

# Water Chemistry Overview

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# What's the #1 fish killer in aquaculture?



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Photo by Matt Recsetar/Dr. Travis Brown

- **Buy/hatch fish/shrimp + tap water + feed + harvest**
- **Profits!?**





# Unfortunately not...

## Knowing your water is one of the best things you can do!

Beginner farmer?.....

- Learn all you can about water chemistry
- Talk to Extension and other farmers
- Be a lifelong student
- Do your due diligence
  - **.edu!!!**



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<https://srac.tamu.edu/viewCategory/25>



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Be sure to click on the What's New button above to see the newest information and publications.

### [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](#)

# Unfortunately not...

If you're already in business.....

- Buy healthy and hardy fish from a reputable dealer!
- Properly temper your fish!
- Check your parameters often and at key periods of time!
- Know your animal's **upper/lower/optimal** water quality limits!
- Maintain good records!
- Always be a lifelong student!

## Key Periods of Time

- 1) Prevent loss of fish at stocking
- 2) Prevent loss during highest feeding rates (usually summer outdoors)
- 3) Prevent fish stress during harvest to minimize loss during transport and restocking



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# So what parameters are important?

**Really depends on your system, species, density, etc.!**

## Ponds?

- Dissolved oxygen (DO)
- Temp.
- pH
- Total ammonia-nitrogen (TAN)
- Nitrite
- Alkalinity
- Hardness



## Other parameters might be necessary

- ✓ Carbon dioxide
- ✓ Iron
- ✓ Chloride
- ✓ Hydrogen sulfide



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# So what parameters are important?

**Really depends on your system, species, density, etc.!**

## Tanks (RAS)?

- Dissolved oxygen (DO)
- Temp.
- pH
- Total ammonia-nitrogen (TAN)
- Nitrite
- Carbon dioxide
- Alkalinity
- Iron (initially and then periodically)



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# So what parameters are important?

**Really depends on your system, species, density, etc.!**

## Aquaponic System?

- Dissolved oxygen (DO)
- Temp.
- pH
- Total ammonia-nitrogen (TAN)
- Nitrite & Nitrate
- Alkalinity
- Carbon dioxide



Also recorded frequently  
in aquaponics

- ✓ Phosphorus
- ✓ Iron
- ✓ Calcium
- ✓ Potassium



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**Can't I just check it every  
once in awhile???**



# Once again, unfortunately not...

Daily testing!

Bi-weekly testing!

Bi-monthly testing!

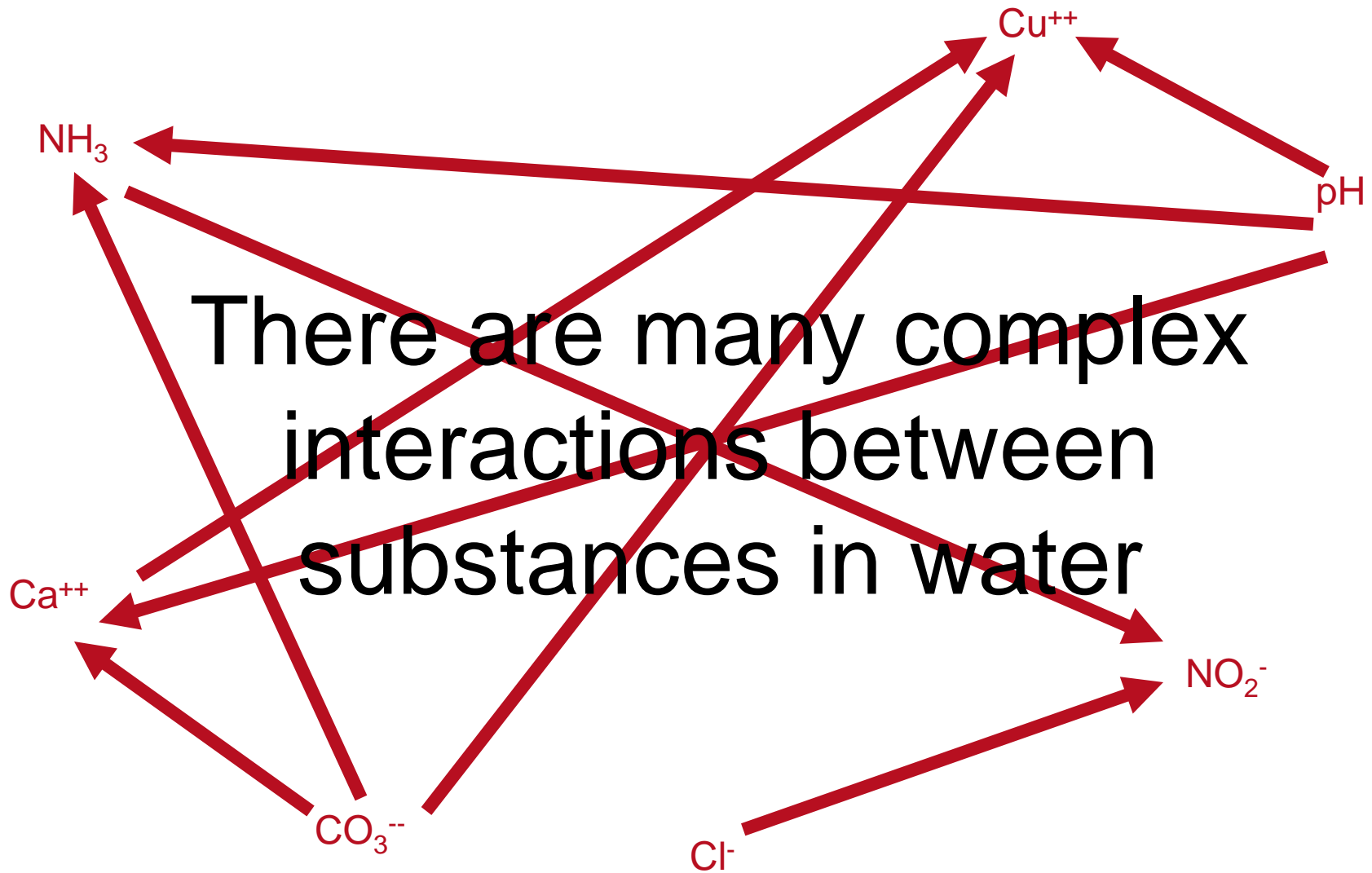
Monthly testing!

Annual testing!



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# Yellow Perch Pond Example

Let's say you check your pH, temperature, and TAN in the **morning**. Say the levels are .....

## Morning

8.4 pH

72°F

0.25 mg/L TAN

0.03 mg/L un-ion.

30 mg/L Alkalinity

**Well that's not bad!**



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# Yellow Perch Pond Example

Let's say you check your pH, temperature, and TAN in the **evening**. Say the levels are .....

## Evening

9.8 pH

75°F

0.25 mg/L TAN

0.19 mg/L un-ion.

30 mg/L Alkalinity

Well that's **not** as good!



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# Yellow Perch Pond Example

## My TAN didn't change! What happened?

It's because of that complex interaction I mentioned  
The series of events went as followed

- ✓ DO is lowest in the morning
- ✓ DO increases as photosynthesis starts back
- ✓ CO<sub>2</sub> decreases due to plants using it up to produce O<sub>2</sub> as a by-product
- ✓ Removal of CO<sub>2</sub> **INCREASES** the pH due to the removal of acid
- ✓ **Increase in pH (& temp ) shifts more** of the TAN into the un-ionized form
- ✓ Increase = stressed fish



<u>Morning</u>
8.4 pH
72°F
0.25 TAN
0.03 NH <sub>3</sub> (un-ion.)

<u>Evening</u>
9.8 pH
75°F
0.25 TAN
0.19 NH <sub>3</sub> (un-ion.)



# Un-ionized ammonia calculator

**TAN, pH, and temperature need to be recorded AT THE SAME TIME in order to determine the amount present in your system**

**Table 2 Percentage Un-ionized Ammonia in Aqueous Solution by pH Value and Temperature  
Calculated from data in Emerson, et. al\***

pH	Temperature (°C)														
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
7.0	0.11	0.13	0.16	0.18	0.22	0.25	0.29	0.34	0.39	0.46	0.52	0.60	0.69	0.80	0.91
7.2	0.18	0.21	0.25	0.29	0.34	0.40	0.46	0.54	0.62	0.82	0.83	0.96	1.10	1.26	1.44
7.4	0.29	0.34	0.40	0.46	0.54	0.63	0.73	0.85	0.98	1.14	1.31	1.50	1.73	1.98	2.26
7.6	0.45	0.53	0.63	0.73	0.86	1.00	1.16	1.34	1.55	1.79	2.06	2.36	2.71	3.10	3.53
7.8	0.72	0.84	0.99	1.16	1.35	1.57	1.82	2.11	2.44	2.81	3.22	3.70	4.23	4.82	5.48
8.0	1.13	1.33	1.56	1.82	2.12	2.47	2.86	3.30	3.81	4.38	5.02	5.74	6.54	7.43	8.42
8.2	1.79	2.10	2.45	2.86	3.32	3.85	4.45	5.14	5.90	6.76	7.72	8.80	9.98	11.29	12.72
8.4	2.80	3.28	3.83	4.45	5.17	5.97	6.88	7.90	9.04	10.31	11.71	13.26	14.95	16.78	18.77
8.6	4.37	5.10	5.93	6.88	7.95	9.14	10.48	11.97	13.61	15.41	17.37	19.50	21.78	24.22	26.80
8.8	6.75	7.85	9.09	10.48	12.04	13.76	15.66	17.73	19.98	22.41	25.00	27.74	30.62	33.62	36.72
9.0	10.30	11.90	13.68	15.65	17.82	20.18	22.73	25.46	28.36	31.40	34.56	37.83	41.16	44.53	47.91
9.2	15.39	17.63	20.08	22.73	25.58	28.61	31.80	35.12	38.55	42.04	45.57	49.09	52.58	55.99	59.31
9.4	22.38	25.33	28.47	31.80	35.26	38.84	42.49	46.18	49.85	53.48	57.02	60.45	63.73	66.85	69.79
9.6	31.36	34.96	38.38	42.49	46.33	50.16	53.94	57.62	61.17	64.56	67.77	70.78	73.58	76.17	78.55
9.8	42.00	46.00	50.00	53.94	57.78	61.47	64.99	68.31	71.40	74.28	76.92	79.33	81.53	83.51	85.30
10.0	53.44	57.45	61.31	64.98	68.44	71.66	74.63	77.35	79.83	82.07	84.08	85.88	87.49	88.92	90.19
10.2	64.53	68.15	71.52	74.63	77.46	80.03	82.34	84.41	86.25	87.88	89.33	90.60	91.73	92.71	93.58

\* Emerson, K., R. C. Russo, R.E. Lund, and R.V. Thurston. 1975. Aqueous ammonia equilibrium calculations: effect of pH and temperature. *J. Fish. Res. Board Can.*, 32:2379-2383.

**Dissolved oxygen, carbon dioxide, pH changes in ponds over 24 hours**

<b>Time</b>	<b>Change</b>		
	<b>DO</b>	<b>CO2</b>	<b>pH</b>
<b>Daylight</b>	Increases	Decreases	Increases
<b>Nighttime</b>	Decreases	Increases	Decreases

Tucker 1984

**Morning**

8.4 pH

72°F

0.25 TAN

0.03 NH3 (un-ion.)

**Evening**

9.8 pH

75°F

0.25 TAN

0.19 NH3 (un-ion.)





## Questions?

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