing cylinders since it's required less frequently. He quickly saw the improvement achieved in weld start quality as a significant advantage! Kyle, an excellent automotive painter, was well aware of the effects of gas surge caused by pressure buildup in the delivery hose when stopped. He has to deal with the visible effects in the air hose lines on the spray gun in his paint booth! It's too bad we can't see the shielding gas waste as Kyle can the effects of excess pressure when he triggers his spray gun! The paint surge is visible and creates defects unless the gun is triggered off the part being painted! Kyle can manage the surge by triggering the paint gun off the part; unfortunately we can't start our weld with the MIG gun off the part ! The ***GSS*** has a built in surge flow limiting orifice that keeps the peak flow from becoming excessive. So you not only save gas you improve your weld starts!

How Does The GSS Work?

Gas waste occurs every time you pull the MIG torch trigger even if it's only to inch the wire to cut off the end.



To keep flow at the preset level the gas pressure in the cylinder regulator will be between 25 and 80 psi. Flowgauge regulators (those with a flow calibrated pressure gauge) operate in this pressure range as well.) However to flow shielding gas though the welder and torch typically requires 3 to 5 psi depending on restrictions. Therefore every time welding stops the pressure in the gas hose raises to the regulator pressure of 25 to 80 psi. That stores up to 7 times the hose volume of gas in the hose. This is similar to your shielding gas cylinder which holds about 150 times the volume of gas as the physical volume of the cylinder due to the high pressure!

The patented ***GSS*** stores over 80% less gas then typical shielding gas hoses. In addition to the wasted gas (which you can hear when you pull the torch trigger) the high flow also causes air to be pulled into the turbulent shielding gas stream! This is like starting with the gas cylinder shut off! You have probably experienced that before when you forgot to open the valve!

It takes a short time for the shielding gas flow to return to a smooth less turbulent (laminar) flow even when the start gas surge flow reduces. That can take several seconds so when making short welds or tack welds you're not getting all the benefits of the shielding gas you're purchasing!

SUMMARY:

The ***GSS*** can cut your gas use in half or more. It also has a surge restriction orifice built into the fitting at the welder- wire feeder end. That limits peak flow (*but not your set flow*) to a level that avoids excess turbulence for better starts. It allows a controlled amount of shielding gas to quickly purge the weld start area.

All you need to do is replace the exiting gas hose from cylinder regulator to welder with our patented *GSS*. *It is available in various lengths at* www.NetWelding.com .

There are more testimonials at:

http://www.netwelding.com/production_test_results.htm

Have more questions? See:

http://www.netwelding.com/Overview_GSS.htm

Or email us at:
TechSupport@NetWelding.com