AquaScience Research Group, Inc.
ULTIMATE®
FULL-FUNCTION WATER CONDITIONER

PURPOSE AND BENEFITS

ULTIMATE® is a convenient, liquid, single phase, full-function water conditioner that has been scientifically formulated for use in freshwater and saltwater aquariums and garden ponds. **ULTIMATE®** should be used (1) when conditioning new water for aquariums or ponds, (2) after or during water additions, and (3) before adding new plants, invertebrates fishes or amphibians.

WATER CONDITIONING; GENERAL CONSIDERATIONS

Water conditioning is the process of altering water so that aquarium and pond life can survive and thrive in it. Municipal water sources are treated so that the water delivered to the tap is free of viable disease-causing bacteria, viruses and other organisms as well as appearing clean and clear and being free of disagreeable odors and flavors. While such water is typically suitable for human consumption with no further treatment it is almost always quite deadly to aquatic life.

In broad terms, a water conditioner must remove or mitigate those substances which are toxic to aquatic life and add those substances which promote the health and well being of aquatic life. **ULTIMATE®** is just such a water conditioner and continues the long tradition of powerful and safe water conditioners developed and distributed by AquaScience Research Group, Inc..

WATER CONDITIONING; SPECIFIC CONSIDERATIONS

Water from different sources will have different problems which need to be corrected before it can be safely used for aquariums and ponds.

CHLORINE: This is the most commonly used disinfectant substance found in tap water in the world. This is because it is highly effective and inexpensive and the technology, in water treatment, is well documented and understood. The chlorine content of any water sample can be easily determined with available chlorine test kits. The best kind of kit is one which will give two different, but related, measurements: (1) "free, available chlorine" and (2) "combined available chlorine".

In the United States the federal Environmental Protection Agency and various federal, state and local public health agencies have required that for overall human health that the amount of trihalomethanes (mostly as chloroform, $CHCl_3$) be significantly reduced or totally eliminated from drinking water. The source of trihalomethanes in drinking water comes mainly from the reaction of "free, available chlorine" with low levels of dissolved organic substances in the treated water.

The obvious problem with reducing "free, available chlorine" is that disease-causing organisms (e.g. polio virus, typhoid fever bacteria, and fecal coliform bacteria) would likely make it through the water treatment process and arrive at the customers' taps.

"Free, available chlorine" is known, chemically, as "hypochlorite". The hypochlorite ion, OCl^-, is the same ion that is found in common, household bleach products. As every homemaker knows, bleach is one of the best disinfectants available. Some small water treatment companies even "batch treat" their water supplies by adding the required amount of industrial bleach solution to a large tank of water before it gets distributed through the water supply system. The larger water treatment companies simply add chlorine gas directly to the water treatment stream and thereby produce the hypochlorite *in situ*.

The actual concentration of hypochlorite in the delivered water will vary from day to day and from season to season depending upon the conditions of the feed water and how the chlorine is added to the water.

The removal of chlorine; called "dechlorination" is relatively simple and can be achieved by a number of chemical substances. In addition, when water contained almost exclusively "free, available chlorine" it could be strongly aerated for a few days at room temperature and most (but usually not all) of the chlorine would dissipate. This was called "aging" the water.

As natural water sources around the US and, indeed, around the world became more and more polluted it became necessary to more aggressively treat water to insure a healthy product. This also meant adding increasing amounts of chlorine so that the water treatment agencies could insure that the chlorine residual being delivered to the customer was sufficient to maintain safe water throughout the ever aging distribution systems.

As chlorine content (as "free, available chlorine") increased so did the trihalomethane content. Trihalomethanes are known cancer-causing agents (carcinogens). To counteract the trihalomethane threat and still provide safe water is was known that by increasing the "combined, available chlorine" content one could both make the water safe and eliminate the carcinogens. "Combined, available chlorine" is better know as "chloramines".

CHLORAMINES: These substances are formed from the reaction between chlorine (or hypochlorite) and ammonia or ammonium compounds in water. There are three substances which can be called chloramines. These are (1) monochloramine, NH_2Cl, (2) dichloramine, $NHCl_2$, and (3) trichloramine, or nitrogen trichloride, NCl_3. The formation of these compounds are relatively easy to understand if one looks at the ammonia molecule, NH_3, which consists of a central nitrogen atom, N, with three hydrogen atoms, H, attached. Any or all three of the hydrogens can be removed in a chemical reaction and each can be replaced by a chlorine atom, Cl.

In water treatment the first such compound, monochloramine, is the most desirable due to its stability in solution and its ability to kill viruses, bacteria and other microorganisms. In actual practice, there is always a small percentage of the total chloramine content present as dichloramine, but never any trichloramine. The trichloramine is very unstable and rapidly decomposes to free nitrogen and chlorine (that's why one should never mix bleach and household ammonia (or ammonia-containing cleaners)).

When dechlorinated with ordinary dechlorinators the chloramines release the bound ammonia into the water. In addition, the chloramines are resistant to dissipation, even when the water is strongly aerated. The removal, or destruction, of chloramines is called "dechloramination". There is only one substance which not only dechloraminates water, but is also stable in solution and nontoxic. This substance is found in **ULTIMATE®** and is protected by US and foreign patents.

AMMONIA: Ammonia comes from many sources in aquarium and ponds. These include accumulated and decomposing feces, uneaten food and dead plants. In aquariums, however, it has been shown that the majority of the ammonia in the water comes from the living fishes. Fishes expel ammonia directly into the water from exchange sites on their gills. This means the ammonia enters the water directly without having to be first mineralized from feces, etc. This is why starved fishes will still pollute their water with ammonia even though little or no fecal matter is produced.

The actual molecular or ionic form of the ammonia present in the water is directly dependent upon the pH, temperature and salinity. The pH is the most important factor affecting the equilibrium between molecular (= "free"), NH_3, and ammonium ion (="ionic ammonia"), NH_4^+. As the pH increases the percentage of molecular ammonia in-

creases, and as the pH decreases the percentage decreases. Another way of understanding this is to remember that at acid pH's (pH < 7) the ammonia becomes less toxic to the fishes and at alkaline pH's (pH >7) it becomes more toxic. **Ultimate®** reacts with ammonia in is free, or unionized form. **ULTIMATE®** will not only remove the "toxic ammonia" but due to the concentration present in standard dosages it will also remove all the ammonia as the equilibrium between ammonia and ammonium ion shifts as the NH_3 is consumed in the reaction. At low pH's this reaction proceeds slower than at pH's above 7, but in practical terms the reaction proceeds quickly enough to provide complete ammonia removal in an hour or less.

Unlike other water conditioner which claim to remove toxic ammonia, **ULTIMATE®** will do so even if the pond or aquarium is not cycled, overstocked or improperly filtered (this is why **ULTIMATE®** can be used in shipping bags where there is no filtration and where the number of fishes per volume of water is typically several times that found in an aquarium or pond). Additionally, when using **ULTIMATE®** to remove ammonia there is no need to do water changes nor to vigorously aerate the water to facilitate is action. This does not mean that **ULTIMATE®** should be used instead of proper aquarium and pond maintenance.

HEAVY METALS: Depending upon the source some tap waters contain copper and lead and other heavy metals. The various public health agencies have very strict regulations on heavy metal content and these are constantly monitored in most public water supplies. Interestingly, the concentrations of certain heavy metals which can be tolerated by humans and other mammals is often much greater than what can be tolerated by aquatic organisms.

Copper, for instance, is often added to water sources (prior to treatment for human consumption) to control algae and other organisms. Some of the copper is removed during the treatment process. However, in some supplies the concentration which flows from the tap is great enough to be deadly to fishes and invertebrates. **ULTIMATE®** deals with heavy metals through chelation and/or precipitation so that detoxification is achieved.

HARDNESS AND OTHER METALS: Hardness varies from extremely soft water to extremely hard water. Typically, we humans demand relatively soft water so that our cleaners and detergents work better and there are fewer "bathtub rings". For fishes and other aquatic life, however, the actual hardness is much less important. It is doubtful that fishes and aquatic invertebrates actually have any physiological mechanisms for determining water hardness, and unless the total amount of dissolved metal salts is so high that osmotic stress occurs (such as when a freshwater fish is placed in seawater) most waters will be equally tolerated without having to make any changes to the hardness.

On the other hand, a certain amount of hardness in the form of calcium, Ca^{+2}, is necessary for all fishes and invertebrates and plants. The amount needed is quite high for marine invertebrates such as corals and most molluscs. Fishes, of course require calcium for bone development, but unlike filter feeding invertebrates their calcium is derived from the food they eat and little or none is acquired from the surrounding water.

Calcium is also need for fish eggs to properly "water harden" once they have been laid and fertilized. Without enough Ca^{+2} in the water the eggs are subject to bursting from water intake or to invasion from disease-causing organisms. Also, Ca^{+2}, in the surrounding water can aid in the mitigation of stress for freshwater fishes. **ULTIMATE®** adds a small amount of calcium to the water without significantly increasing the hardness.

OTHER SALTS: Osmotic stress in aquarium and pond fishes is of concern when placing them in new water. This is because the "osmotic pressure" of new water is often less than that of natural waters and even of old aquarium or pond water. The effects of osmotic stress are typically small and can usually be ignored. Some aquarium authorities recommend, however, the addition of varying amounts of ordinary salt, sodium chloride, NaCl, to aid in the osmotic "balance" of aquarium and pond waters.

The problem with adding salt is that for many aquarists and pondkeepers the amount added is much more than necessary and often so much so that the fishes and plants suffer from increased osmotic pressure and too high of a chloride, Cl^-, content. In practical applications the amount of salt needed for freshwater fishes should be related to the actual or expected concentration of nitrite, NO_2^-, which is encountered in new systems as the biological filtration becomes established.

Nitrite is the intermediate step in nitrification as ammonia excreted from the gills of the fishes is converted to essentially nontoxic nitrate, NO_3^-. It is known from research that a chloride ion content of about 30 times the nitrite ion content will help protect freshwater fishes from the toxic effects of the nitrite. It does this by "swamping" the nitrite and preventing its uptake into the blood of the fishes where it would irreversibly tie up the hemoglobin and cause asphyxiation. Since nitrite rarely reaches levels of more than 1.0 mg/L (as NO_2^-) then little more than 30 mg/L chloride is needed to protect the fishes. Marine fishes do not usually suffer nitrite poisoning due to the extremely high levels (> 19,000 mg/L) of chloride in saltwater. **ULTIMATE®** adds the necessary chloride to the treated water so that additional salt application is rarely needed.

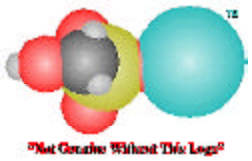
pH AND ALKALINITY: The pH of most tap water is usually greater than 7.0, sometimes greatly so, and as such usually doesn't need to the buffered higher for freshwater use. In saltwater systems the synthetic sea salts do the job of buffering the water and no water conditioner can significantly increase or decrease the pH as a result. In ponds the pH changes diurnally (from day to night) and will be different depending upon the time of day it is measured. This happens primarily because of photosynthesis of the plants and algae in the ponds.

In aquariums the pH tends to remain stable throughout the day and night with little or no variation. In heavily planted tanks, with little or no active filtration and with suitable lighting, the pH can behave as in an outdoor pond. It is desirable to prevent great pH swings as much as possible. In an outdoor pond there is little the pondkeeper can do to control these diurnal swings, but the fishes and plants adapt and can easily handle these natural changes.

Where photosynthesis is not a major factor the pH will typically decline with time as nitrification consumes the alkalinity (usually as bicarbonate, HCO_2^-) and releases hydrogen ions, H^+, into the water. Hydrogen ions cause the pH to drop and loss of alkalinity ("acid-neutralizing capacity") causes the pH to drop much sooner. **ULTIMATE®** adds buffering agents which boost the alkalinity without causing the pH to rise significantly in freshwater. **ULTIMATE®** helps stabilize the pH.

SPECIFICATIONS

ULTIMATE® adds a buffering system (to boost alkalinity without significantly affecting the pH), ClorAm-X®,



a dechloraminating agent (to react chemically with chloramines, chlorine and ammonia), physiologically active electrolytes (including calcium, sodium and chloride ions), a tertiary polymer system (for skin-slime replacement and protection) and product stabilizers.

Dosage: use 1 teaspoon (~ 5 mL) per 10 gallon of water.

CONTRAINDICATIONS

ULTIMATE® is not a medication, chemotherapeutic agent nor an economic poison and is not indicated for the treatment or control of any specific or general disease condition in aquarium organisms nor for the control of any pests. **ULTIMATE®** is intended for use as a multipurpose aquarium and garden pond water conditioner.

STABILITY

ULTIMATE® is stable for an indefinite period if kept in its original container and stored away from heat and sunlight. When not in use store at room temperature (above 60° F and below 100° F) out of

direct sunlight. Do not return unused portions to the original container; do not introduce any water or other chemicals into the container. A slight haziness to the liquid and/or the presence of a slight precipitate does not affect the efficacy of the product.

COMPATIBILITIES

WITH OTHER WATER ADDITIVES: ULTIMATE® is compatible with most other water conditioners. It is incompatible with strong oxidizing agents such as potassium permanganate. Do not use with unchelated ("free") copper medications since the metal will be precipitated and/or chelated and thereby inactivated. Due to its ability to reduce certain dyes **ULTIMATE®** should not be used with treatments containing malachite green or methylene blue or related dyes. **ULTIMATE®** is compatible with most antibiotics. **ULTIMATE®** can be added directly to aquariums or ponds utilizing biological filtration, and it will not interfere in the nitrification process.

USE IN WATER PREVIOUSLY TREATED WITH CHLORITE-CONTAINING DRUGS: It has been confirmed that chlorite-containing drugs, used to treat and control "ich" and other diseases in pond and aquarium fishes, will inhibit normal nitrification and ammonia levels can increase significantly. **ULTIMATE®** will react with chlorite in a manner similar to its reaction with hypochlorite. Unfortunately, if not enough product is added, the reaction with chlorite, ClO_2^-, may not go to completion (at which point nontoxic chloride ions, Cl^-, are formed). Instead, if only enough **ULTIMATE®** is added to remove the measured ammonia it may react with the chlorite only to the extent that the chlorite is partially reduced and hypochlorite is formed. Even extremely low concentrations of hypochlorite are more toxic to pond and aquarium inhabitants than similar levels of chlorite. The result of this partial reduction of the chlorite in the treated water can be that the animals are poisoned by the resulting hypochlorite (small, nearly undetectable, concentrations of hypochlorite can significantly increase the toxicity of even low concentrations of ammonia). To prevent this occurrence one must measure the "available chlorine" concentration in the water before and immediately after treatment with **ULTIMATE®**. Additional product must be added to completely dechlorinate the treated water as well as enough to eliminate the unwanted ammonia.

Since there are areas where the use of chlorite-containing drugs is standard practice, the inhibition of nitrification and the subsequent increase in ammonia levels is a well-known and expected reality.

WITH TEST KITS: Water treated with **ULTIMATE®** will often give false (high) off-scale readings with ammonia test kits which use the Nessler's reagents. Water treated with **ULTIMATE®** is compatible with most salicylate and phenol/hypochlorite test kits. Contact AquaScience if there is a question about ammonia test kit compatibilities.

Water treated with **ULTIMATE®** is compatible with all known nitrite and low-range nitrate test kits.

Water treated with **ULTIMATE®** is incompatible with Winkler and modified Winkler dissolved oxygen test kits. These kits will give false, low, or zero, readings. Water treated with **ULTIMATE®** is compatible with indigo/carmine dissolved oxygen test kits and with dissolved oxygen meters.

WITH COLORIMETERS: Refer to the information above about test kit reagent compatibility. AquaScience has valuable information about ammonia testing using colorimeters and methods which require the use of a blank determination; please contact us for details.

WITH ELECTRONIC METERS AND ISE'S: When testing treated water with an ammonia ion-specific electrode (ISE) and electronic meter omit the step where 10*N* sodium hydroxide solution is added. Instead, dilute the electrode's picric acid filling solution with deionized water (to increase the electrode's sensitivity) at a ratio of 1 (filling solution) : 9 (deionized water), by volume, and measure the free ammonia directly. Refer to available charts to calculate the total ammonia from the free ammonia value determined and the known temperature, pH and salinity. Contact AquaScience for more information about how to do measurements with an ammonia ISE in water treated with **ULTIMATE®**.

TOXICITIES

ULTIMATE® is not known to be toxic to any commonly kept aquarium or garden pond plants and animals.

PACKAGING

ULTIMATE® is packaged under three different labels that are specific for (1) freshwater aquarium use, (2) saltwater aquarium use, and (3) water garden and pond use in convenient 4 fl.oz., 32 fl.oz., 1 gallon and 5 gallon containers. All containers are recyclable.

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