



ALKEN-MURRAY CORP.

INTERPRETING WATER ANALYSIS TEST RESULTS

1. Alkalinity: This is the sum of components (mainly bicarbonate, carbonate, and hydroxide) in the water that tend to elevate the pH of the water above 4.5. These factors are characteristic of the source of water and the natural processes taking place at any given time. Alkalinity represents the buffering capacity of water and its ability to resist a change in pH. Alken-Murray recommends alkalinity above 75 mg/L to offset acid produced by bacteria nitrifying ammonia.

The acceptable range for most finfish is 20-200 mg/l (ppm).

CHEMetrics kits recommended K-9810: 10 - 100 ppm & K-9815: 50 - 100 ppm

2. Ammonia: Ammonia nitrogen (N) is present in variable concentrations in many surface and ground water supplies. A product of microbiological activity, ammonia when found in natural water is regarded as indicative of sanitary pollution.

Ammonia is rapidly oxidized by certain bacteria, in natural water systems, to nitrite and nitrate—a process that requires the presence of dissolved oxygen. Ammonia, being a source of nitrogen is also a nutrient for algae and other forms of plant life and thus contribute to overloading of natural systems and cause pollution.

In fish, ammonia represents the end-product of protein metabolism and what is important is whether it is present in the un-ionized form as free ammonia, NH_3 , which is toxic to fish (both freshwater and marine) at $>0.03 \text{ mg/L (ppm)}$, or in the ionized form, NH_4^+ , in which it is innocuous. The relative concentration of each is pH and temperature dependent. **The higher the pH, the more of the NH_3 will be present.** Ammonia can block oxygen transfer in the gills of fish, thereby causing immediate and long term gill damage. Fish suffering from ammonia poisoning will appear sluggish and come to the surface, as if gasping for air. In marine environments, the safe level of NH_4^+ is between 0.02 and 0.4.

The USEPA recommends a limit of 0.02 ppm as NH_3 in freshwater or marine environments. Total ammonia levels, at this limit, can range from 160 ppm at pH 6 and temperature of 5 degrees C to 0.06 ppm at pH 9 and temperature of 25 degrees C.

*Interpreting
Water Analysis
Tests ①*

Alken Murray

If large quantities of fish are suddenly added to the water body (such as during stocking), the ammonia level can spike because the natural bacteria that degrade ammonia are slow to reproduce (having a 14 day cycle), so it is best to add a seeding quantity of Alken Clear-Flo 1100 or Alken Clear-Flo 1200 at the same time you add your new fish, to avoid this problem.

CHEMetrics kits recommended: K-1510: 0-1 ppm & 1 - 10 ppm

3. Carbon Dioxide: Carbon dioxide (CO₂) is present in water supplies in the form of a dissolved gas. Typically, surface waters contain less than 10 ppm free carbon dioxide while ground waters may have much higher concentrations. Dissolved in water, CO₂ forms carbonic acid which lowers pH.

Aquatic plant life, from phytoplankton to large rooted plants, depends upon carbon dioxide and bicarbonates in water for growth. Of significance for fish is the fact that when the oxygen concentration falls (e.g. through the degradation of organic wastes), the carbon dioxide concentration rises. This increase in carbon dioxide makes it more difficult for fish to use the limited amount of oxygen present. To take in fresh oxygen, fish must first discharge the CO₂ in their blood stream, a process which is slowed down considerably when there are high concentrations of CO₂ in the water itself. Unfortunately the CHEMetrics test kits do not measure below 10 mg/L, so if you get a reading on this test, you know your water body is in trouble.

The acceptable range of carbon dioxide for most finfish is <2.0 mg/L (ppm).

CHEMetrics kit recommended: K-1910: 10 - 100 ppm

4. Chloride: Chloride is one of the major anions to be found in water and sewage. Its presence in large amounts may be due to natural processes such as the passage of water through natural salt formations in the earth or it may be an indication of pollution from sea water intrusion, industrial or domestic waste or deicing operations. Potable water should not exceed 250 mg/L of chloride. When calcium or magnesium is the cation, up to 1000 mg/L can be tolerated without a salty taste to the water.

CHEMetrics kit recommended: K-2002: 2 - 20 ppm

5. Dissolved Oxygen: Vital to aquatic life, oxygen enters the water by diffusion from the atmosphere or through plant photosynthesis. Actual solubility is directly proportional to the partial pressure in the gas phase, to salt concentration and temperature. The dissolved oxygen level in water is constantly changing and represents a balance between respiration and decomposition that deplete

oxygen and photosynthetic activity that increases it. Organic waste may overload a natural system causing a serious depletion of the oxygen supply in the water that in turn leads to fish kills. Likewise, eutrophic waters, that is those rich in nutrients, achieve the same result through causing massive proliferation of algae (algal blooms) whose eventual decomposition uses up the available dissolved oxygen.

Recommended minimum dissolved oxygen levels for fresh water fish are as follows:

warm water fish 5.0 mg/L (ppm)

cold water fish 6.0 mg/L (ppm)

Koi..... 8.0 mg/L (ppm)

Marine fish.....5.0 mg/L (ppm)

Marine Shrimp....> 5.0 mg/L (ppm), close to saturation*

* Reference for shrimp is page 124 ***Marine Shrimp Culture: Principles and Practices*** edited by Arlo W. Fast & L. James Lester

CHEMetrics kit recommended: K-7510: 0 - 10 ppm & K-7512: 1 - 12 ppm. A dissolved oxygen meter can be used, if calibrated according to manufacturer's instructions. Self-stirring DO probes are easier to work with, if this option is available, but the test kits are often preferred by consumers treating a single pond.

6. Nitrites: Nitrites occur in water as an intermediate product in the biological breakdown of organic nitrogen, being produced either through the oxidation of ammonia or the reduction of nitrate. The presence of large quantities of nitrites is indicative of waste water pollution. **The level considered ideal for marine fish is between 0.01 and 0.04 ppm.**

Levels exceeding 0.55 mg/L (ppm) nitrite-nitrogen can cause 'brown-blood' disease in finfish.

CHEMetrics kit recommended: K-7002: 0 - 0.4 ppm & 0.4 ppm - 4 ppm

7. Nitrates: Nitrates occur in water as the end product in the biological breakdown of organic nitrogen, being produced through the oxidation of ammonia. Although not particularly toxic to fish, excess nitrates in the water is often used as an indicator of poor water quality. Under anaerobic conditions, such as in the sludge or soil at the bottom of a pond, lake or aquarium, denitrification can be used to convert nitrate back to nitrite and from there to nitrogen gas, removing total nitrogen from the aquatic system. **In marine environments, levels of 0.1 to 0.2 are considered ideal.**

Levels exceeding 50 mg/L (ppm) nitrate-nitrogen are considered unhealthy for lakes.

Levels from 10 mg/l to 40 mg/l indicate poor water in aquariums, depending on the species being raised.

CHEMetrics kit recommended: K-6902: 0 - 1 ppm & 1 - 5 ppm

For larger, seriously polluted ponds, lakes, etc., also use: K-6902D: 0 - 25 ppm & 25 - 125 ppm

8. pH: By definition, pH is the negative logarithm of the hydrogen ion concentration. It is in effect an "Index" of the amount of hydrogen ion present in a substance and is used to categorize the latter as acid, neutral, or alkaline (basic).

Most natural waters will have pH values from pH 5.0 to pH 8.5 (compare the range in which **Alken Clear-Flo** products work best: 6.0-8.5). Fresh rain water may have a pH of 5.5 to 6.0. The carbon dioxide produced by respiration of animals and plants in water have the effect of lowering pH. Carbon dioxide and bicarbonate removed from the water by the photosynthetic processes of aquatic plants raises pH. The same processes alter the dissolved oxygen content; oxygen drops during respiration and decomposition; it rises with photosynthetic activity. A pH that is too high is undesirable because free ammonia increases with rising pH.

The acceptable pH range for most finfish and shellfish species is 6.8-8.5

9. Total Hardness: The Total Hardness of a water represents primarily the total concentration of Calcium and Magnesium ions expressed as calcium carbonate. Hardness may range from zero to hundred of parts per million, depending on the origin of the water or the treatment to which the water has been subjected.

Waters containing hardness concentrations of up to 60mg/L (ppm) are referred to as "soft", those containing 120-180 mg/L (ppm) as "hard".

Recommended level: >130 mg/L (ppm)

CHEMetrics kit recommended: K-4502: 2 - 20 ppm & K-452: 20 - 200 ppm

10. Density: The amount of crowding each species of finfish and shellfish will tolerate varies between species. For the majority of finfish, the limit is 0.2 to 0.5 lbs of fish per inch of body length per cubic foot of rearing space. When the tolerable limit is exceeded, fish will exhibit signs of stress including darkening of body color, "clubbing" of gills, fin nipping or loss of tissue between the fin rays and reduced immunity to disease. Shrimp and prawns will also become more susceptible to disease when over-crowded.

In addition to your standard tests, there are circumstances which suggest that additional tests may be required before **Alken Clear-Flo®** can be prescribed.

These include:

1. **Chlorine:** Because of its strong oxidizing properties, chlorine acts as a BIOCID. The test for this should read "0" (zero), before **Clear-Flo®** is added. If this is a problem in your natural waterbody, someone is likely backwashing a swimming pool into your influent water or else there is an industrial or municipal effluent in your influent water. If the problem is a swimming pool nearby, have a talk with your neighbor and encourage them to dump elsewhere. If you cannot locate the source of this problem, contact Ken at Alken-Murray to prescribe a chemical de-chlorination solution for you. Fish, plants, algae and bacteria can all be killed by Chlorine.

CHEMetrics kit recommended: K-2505: 0 - 1 ppm & 1 - 5 ppm

2. **Copper** (total soluble): Copper sulfate is often added to water to control algae. This is toxic to both fish AND bacteria. **DO NOT APPLY Alken Clear-Flo® when the copper test measures levels above 0.5 ppm (mg/l).** Lethal concentrations of copper for marine organisms is 5.8 to 600 ppm, depending on species. Copper is toxic to *Mysid shrimp* at 77 ppm.

CHEMetrics kit recommended: K-3510: 0 - 1 ppm & 1 - 10 ppm

3. **Detergents:** Where detergents (anionic surfactants) are used to clean machinery, animals, and the household, the runoff may be contaminated. The **Clear-Flo® 1200** will work to eliminate this contaminant when its concentration is less than 1 mg/L. **Alken Clear-Flo® 7004** should be used to treat detergents greater than 1 mg/L. Some surfactants can be lethal in quantities as small as 10 to 12 mg/L (Triton-X114), so this is an important parameter if you suspect runoff from animal washing or other industrial effluent. The U.S. drinking water standard prohibits levels above 0.5 mg/L.

CHEMetrics kit recommended: K-9400: 0 - 3 ppm

4. **Iron:** Concentrations above 1 mg/L will impart a foul taste to the water. High concentrations can indicate runoff from mining operations or industrial effluent and indicate the need for further investigation before prescribing a treatment regimen. The US drinking water standard prohibits levels above 0.3 mg/L.

CHEMetrics kit recommended: K-6010: 0 - 1 ppm & 1 - 10 ppm

5. **Lead:** Lead is a poison whose effects are cumulative. Drinking water should not exceed 20 ppb. When groundwater contains a higher level, it may indicate contamination from the discharges of smelting or mining operations, or leachate from municipal sewage sludge fertilizer. Lead is toxic to freshwater species at 1.3 to 8.7 ppm, while marine species are more tolerant. The LC50 of lead for

diatoms is 7940 ug/L. (Test needs to be performed by a suitable independent laboratory)

6. Mercury. Mercury is a common trace metal used in industry as a biocide. **Acutely toxic to marine organisms in the range of 3.5 to 1678 ppm. Organomercuric compounds may be toxic to marine organisms in the range of 0.1 to 2.0 ppm.** Alken-Murray's current formulas cannot withstand high levels of mercury, so alternative treatment options must be considered to decrease the level of mercury. (Test needs to be performed by a suitable independent laboratory)

7. Tributyl Tin. This substance has been declared, by the California Department of Fish and Game, to be "the most toxic substance ever released in the marine environment." This substance, which can be toxic in concentrations as low as **50 parts per trillion in water**, is found in marine paints and antifouling coatings. Fortunately, Tributyl tin appears to be less bioavailable in sediment than it is in seawater, so higher levels may have less effect on benthic biota (bottom dwelling creatures) than might be expected, were the substance suspended in water. If you suspect this substance, obtain testing from an environmentally certified laboratory. We are not aware of any test kits for this substance. (sometimes misspelled as tributyltin)

8. Sulfite: Sulfite is not normally found in natural waters. Its presence, therefore, usually indicates contamination from pulp and paper industrial effluent, or food canning (used as a preservative). An excess of sulfite can lower the pH and render the water corrosive.

CHEMetrics kits recommended: K-9602: 2 - 20 ppm

For seriously polluted water, you may also need kit K-9610: 10 - 100 ppm

9. Phosphate: High phosphate concentrations in surface waters may indicate fertilizer runoff, domestic waste discharge, or the presence of industrial effluents or detergents. If high phosphate levels persist, algae and other aquatic life will flourish, eventually decreasing the level of dissolved oxygen due to the accelerated decay of organic matter. Algae blooms are encouraged by levels of phosphate greater than 25 micrograms/L. Obtain tests in the 0 to 25 ppm and 25 to 200 ppm ranges. To combat waste accumulation, in the presence of high phosphate levels, you must *double the initial dose of Alken Clear-Flo®* normally prescribed for the size of the pond/lake/waste treatment plant.

Phosphorous Discharge Standards

- 1) Total Phosphorous for discharge < 100 micrograms/L
- 2) Where stream enters lake < 50 micrograms/L
- 3) Discharge into a lake < 25 micrograms/L
- 4) Algae blooms are encouraged by levels of phosphate > 25 micrograms/L
- 5) Phosphate phosphorous - > 100 micrograms/L may interfere with coagulation process in water treatment plant

CHEMetrics kit recommended: K-8510: 0 - 1 ppm & 1 - 10 ppm & K-8510D: 0 -

25 ppm & 25 - 250 ppm

10. **Phenol.** Phenol is usually found in a waterbody if pine cleaners and phenolic sanitizers are used and then washed into the drain system. If water has more than 1 ppm, add Alken Clear-Flo® 7002 to your **Clear-Flo 1000** line prescription.

CHEMetrics kit recommended: K-8012: 0 - 1 ppm & 1 - 12 ppm

11. **Hydrocarbons.** Although most people know that petroleum spills are toxic to aquatic life, they are often unaware that rinsing used motor oil into the storm sewer or pond is also harmful. Benzene, Toluene, Xylene and Benz(a)Pyrene should not exceed 0.1 ppm. Smaller amounts can be handled by **Clear-Flo** formulas, but amounts exceeding 0.1 ppm should be treated with Clear-Flo 1006. *Botryococcus braunii*, a chlorophyte order of Chlorococcales algae produces C34 hydrocarbons with characteristics similar to crude petroleum. When it blooms, this algae appears as a **slimy bright green scum** on the surface of the water. *B. braunii* grows especially well in the presence of high nitrates, and will test positive on a hydrocarbon test when present. **Clear-Flo 1006** should be prescribed to clean the water, eliminating both the food for this algae and its exudate.

(Kit for this is more expensive than to have TPH tested by an independent lab, so we only recommend CHEMetrics K-9310, along with equipment, for distributors to monitor treatment of soil for their clients.)

12. **Cyanide.** Cyanide is used in many chemical and refining processes. Effluent from electroplating and metal cleaning operations, coke ovens, steel manufacturing, etc. can end up in lakes and ponds if the factory is not careful. Levels above 0.01 ppm are unsafe for marine species. If the waterbody **does** contain fish, you can apply Alken Clear-Flo 1015, but request that *Yucca schidigera* be omitted, to allow application of higher dosages, with safety. For municipal or industrial wastewater with cyanide problems, you can apply Alken Clear-Flo 7015, which is currently available or ask Alken-Murray to augment whatever bacterial product has been selected, to remediate other pollutants in your system, with a serious percentage of Alken-Murray's cyanide-degrading *Bacillus megaterium*, AMC 300. Fortunately, *B. megaterium* AMC 300 has demonstrated remarkable compatibility with a wide assortment of strains in the Alken-Murray microbial collection, but any new combinations should be verified with Valerie Anne Edwards.

A chemical solution for cyanide in wastewater that does not also contain high levels of ammonia is alkaline chlorination to safely remove cyanide, but if ammonia levels are high, you could end up with undesirable levels of chloramines.

CHEMetrics kit recommended: K3810: 0 - 0.1 & 0.1 to 1.0

13. **COD.** Chemical Oxygen Demand measures organic and inorganic content as indicators of the amount of dissolved oxygen that will be removed from the water column or sediment due to bacterial and/or chemical activity. **Normal COD in a pond should be less than 10 mg/L.** A COD of 60 mg/L in a natural pond or lake or aquaculture pond or tank is in emergency need of treatment.

CHEMetrics kit recommended to distributors only, as equipment is needed too: K-7351 (0 - 150 ppm), K-7361 (0 - 1500 ppm), & K-7371 (0 - 15000 ppm) plus Hach COD Reactor model 45600, Lab-Guard or Hach Safety Shield, Hach DR-890 datalogging colorimeter and Eppendorf Electronic pipettor (100 l - 5 ml).

14. **BOD.** Biological Oxygen Demand measures the amount of oxygen utilized by organisms in the biochemical oxidation of organic matter in a wastewater sample in a specified time (usually 5 days), and at a specified temperature. BOD measurements are used as a measure of the organic strength of the water. Although it is not identical to COD, the speed with which one can obtain COD test results, often dictates that this test is used for prescription purposes. **Typical natural water has a BOD from 0.8 to 5 mg/L.** Anything above 6 mg/L needs to be treated as it will rob the water of needed oxygen for the fish.

Testing for BOD should be performed by an outside lab unless distributor has appropriate equipment. The BOD test performed independently is fairly inexpensive for an individual pond owner.

15. **Pesticides.** Although the USA banned the use of DDT since the early 1970's, nondegraded DDT can still be found in water, released by erosion and storm runoff. Levels as low as 14 ppm in the water are acutely toxic to marine organisms. Chlordane is acutely toxic between 2.4 and 260 ppm. Heptachlor epoxide is acutely toxic at 0.04 ppm. Endrin is acutely toxic from 0.037 to 1.2 ppb. Dieldrin is toxic above 0.1. Alken-Murray's formulas can withstand and degrade small amounts of these substances, but a large scale contamination may require alternative treatment options. Independent laboratory tests are required if you suspect pollution from particular pesticides.

16. **FOG,** aka Fats, Oils, and Grease (from natural plants, fish and animal feed etc) can cause stress to aquatic animals if the level is above 0.1 mg/L. Sudden die-offs will occur if this level reaches 85 - 100 mg/L. Most **Alken Clear-Flo 1000** line aquatic products contain some degraders of fats and greases, but if the level exceeds 6 mg/L, you should add Clear-Flo 1003 to your regimen of pond water treatment.

Independent laboratory tests are recommended for this only if you suspect this to be high in your pond or lake, such as from kitchen waste runoff (illegal in the USA), fatty diet fed to cultured fish showing an oily layer at the top of the water.

17. **Silicate,** often contributes to pond water turbidity and helps diatoms and algae to proliferate. Higher levels of microbial assistance are needed when silicate levels are high (up to 100 mg/L has been found). Adding sand to a formula, adds silica, which can feed algae. **Ideal levels to discourage algae**

should be low, < 15 mg/L.

CHEMetrics kit recommended: K-9010: 0 - 1 ppm & 1 - 10 ppm & K-9011: 0 - 0.2 ppm

1. **Selenium:** No specific toxicity data is available, but the USEPA 1986 has set 54 - 410 ppb (parts per billion) as an action level for this compound in marine environments. This element is necessary in small amounts in feeds.

If you suspect a large contamination, have an independent laboratory test this parameter for you.

2. **Chromium:** Chromium is toxic to marine organisms at 2000 to 105,000 ppm. The most toxic form, hexavalent chromate, is produced in pickling and plating operations, anodizing aluminum, leather tanning, manufacturing of paints, dyes and explosives. Also used to inhibit corrosion in open and closed system cooling towers. After PG&E lost a lawsuit over hexavalent chromium discharged to drinking water of the plant's neighbors, causing major health problems and a movie, named Erin Brockovich became a huge hit, most manufacturers of chemical water treatment for cooling towers can easily convince their clients to use other corrosion inhibitors with less hazardous environmental consequences attendant to accidental release from holding lagoons, so hopefully we will see less hexavalent chromium in ground water, reservoirs and recreational ponds and lakes.

I recommend CHEMetrics kits K2810B (measures 0 to 120 mg/L and 120 to 1200 mg/L) and K2810C (measures 0 to 1200 mg/L and 1200 to 12,000 mg/L), but you can also purchase K2810D to measure 0 to 30 mg/L and 30 to 300 mg/L and K2810A to measure 0 to 60 mg/L and 60 to 600 mg/L, if you want to test the entire range possible with visual test kits, using the Diphenyl Carbazine method, APHA Standard Methods for Analysis of Water and Wastewater, method 3500-Cr-D (approved in 1995) Alternatively, you can ask an accredited USEPA laboratory to perform this test for you, especially valuable if you intend to sue the company discharging hexavalent chromium to a source that could end up in your lake, pond or reservoir.

3. **Nickel:** Nickel is toxic to marine organisms at 141 ppm. Get an EPA lab to test for this, if you suspect it to be causing fish deaths.

4. **Zinc:** Zinc causes acute marine toxicity at 192 to 320,000 ppm, depending on the species and is chronically toxic at levels of 120 ppm. The average acceptable level of zinc in potable water is 1 mg/L.

Although CHEMetrics offers test kits that measure up to 6 mg/L, to test for serious contamination, send sample to an accredited USEPA laboratory that tests water and wastewater.

5. **Cadmium:** Cadmium is acutely toxic to freshwater species at 10 ppb - 1 ppm.

Cadmium is acutely toxic to marine species at 320 ppb to 15.5 ppm. If suspected, send a water sample to a USEPA accredited lab that tests water and wastewater.

6. Manganese: Manganese is required by aquatic species and no toxicity data is available. Surface and ground water rarely contain more than 1 ppm of manganese. Acceptable levels in potable water is less than 0.05 mg/L.

7. Inorganic Arsenic: Arsenic is toxic to marine organisms at the level of 2000 mg/L. If this is suspected, send sample to an accredited USEPA laboratory, testing water and wastewater samples. If a massive fish kill or human death is suspected to be caused by Arsenic, contact your local police department for forensic testing for arsenic. If only minor toxicity is suspected, a USEPA accredited laboratory will test water and wastewater samples.

8. Hydrogen Sulfide: Hydrogen sulfide inhibits aerobic respiration, inhibits muscle contractions, including breathing, and promotes excess breakdown of glucose. Hydrogen sulfide develops when sulfate-reducing bacteria grow up in the anaerobic sludge of a pond, and no harm is noticed shrimp, prawns, catfish and other bottom-feeders disturb the sludge layer, releasing hydrogen sulfide into the water, where it is first noticed when dead shrimp, prawns or fish float to the surface and a rotten egg odor, is observed. The rotten egg odor will be noticed when as little as 0.25 micrograms of unionized hydrogen sulfide is present in each 1 Liter of pond water. Levels of unionized H₂S in ponds is toxic above 0.033 mg/L are toxic to shrimp and many fish. Some researchers suggest that H₂S above 0.005 mg/L should be considered toxic and treated with **ALKEN CLEAR-FLO 1005**

If a pond owner attempts mechanical dredging to recover pond depth taken up by organic sludge, this process can accidentally release sufficient hydrogen sulfide gas to cause human deaths, unless workers wear NIOSH approved SCBA (self-contained breathing apparatus). See **Biodredging** to learn about biological dredging of ORGANIC sludge, another option for recovering pond depth lost to an accumulation of organic sludge. If sufficient percentages of inorganic sludge are present (sand, rocks, dirt, etc.) washed down due to soil erosion, mechanical dredging may be the only option to recover pond depth, but to avoid issues with hydrogen sulfide, sludge should be pre-treated with **ALKEN ENZ-ODOR 6** to avoid the risk of releasing dangerous levels of hydrogen sulfide when the mechanical dredging begins. This pre-treatment is especially important if the pond is located close to the owner's home. Alkalinity and nitrate levels should be tested to determine if addition of sodium nitrate or **ALKEN ENZ-ODOR 9** are also needed or if pond pollution levels are sufficient to prevent formation of acid during oxidation of unionized hydrogen sulfide in the sludge layer of the pond.

CHEMetrics test kit recommended by Alken-Murray for pond testing is: K-9510: 0 - 1 ppm & 1 - 10 ppm., since any level above 10 ppm will have killed everything in the pond and be obvious due to severe rotten egg odor coming from the pond. For wastewater testing, Alken-Murray recommends CHEMetrics kits K-9510D for 0 - 30 and 30 - 300 ppm, K9510A for 0 - 60 ppm and 60 - 600 ppm, K9510B for 0 to 120 and 120 to 1200 ppm, and 9510C for 0 - 1200 and 1200 to 12,000 ppm, providing you the entire possible range of sulfide in water. The

protocol for all of these kits is the APHA Standard Methods method 4500-S-2D, which uses methylene blue methodology to detect sulfides in solution in water.

9. **Sulfate:** I have not found any aquatic limits for sulfate, but the US Public Health has set 250 mg/L as the limit allowed in drinking water.

This test requires an independent laboratory to test. . We usually do not test for this parameter in natural waterbodies, but it is of interest in wastewater treatment.

10. **Salt:** The average acceptable levels for freshwater fish are 0 - 5 ppt. Seawater averages 25 to 70 ppt. The level that is toxic varies with the species of aquatic animal, from 205.5 ppb for *Zebra danio* to 3,412,000 ppb for pond snails. LaMotte offers a test kit that measures 0 - 20 ppt of salt. A **Sper Scientific Refractometer**, measures 0 - 28% Salinity, and this is the instrument Alken-Murray uses to test salinity.

11. **Magnesium:** The US Public Health has set 150.3 mg/L as the acceptable level of magnesium in drinking water. I cannot find any limits for aquatic applications.