

Water Quality for Fish Farmers

Iowa Aquaculture Conference 2017

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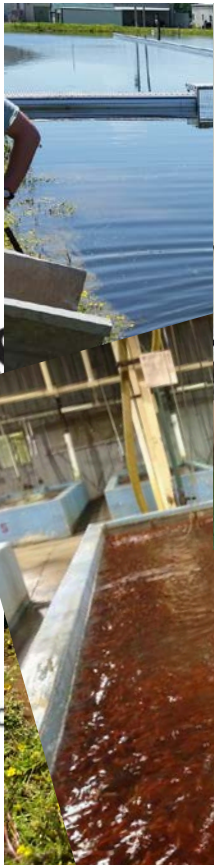
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WQ can be overwhelming



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What are your goals?

- Feed the family?
- Hobby?
- Retirement money?
- Part-time?
- Full-time?
- Investor?
- Combination?
- Don't really know?



What are your goals?

- Your goals are going to tell you how much time and energy to invest
- **Small-scale hobby?**
 - Likely much lower densities
 - Less worried about survival and stress
 - Lower feeding rates
 - Money in and only enjoyment out
 - Less stress on you



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What are your goals?

- Your goals are going to tell you how much time and energy to invest
- **Full-time?**
 - Likely higher fish &/or plants
 - More worried about survival/stress
 - Higher (appropriate) feeding rates
 - An investment
 - Plenty of stress



When and what to test at commercial densities?

- A few factors/questions can help you determine when/what to test
 - Type of system
 - Farmer's experience with that particular system
 - Age of the system
 - What do the records say?
 - Have fish been moved recently?
 - Are fish about to be moved?
- Some parameters should be tested daily regardless of the system
... such as oxygen, temperature, and maybe pH



RAS testing as an example

Daily

- Temperature
- Dissolved oxygen
- pH

Weekly

- TAN & unionized
- Nitrite

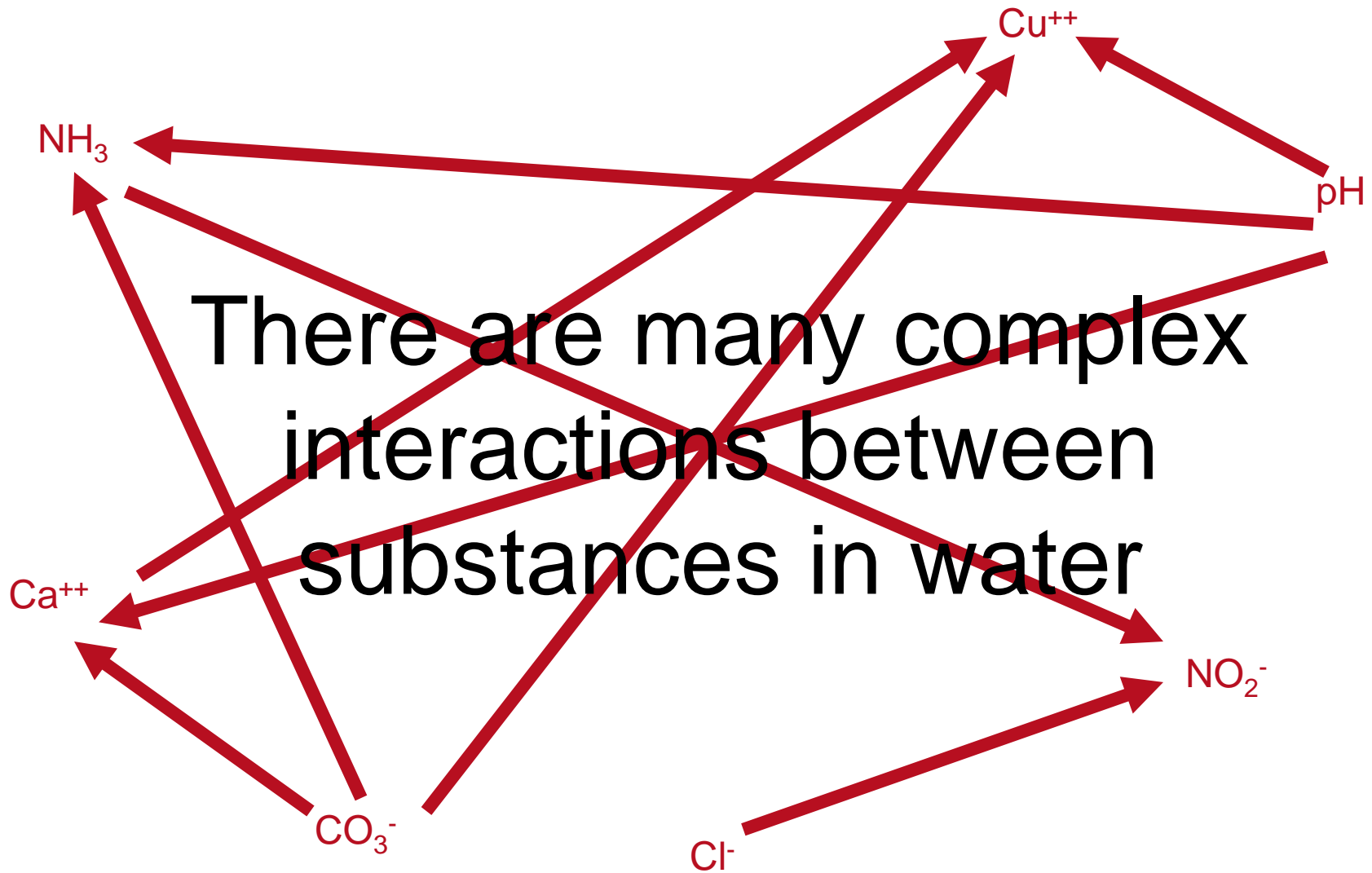
Biweekly/Monthly

- Nitrate (can neg. affect fish in RAS)

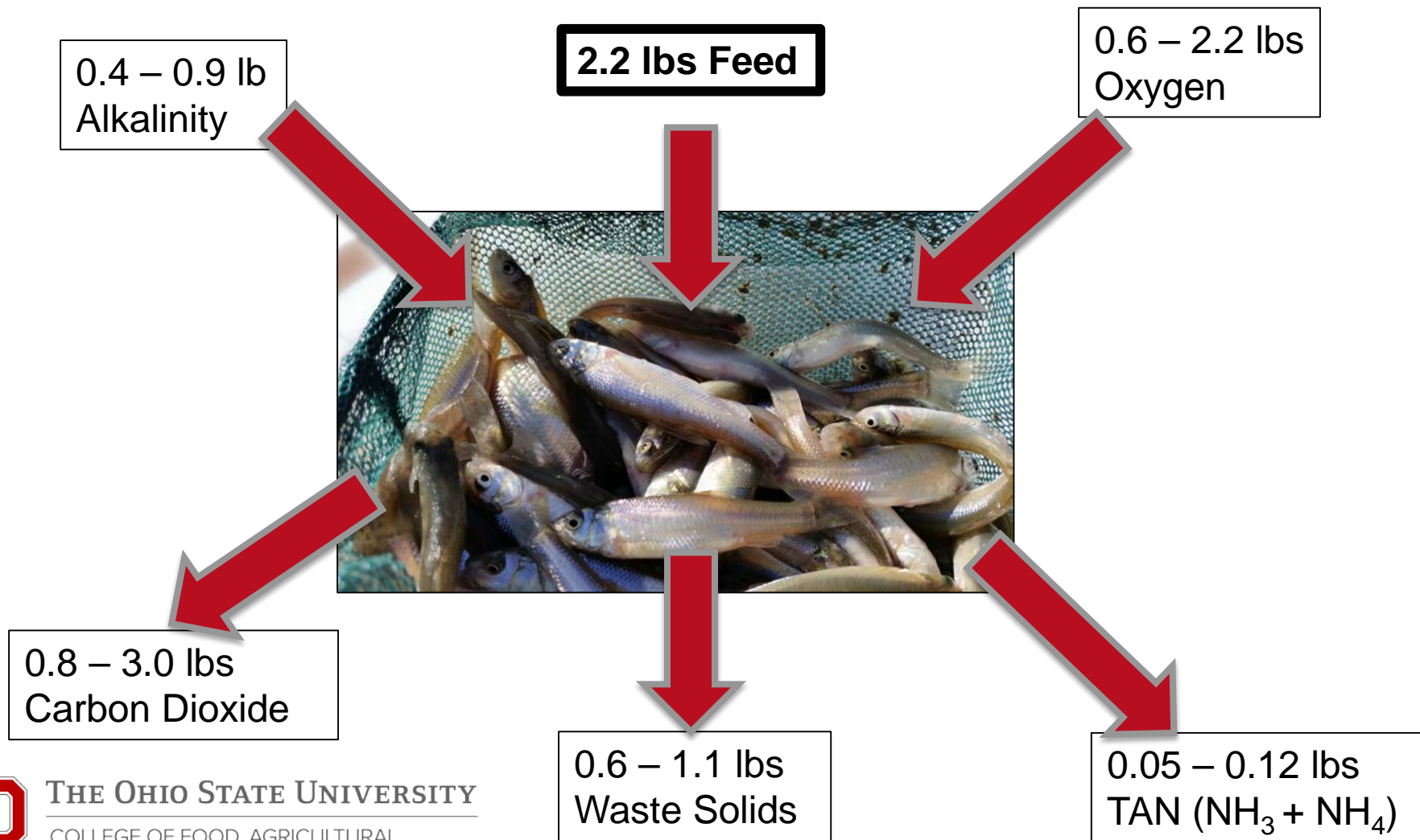
Monthly

- Alkalinity
- Iron
- Calcium hardness
- Chlorides
- Others as necessary





What happens when you feed?



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Parameters – temperature

- Humans are homeotherms
 - We self-regulate at ~ 98.6 F
- Fish are poikilotherms
 - Poikilo = irregular/varied
- Means that body temperature is determined by temperature of the environment (i.e. water temp)
- Species specific
 - Warm water, cool water, cold water
 - Tilapia, yellow perch, salmon



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Parameters – temperature

- Tilapia as an example
 - Too hot? Spend all of their energy covering “cost to survive” – maintenance ration too great; will not grow/ stress
 - Too cold? Metabolism is so low that they stop eating or eat very little. Maintenance ration low; will not grow much
 - Within range? Will grow okay and be healthy/less stressed
 - Optimal temp? Growth often 3-10 x greater than tolerable
 - Die outdoors overwinter in many Midwest states

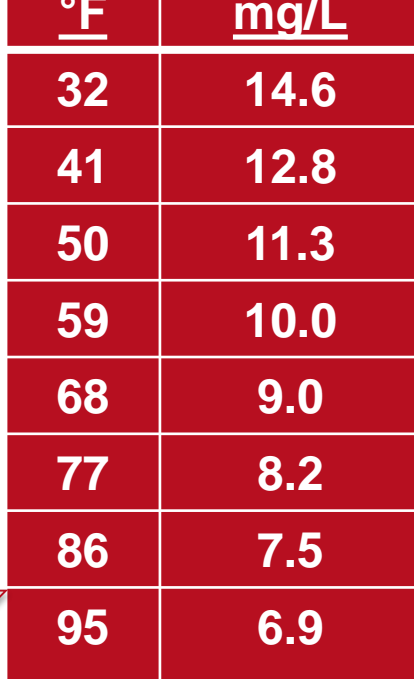


Parameters – dissolved oxygen

- ✓ Oxygen necessary to survive
- ✓ Fish, plants, bacteria, uneaten feed, fish waste
 - all use up oxygen
- ✓ Microscopic plants produce oxygen when the sun is out
 - how?
- ✓ Beneficial organic decomposition occurs because of aerobic processes
- ✓ $> 5 \text{ mg/L}$ for bacteria, plants, and fish
- ✓ Check DO all over the system



Oxygen saturation



<u>°F</u>	<u>mg/L</u>
32	14.6
41	12.8
50	11.3
59	10.0
68	9.0
77	8.2
86	7.5
95	6.9



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Parameters – pH

- ✓ How acidic or basic something is
- ✓ Low = acidic | High = basic
- ✓ Need to consider the fish, plants, and bacteria
- ✓ Each have their own ranges and optimum growth
- ✓ Large pH swings = fish stress | plant stress
- ✓ pH determines amount of ammonia in harmful form
- ✓ Limit pH swings with higher alkalinity; buffer



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Parameters – pH in aquaponics

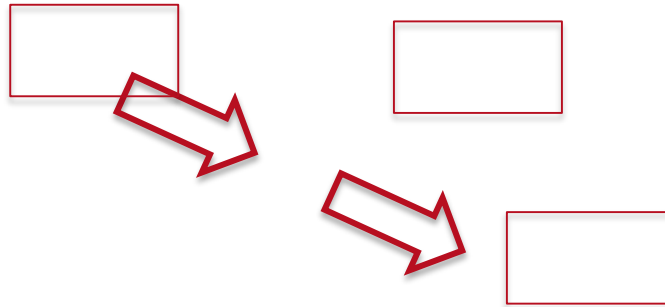
Overlap as much as possible; although we know farms thrive outside of these ranges¹⁵

Parameters – ammonia & nitrite

- ✓ Ammonia (often seen as total ammonia-nitrogen or TAN) ends up in an aquaculture/aquaponic systems through...
 - ✓ Uneaten feed
 - ✓ Fish waste
 - ✓ Added to “jump start” a system
- ✓ NH_3 is known as the toxic form (un-ionized)
- ✓ NH_4^+ is known as the non-toxic form (ionized)
- ✓ Ammonia in the toxic form is very harmful
- ✓ Know what form the ammonia is in and how to make sure your fish are safe!

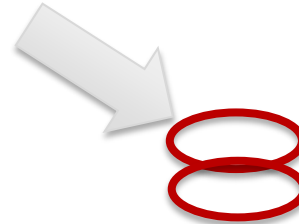


Parameters – ammonia & nitrite | SRAC 463



Parameters – temp/pH/ammonia relationship example

~ 6.5 – 7.2 ideal
in aquaponics



Check pH, temp, and
TAN with field kit at the
same time

pH = 7.0
Temp = 24 (75 F)
TAN = 2 ppm



0.01 ppm
toxic form

24 C = 75 F

Parameters – temp/pH/ammonia relationship example

~ 6.5 – 7.2 ideal
in aquaponics

pH shock (fish or plants)
Toxic un-ionized

pH = 8.6
Temp = 24 (75 F)
TAN = 2 ppm

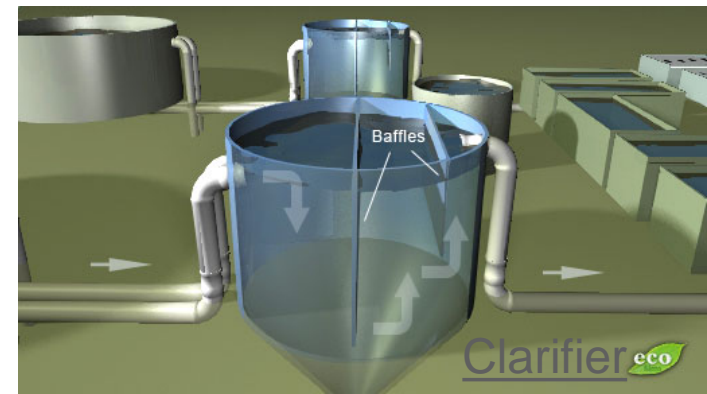
0.34 ppm
toxic form



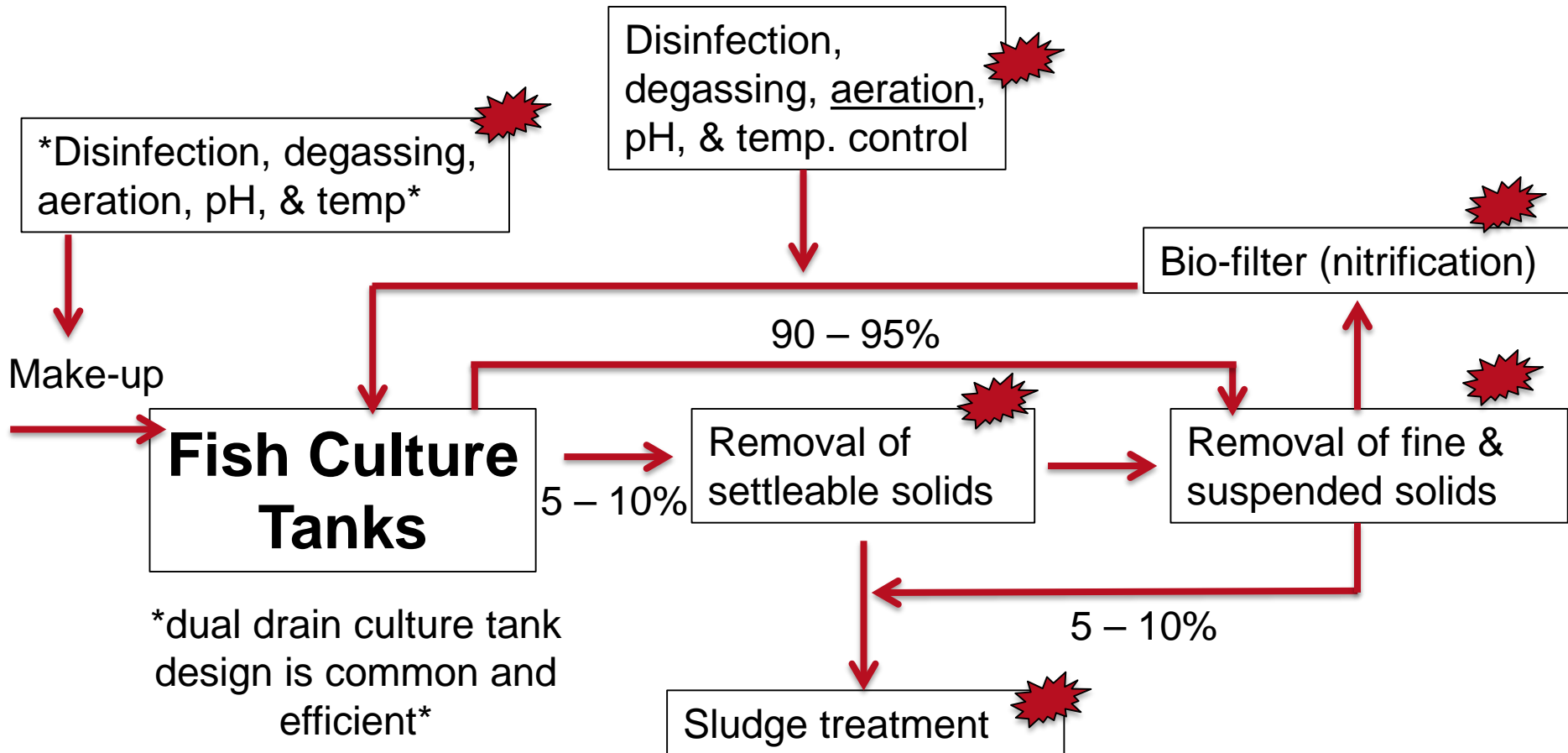
24 C = 75 F

Filtration/water remediation

- Several factors including species, system type and density/age of system will determine how/what to filter
- Settleable and suspended solids; ammonia; pathogens; CO₂; etc.
- Ponds rely on bacteria that adhere to any floc, aquatic plants, soil, etc. to remediate water
- RAS often rely on drum filters (or something similar) and bacteria located all throughout the system to remediate but primarily in the biofilter/ MBBR
- Aquaponics often rely on clarifiers/swirl filter, biofilter, and then bacteria located throughout the system



General water flow in a RAS



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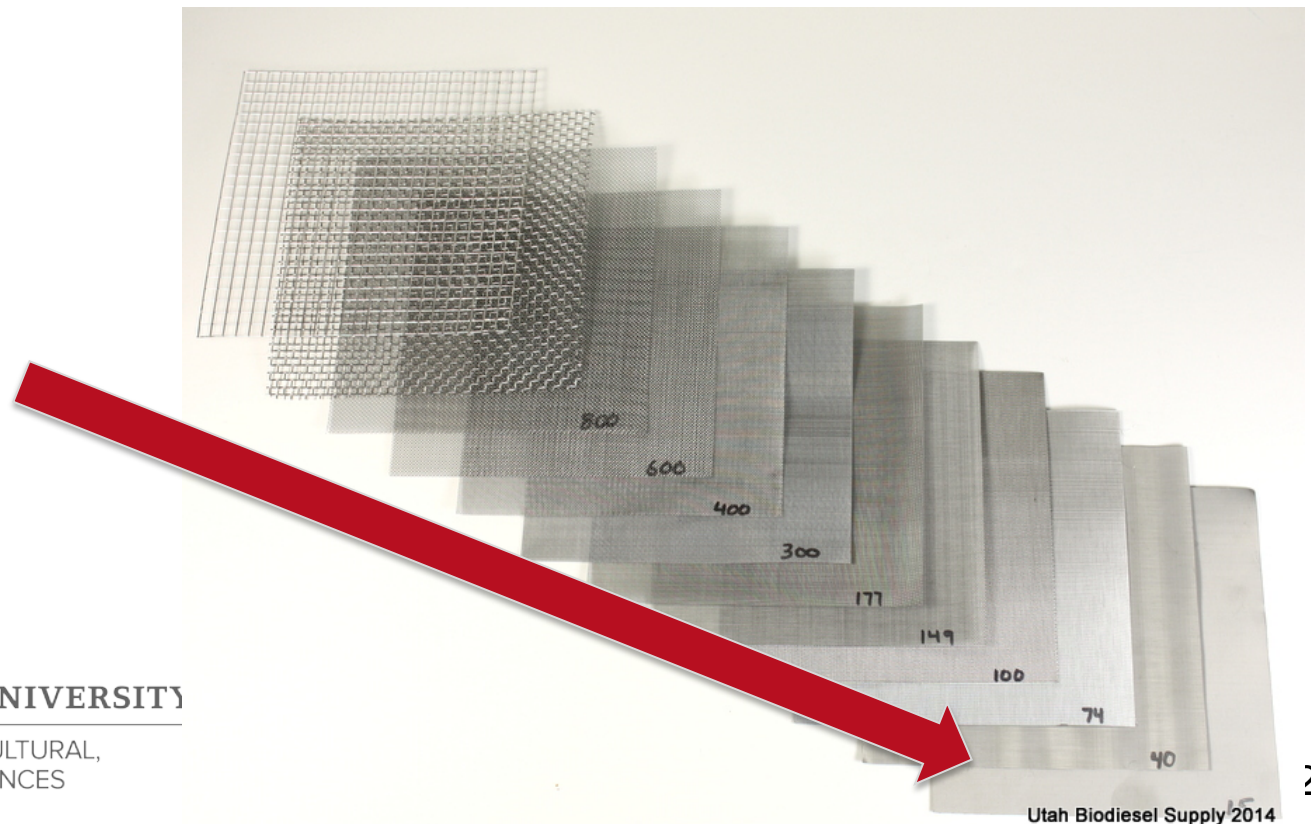
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= Type of filtration!
Keeping water clean is key!

Why is filtration so important in indoor systems?

- Approx. half the feed consumed is excreted as solid waste
- That waste must be removed because it is **toxic** to the fish
- Multiple filters improves efficiency (size specific)



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Source water

- Chlorine vs. chloramine – know the difference, contact your water treatment plant
- Iron, ammonia, carbon dioxide – can be present in well water
- Rain water? Check pH; salt or other nutrients may need to be supplemented
- Check your source water and try to get on a “notify” list with water treatment plant – If they change their treatment then you need to know!



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Ohio EPA

Test on site and often

- Field test kits are available for purchase by many aquaculture companies
- Website designed to be a “one-stop shop” for all aqua needs
- Find a good kit and stick with it
 - Test strips
 - Colorimetric
 - Titration
- Ranges from \$ to \$\$\$\$
- Cheaper alternatives okay if reliable

Partial list of supply companies

Texas A&M AgriLife Extension Aquaculture, Fisheries, & Pond Management

Welcome	Aquaculture	Aquaponics	Aquatic Vegetation Management (Pond Weeds)	Fish Die-Offs
Pond & Sport Fish Management	Forms & Permits	Mobile Apps	Youth Aquaculture	Youth Education
Youth Fishing	About Us	News & Events	People	Resource Links

Aquaculture Product Suppliers



Need assistance with wildlife and fish management on your ranch, backyard, or pond? Simply call your local [County Extension Agent](#).

Finding the correct supplies for your aquaculture business can be difficult. Below are links to some of the companies that provide goods and services to the aquaculture industry. Got a good link to an aquaculture supplier we should add? Let us know and we will post it.

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SITE PAGES

- About Us
- Water Chemistry of Well and Surface Waters in Texas
- Youth Aquaculture Education
- Youth Education
- Aquaculture
 - Aeration
 - Alligators
 - Aquaculture Product Nutritional Information
 - Aquaculture Product Suppliers
 - Beginning Aquaculture
 - Freshwater Baitfish
 - Business/Economics
 - Cage Culture
 - Catfish



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Recording your results

- Testing and interpreting today's results assists in good management techniques today and tomorrow
- Recording every day assists in good management techniques for the season and years to come
- Microsoft Excel (or at a minimum pen and paper) are cheap. Use them
 - Unsure how to use Excel for your fish farming needs? Contact me!



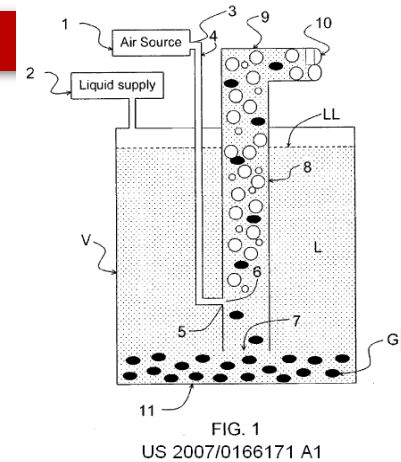
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2016 Water Quality Workshop

Overcoming WQ obstacles

- DO low in a system?
 - Compressed air, liquid oxygen, air lifts, combo?
 - Do the airstones need cleaning? Are they big enough?
 - Is there a reason other than increase in good bacteria and fish growth?
 - Additional BOD not necessary for a system will deplete the oxygen in the system
 - For example: too much organic waste accumulated in a system
 - uses up oxygen in the system
 - Check all sections of the system for dead fish or organic accumulation



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Overcoming WQ obstacles

- Temperature off in a system?
 - Short answer is turn the heaters/AC up
 - Longer answer is that it depends
 - Are you heating/cooling just air or just water? Both?
 - Currently using small stick titanium heaters or glass heaters?
 - Might be time to upgrade to drop in coil heaters, in-line heaters, gas/wood heaters, etc.



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Overcoming WQ obstacles

- pH off in a system?
 - Check source alkalinity and system alkalinity
 - Biofilters “eat up” alkalinity, causing a system to become more acidic
 - Addition of an alkaline base common
 - Fix the source of the problem but properly treated water can be added for a temporary fix
 - Something leaching?



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Overcoming WQ obstacles

- Un-ionized ammonia too high in a system?
 - Quick fix (won't last) is to do some water exchanges
 - Know the reasons – probably feeding too much for what the filters are able to handle
 - Right grow area vs. fish tank or vice versa
 - Correct filtration in an RAS
 - Overloading a pond with too much feed
 - Use online calc. or the graph



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Overcoming WQ obstacles

- Nitrates too low in an aquaponic system?
 - New system? If so then it'll take weeks for it to completely mature
 - More isn't always better
 - Ammonium hydroxide
 - Give it time, measure TAN, nitrite, and nitrate → you'll see it shift forms (figure shown several times in the recent past)
 - More established system? Measure parameters, likely not enough feed being added to the system



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Take homes

1. If this is/will be a full-time for-profit enterprise then treat it as such and invest time, money, and resources in testing WQ
2. Testing only when there is trouble is reactive and not proactive
3. “An ounce of prevention is worth a pound of cure”
4. Analyzing water is worth the time; machines/kits will pay for themselves if used correctly and often
5. Kits don’t have to be expensive
6. Record your data for future use
7. Fish that appear happy might not be; so test



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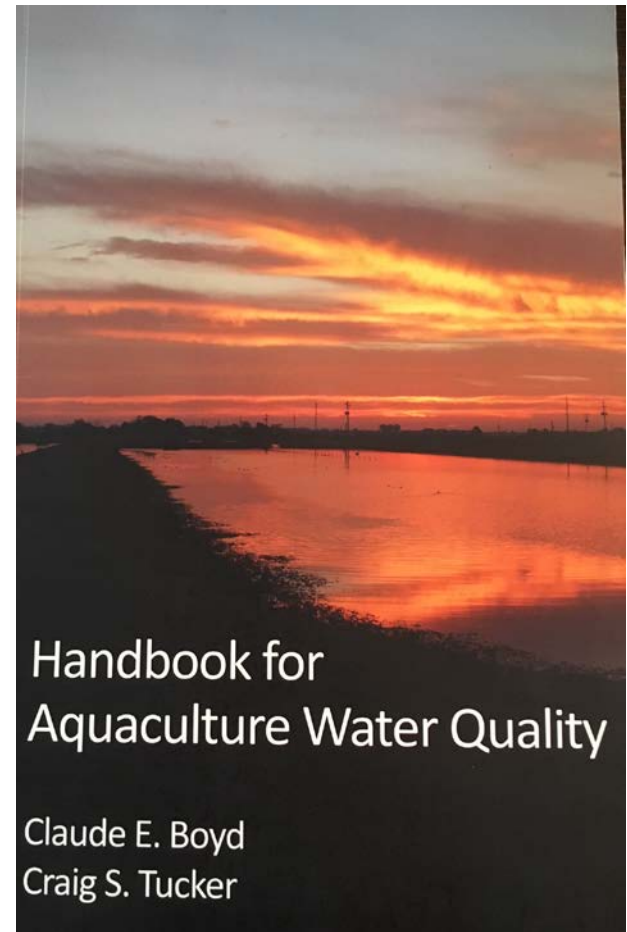
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Suggested readings

Southern Regional Aquaculture Center

Fact Sheets » Water Quality (460-471; 4600-4699)

- [SRAC 0460: Control of Clay Turbidity in Ponds](#)
- [SRAC 0461: Water Quantity and Quality Requirements for Channel Catfish Hatcheries](#)
- [SRAC 0462: Nitrite in Fish Ponds](#)
- [SRAC 0463: Ammonia in Fish Ponds](#)
- [SRAC 0464: Interactions of pH, Carbon Dioxide, Alkalinity and Hardness in Fish Ponds](#)
- [SRAC 0466: Algae Blooms in Commercial Fish Production Ponds](#)
- [SRAC 0467: Cost of Alternative Effluent Treatments for Catfish Production](#)
- [SRAC 0468: Carbon Dioxide in Fish Ponds](#)
- [SRAC 0469: Fertilization of Fish Fry Ponds](#)
- [SRAC 0470: Characterization and Management of Effluents from Aquaculture Ponds in the Southeastern United States](#)
- [SRAC 0471: Fertilization of Fish Ponds](#)
- [SRAC 4600: Toxicities of Agricultural Pesticides to Selected Aquatic Organisms](#)
- [SRAC 4601: Measuring Dissolved Oxygen Concentration in Aquaculture](#)
- [SRAC 4602: Pond Mixing](#)
- [SRAC 4603: Managing Ammonia in Fish Ponds](#)
- [SRAC 4604: Managing High PH in Freshwater Ponds](#)
- [SRAC 4605: Algal Toxins in Pond Aquaculture](#)
- [SRAC 4606: Interpretation of Water Analysis Reports for Fish Culture](#)



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Questions?

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