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The Science of PureMagic Electronic Oxidation/Ionization

PureMagic[®] circuitry transforms AC power to low D.C. voltage and low amperage on its proprietary titanium electrodes. Water purifies from the water molecule itself. OH hydroxyl ion, theoretical atomic oxygen (O¹) and oxygen (O²) are generated-within the sealed pressure line to oxidize the water without using sodium or chemical. 20-60 grams per minute of oxygen radicals are created from the water, at 2-to 800 gpm flow and are noted on the following Oxidation Reduction Potential (ORP) Chart, as accepted by most chemists. Oxidation-Reduction Potential In practical terms is a measurement to oxidize contaminants.

Each PureMagic[®] oxidizer is more powerful than sodium hypochlorite, the dominant form of chlorine

OXIDATION REDUCTION POTENTIAL (ORP) (PureMagic [®] Oxidizers in Bold)		
Chemical	Symbol	ORP Relative Value
Fluorine	F	2.25
Hydroxyl Radical	OH	2.05
Atomic Oxygen	O¹	1.78
Ozone	O³	1.52
Hydrogen Peroxide	H²O²	1.30
Permanganate	KMn²	1.22
Hypochlorous Acid	HOCL	1.10
Chlorine (Gas)	CL	1.0
Oxygen	O²	.94
Sodium Hypochlorite	NaCL²	.69
Bromine	Br	.57

SPECIFIC TARGET OXIDATION APPLICATIONS
Uric Acid, Bacteria, Virus: Swimming Pool 6.5 pH - 7.4 pH
Iron, Manganese, Hydrogen Sulphide: Well Water 6.4 pH - 8.0 pH to 12 ppm
(No chemical regeneration or supplement required.)

The electrodes may further oxidize and change the chemical form of sulphides in well water. Specific removal under wide parameters has occurred with hydrogen sulphide, sulphur bacteria and magnesium sulphate. No chemical regeneration of the filter media is required, and it rinses or backwashes with the source water.

PureMagic® oxidation eliminates odours in all applications while reducing filter change out frequency

Copper Ionization:

PureMagic® uses conventional copper ionization (without silver) in two different ways in its technology (95 CU grade or better.): PureMagic® copper electrodes are manufactured in a water soluble, non-chemical or machine oil process.

Point-of-Entry:

In both residential and commercial applications between .15 ppm and .25 ppm trace ionization is placed constantly in the water flow. Most water pipe size applications have been addressed. When used with PureMagic® electronic oxidation, calcium is kept in the soft bicarbonate form in standing pressure lines, and at fixtures. The heat point required to precipitate calcium in the carbonate form is increased substantially. PureMagic® has specific successful history to 26 grains of hardness, (442 ppm) with a TDS level as high as 3000. No pH histories above 8.4 have been tested. PH levels of 5.2 to 8.3 are therefore required. PureMagic® manufactures low and high TDS water models for Point-of-Entry equipment.

Spas and Swimming Pools:

PureMagic® uses ionization in trace residual amounts for spa and swimming pool applications. Double positive charged ionic copper (Cu++) is kept at .4 to .7 ppm residual requiring ionization for a maximum of 15 minutes per week on a 600 gallon spa and 4 hours per week on a 24,000 gallon swimming pool. No constant introduction of copper occurs and the residual sanitizer in the pool is recognized by the National Sanitation Foundation (NSF) and the U.S. Environmental Protection Agency.

PureMagic[®] provides the benefits, without the environmental health costs associated with chemicals

PureMagic[®] Anodyne Oxygen Process and Ozone are the only known disinfectants that have the Oxidation potential to be effective against the water borne pathogen, cryptosporidium. The main advantage of the PureMagic[®] process and ozone is, they do not create health threatening by-products such as Dioxins, Trihalomethanes (THMs) and haloacetic acids that are created by Chlorination.

PureMagic[®] Anodyne process produces a more powerful and effective non-chemical method of water treatment than ozone. PureMagic[®] generates more oxygen radicals in one minute (20 to 80) than most ozonators can generate in one hour (1/3 gram to 50 grams). PureMagic[®] Anodyne process is a proprietary water purification technology that provides much greater oxidation potential than ozone.

To give comparison of oxidizing potential, if chlorine is the benchmark, then ozone is exponentially more effective than chlorine and PureMagic[®] Anodyne process would be exponentially and logarithmically more powerful than chlorine.

The Anodyne Oxygen Process:

By the use of low voltage electricity applied to water, the simple process of electrolysis causes the electro-physical separation of water into oxygen O¹ and hydrogen which then forms Hydroxyl radicals OH. PureMagic[®] Anodyne process creates a combination of the most powerful oxidizers available for water disinfection, at a grams per minute level not available with ozonation.

An advantage of the Anodyne Process When Chlorine is Present (Regulated Water):

The primary benefit to the Anodyne process is, oxidation benefits are obtained prior to Chlorination or bromination. Consequently, most of the oxidation and disinfection will be performed by the oxidizers created from the Anodyne process. Unfortunately, many public waters require halogen residuals under city, county or state laws (49 states require halogen residuals).

The real benefit in these chemical residual waters, the oxidizers with the anodyne process do not promote the formation of halogenated by-products, organic or inorganic contaminants (including halo mines.) In addition, the detrimental effects of halo generations can be diminished or eliminated entirely by the Anodyne process. Chemical expenses may fall 50 to 80%.

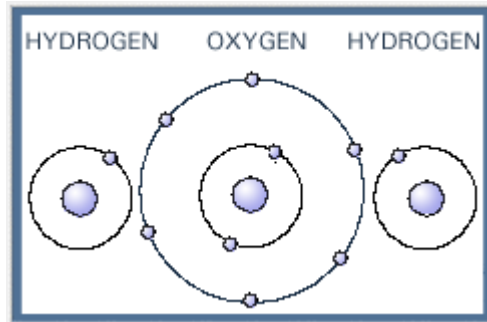
Additional benefits are:

Reduced odours, reduced skin and eye irritation and eliminating the use of anti-chlorine shampoos. The pre-treated water is blue not green and possesses remarkable clarity. Only the waters are treated and disinfected, not the swimmer. When properly used, the anodyne process reduces or eliminates the bathtub ring or swimming pool water line and produces other aesthetic benefits. The bottom line is the anodyne process will lower chemical costs due to lowering the amount of chlorine or halogens, which must be added to obtain the required residual.

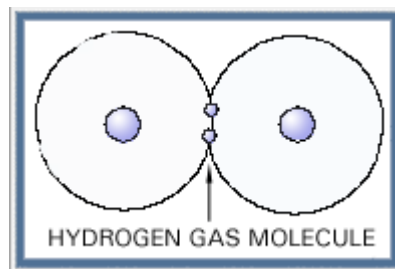
In turn, this will lower the amount of chemicals which must be added to maintain the pH and water balance. PureMagic[®] has several applications experiences and estimates chemical reduction of 50-80%, depending on pool housekeeping, local climate, and application. Carbon dioxide or PMAR03 (Acid Replace) is strongly recommended for commercial sites.

How We Use The Structure of Water

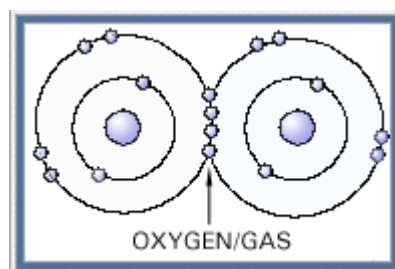
Water is an extremely stable compound. It does not easily decompose and it does not readily ionize. Water (H₂O) is composed of 2 parts hydrogen and 1 part oxygen.



- **Hydrogen:** When hydrogen exists in a stable or balanced form, two atoms are joined together. This is elemental hydrogen gas, shown symbolically as H₂. The two hydrogen atoms in hydrogen gas share two electrons.



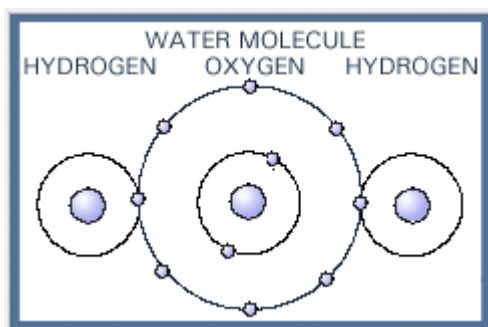
- **Oxygen:** When oxygen is in its balanced form it is O₂, or elemental oxygen gas with 8 protons, 8 neutrons, and 8 electrons.



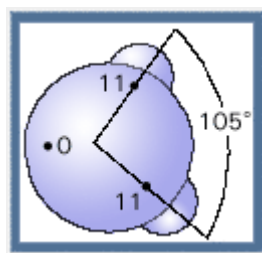
Each oxygen atom now shares 4 electrons with the other atom.

- **Water Molecule:**

In a water molecule, composed of two hydrogen atoms and one oxygen atom, the hydrogen and oxygen atoms are combined and are sharing electrons.



Arrangement of equilibrium positions of the positive and negative charges in water an ionized molecule.



● Ionization:

When electricity is applied to water, electrolysis and ionization occurs. One of the hydrogen ions breaks away from the water molecule, the hydrogen atom now has only a proton and no electron. By losing a negative electron it has become a positive charged ion.

● Ionization of Water:

When the hydrogen ion breaks away, the second hydrogen atom and the oxygen atom remain together, sharing 10 electrons. This results in one extra negative, because the combination has one more electron than proton. This now is a single negative charged hydroxide or hydroxyl ion.

● Ions:

An atom that has acquired an electrical or electrostatic charge is called an ion and can be considered ionized.

Ionized atoms can be negatively or positively charged.

An ionized atom may have one or more positive or negative electrical charges. This happens when an atom gains or loses one or more electrons, thus changing the electrical balance between the protons and the electrons.

● Anions:

Negative ionized atoms are anions and have one or more electrons than they have protons.

● Cations:

Positive ionized atoms are cations and have one or more protons than they have electrons. An atom does not lose protons it loses or gains electrons.

● Ions in the Body:

Virtually all reactions in biological systems are ionic and essential to plant and

animal life.

Everything in water and in living organism's function by electrochemical reactions. Muscles react to electro-chemical stimulation.

Most chemicals, minerals, and metals dissolved in water are electrically charged in an ionic form.

●Electrically charged Water:

Ions dissolved in water make water a good conductor of electricity and they are termed electrolytes.

●Electrolytic Conductivity:

The measurement of conductivity of water is used to determine ionic contamination.

As an example, a sodium ion is positively charged and a chlorine ion is negatively charged. When combined, they become table salt, with a balanced electrical charge. When salt is dissolved in distilled water the sodium becomes a positive ion and the chloride becomes a negative ion and the water becomes conductive. The symbol for chlorine is Cl, and the symbol for a chlorine ion is Cl.

●Table 1. Common ions in natural water

The chemical symbols for an ion includes a plus or minus sign to indicate the unbalanced charge. Cations Anions calcium Ca^{++} bicarbonates HCO^3- magnesium Mg^{++} chloride Cl^- sodium Na^+ sulphate SO^4- - iron Fe^{++} nitrate NO^3- manganese Mn^{++} carbonate CO^3- - copper Cu^{++} phosphate PO^4-

●Ionization Potential:

Is the energy required to remove an electron from an atom. Ionization potential is expressed in Volts.

● Electromotive Force Series:

An arrangement of elements in order of their decreasing potential for ionization.

THE ELECTROMOTIVE SERIES
Electrode Potential, V
At 25 for 1 MOLAL
Metal-Ion Concentration

Magnesium	Mg²⁺	-2.34
Aluminium	Al³⁺	-1.67
Zinc	Zn²⁺	-0.76
Chromium	Cr³⁺	-0.71
Iron	Fe²⁺	-0.44
Cadmium	Cd²⁺	-0.40
Nickel	Ni²⁺	-0.25
Tin	Sn²⁺	-0.14
Lead	Pb²⁺	-0.13
Hydrogen	H⁺	0.00
Copper	Cu³⁺	+0.34
Silver	Ag⁺	+0.80
Palladium	Pd²⁺	+0.83
Mercury	Hg²⁺	+0.85
Platinum	Pt²⁺	+1.20
Gold	Au²⁺	+1.42

●Electro negativity:

Electro negativity was introduced by Linus Pauling in 1932 and is described by him as "the strength at which an electron is held by an atom in a bond," or further defined as: the tendency of an atom to acquire a negative charge.

Electro negativity is: a measure of electrostatic force or ionic potential of an elements' effective nuclear charge on its surface. Metals are considered to be cations bonded together by a cement of mobile electrons.

Electro negativity differentiates the power of one element and its ability to displace or be displaced in an ionic solution by another element of equal positive or negative charge.

With proper grounding of plumbing systems, the above chart demonstrates why PureMagic[®] has no dissimilar metals issues on galvanized pipe applications.

RELATIVE ELECTRONEGATIVITIES OF SOME ELEMENTS
(Relative Compactness Scale)

H	3.55	k	0.42	Rb	0.36	Cs	0.28
Li	0.74	Ca	1.22	Sr	1.06	Ba	0.78
Be	2.39	Zn	3.00	Cd	2.59	Hg	2.93
B	2.93	Ga	3.28	In	2.84	Tl(I)	1.89
-	-	-	-	Sn(II)	2.31	-	-
C	3.79	Ge	3.59	Sn(IV)	3.09	Tl(III)	3.02
N	4.49	As	3.90	Sb(IV)	3.34	Pb(II)	2.38
O	5.21	Se	4.21	Te	3.59	Pb(IV)	3.08
F	5.75	Br	4.53	I	3.84	Bi	3.16
Na	0.70	-	-	-	-	-	-
Mg	1.56	Sc	1.30	Y	1.05	La	0.88
Al	2.22	Ti	1.40	Zr	1.10	Hf	1.05
Si	2.84	V	1.60	Nb	1.36	Ta	1.21
P	3.43	Cr	1.88	Mo	1.62	W	1.39
S	4.12	Mn	2.07	Tc	1.80	Re	1.53
Cl	4.93	Fe	2.10	Ru	1.95	Os	1.67
-	-	Co	2.10	Rh	2.10	Ir	1.78
-	-	Ni	2.10	Pd	2.29	Pt	1.91
-	-	Cu	2.60	Ag	2.57	Au	2.57

*Values for the transitional elements are tentative estimates only.

Electron Affinity:

The degree of electro negativity, or the extent to which an atom holds valence electrons compared to other atoms of the chemical molecule. The differentiation at this point is like comparing apples to apples: 1. Two identical apples in identical size and appearance yet one outweighs the other because of greater density. 2. Two unequal sized apples, each weighing the same because of varying density. Electro negativity is the variable factor that allows for one ion of apparent equal value to displace another.

Microbiological Control:

Micro organisms vary greatly in form, colour, and habits, as well as in size. The variety is enormous. In one classification alone, the Diatomacea, it is estimated there are over 10,000 species, each of which has its own distinctive shape, pattern or design. Some micro organisms live only in sunlight, others thrive in the dark: some are aerobic requiring oxygen for their existence, others are anaerobic and grow in the absence air. They may be mobile or non-mobile. Micro organisms grow, in cold or hot water and even under ice. Micro organisms when introduced in water supplies, cause a variety of problems, many form coatings on piping, reducing flow and restricting valves, pumps, nozzles, or parts of the water distribution system. Filters and water softener media may be contaminated and operation impaired. PureMagic[®] well water installations to date has effectively controlled micro organisms using low level ionization and oxygenating the water with the titanium oxidation electrode.

Disagreeable tastes and odours:

May be produced either from living micro organisms or their decomposition. Discoloration and staining may be caused by micro organisms, primarily moulds and slimes, these growths are difficult to control and exceedingly troublesome as reinfection often occurs. These growths need not be in the source water and may be seeded from the air or other sources. Well water containing iron manganese or sulphur, frequently, has associated bacteria which cause extremely troublesome and clogging growths. Sulphur waters frequently have thread-like growths, which appear on aerators and watering trays. These waters contain elemental sulphur often in colloidal form. This sulphur may be due to the oxidation of the hydrogen sulphide and action by sulphate reducing bacteria, which reduce sulphates to sulphides, and are often responsible for the production of black water.

Destruction, or Prevention of Micro organisms:

Treatment with Ionization and copper Ions produce kill rates for the following micro organisms at the following dosages in concentrations measured in parts per million. No scientific evidence exists that microorganisms are developing immunity to copper ions as has been well documented with various forms of chlorines.

E. COLI SITE HISTORIES

E. Coli killed at 0.1 to 0.2 ppm has been observed at pH ranges 6.5 to 8. Many Municipal public health inspectors in many states and customers at dozens of sites have done independent testing.

The copper ionization residual in the plumbing line is stable to the point of use fixture and is the prudent and proven solution for both Coliform and E. Coli applications.

Copper Kill Rates

Chlorophyceane	Copper ppm rqd
Cladophora	0.50
Closterium	0.17
Coelastrum	0.05 - 0.33
Conferva	0.25
Desmidium	2.00
Draparnaldia	0.33
E. COLI	0.20
Entomnglprn	0.50
Eudorins	10.00
Hydrodictyon	0.10
Microspora	0.40
Palmella	2.00
Pandorina	10.00
Raphidiun	1.00
Scenedesmus	1.00
Spirogyra	0.12
Starastrom	1.50
Ulothrix	0.20
Volvox	0.25
Zygnema	0.60
Protozoa	Fusaria 1.0

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