glas®

MEASURING THE CONCENTRATION OF OXYGEN IN ASO® IN BOTTLED WATER APPLICATIONS:

Technical Discussion

ASO® is a pH balanced, oxygen-enriched saline-based solution that is sold as a dietary supplement. It contains distilled water, sodium chloride and bioavailable polyatomic oxygen (tetra-oxygen). Unlike dissolved diatomic oxygen (O2) or ozone (O3), ASO®'s oxygen molecules exhibit unique physical characteristics that are quite different from their related polyatomic siblings.

The O4 in ASO® is highly stable from 0° to 140° C.
The O4 in ASO® remains in solution and is not affected by UV, heat or cold temperatures.
The O4 in ASO® does not require pressurization to remain in solution.
Considerably higher concentrations per liter of O4 are in the solution when compared to dissolved O2 or O3.
The O4 in ASO® does not require special handling, storage or equipment.
The O4 in ASO® is completely non-toxic.

Because of O4's unique molecular "electrical" configuration and stability, its presence cannot be readily detected using standard dissolved oxygen test methods. It can be visually detected using DPE test tablets and using the Modified Azide-Winkler Test. However, ASO® must be diluted considerably to use these test kits and reagents which can result in significant margin of error calculations. Standard DO (dissolved oxygen) meters (and probes) lack sufficient mechanisms to analyze the electrical potential of O4. Using such devices will result in inaccurate readings.

The most consistent way to detect the presence and strength of ASO® in solution is to measure its electrical potential using an oxidation-reduction meter. Such devices are simple to operate and are extremely accurate to tenths and even hundredths of a millivolt.

Unlike the pH electrode that responds only to hydrogen ion activity, an ORP electrode responds to chemical reaction activity in which material is converted from one oxidized state to another through electron transfer.

Oxidation Reduction Potential (ORP) is, simply put, an indication of a solution's ability to oxidize or reduce another solution. It is a ratio of oxidized species to reduced species in a solution containing both. Some commonly used oxidizers include chlorine, ozone, bromine, sodium hypochlorite, and hydrogen peroxide. Examples of reductants include sodium bisulfite (also known as sodium metabisulfite) and sulfur dioxide. The terms "ORP" and "Redox" are both commonly used and are interchangeable.

Theory

Redox measurements and electrodes are, in certain regards, very similar to pH measurements and electrodes. Where a pH probe indicates acid/base levels by measuring the hydrogen ion activity, a redox probe indicates oxidizing/reducing cabability of a solution by measuring the electron activity.

From acid/base theory, we know that a solution containing a strong acid will also contain its conjugate weak base, and a solution containing a strong base will also contain its conjugate weak acid. Similarly, a solution containing a reducing agent will also contain a corresponding oxidizer.

Returning yet again to the pH analogy, an acid is defined as a substance able to donate a hydrogen ion, where a base is defined as a substance capable of accepting a hydrogen ion. Analogously, a reduction agent is a substance capable of donating an electron, where an oxidizing agent is capable of accepting an electron. Furthermore, there can be no oxidation without simultaneous reduction.

The indicator electrode measures electron activity, and to do this it must be both chemically inert and an electron conductor. Platinum is the most frequently used material for ORP electrodes, except in applications containing strong reducing solutions, such as alkaline cyanide solutions, where the catalytic properties of platinum cause hydrogen ions to be reduced at the electrode surface, forming the generation of stray potentials. In applications such as these, Gold is typically the material of choice.

Unlike pH and other ion-specific electrodes which are specific in nature, one must bear in mind that ORP electrodes merely measure the ratio of oxidized to reduced forms of all chemical species in solution, so some pre-knowledge of the sample's "potential" must be known for the ORP reading to be meaningful.

"Potential" is a word that refers to ability rather than action. Potential energy is energy that is stored and ready to be put to work. It's not actually working, but we know that the energy is there if and when we need it. When all of the oxidizing and reducing materials have reacted, equilibrium is reached and there is usually a surplus. It is this surplus that creates the oxidation or reduction "potential" of a solution.

Potential energy is energy that is stored and ready to be put to work. It's not actually working, but we know that the energy is there if and when we need it. Another word for potential might be pressure. Blow up a balloon, and there is air pressure inside. As long as we keep the end tightly closed, the pressure remains as potential energy. Release the end, and the air inside rushes out, changing from potential (possible) energy to kinetic (in motion) energy.

In electrical terms, potential energy is measured in volts. Actual energy (current flow) is measured in amps. When you put a voltmeter across the leads of a battery, the reading you get is the difference in electrical pressure - the potential - between the two poles. This pressure represents the excess electrons present at one pole of the battery (caused, incidentally, by a chemical reaction within the battery) ready to flow to the opposite pole.

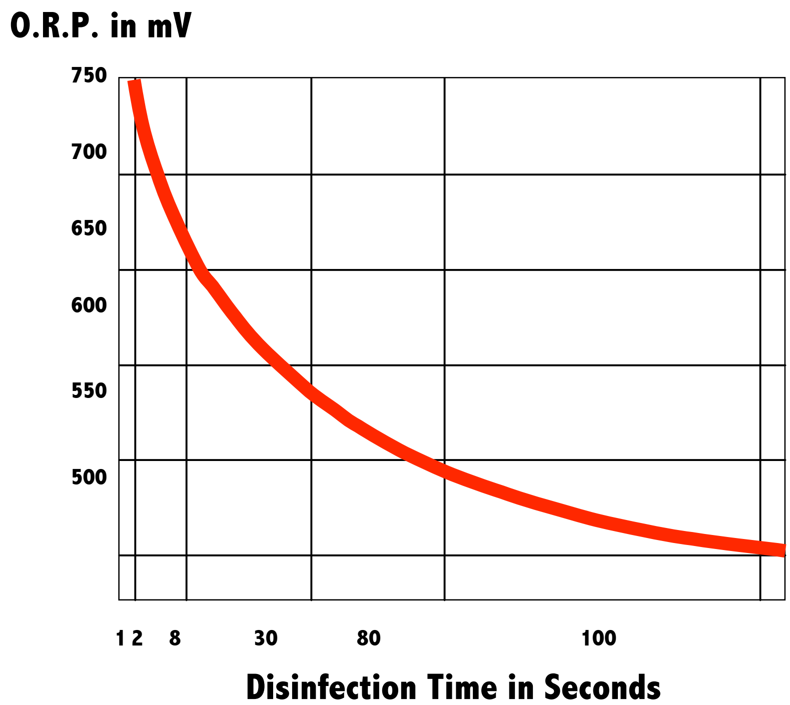
When we use the term potential in describing ORP, we are actually talking about electrical potential or voltage. We are reading the very tiny voltage generated when a metal is placed in water in the presence of oxidizing and reducing agents. These voltages give us an indication of the ability of the oxidizers in the water to keep it free from contaminants.

Once the instruments and methods for measuring ORP were developed in the 1960s, researchers began working toward setting standards under which ORP measurements could be used as an accurate gauge of water quality. In 1966 a study by Carlson, Hasselbarth and Mecke of the Water Hygiene Institute of German Federal Health Office, demonstrated that the rate of killing *E. coli* in swimming pool water was dependant on ORP and not on the free residual chlorine level.

In 1972, the World Health Organization recognized in its Standards for Drinking Water, at an ORP level of 650 mV, water is disinfected and viral inactivation is almost instantaneous.

Research has show that at a level of 650 mV of ORP, bacteria such as *E. coli* are killed on contact or within a few seconds. Tougher organisms such as listeria, salmonella, yeasts and molds may require 750 mV or higher in order to be killed.

In Germany, which has about the strictest water quality standards in the world, an ORP level of 750 millivolts has been established as the minimum standard for public pools (1982) and spas (1984).



In its 1988 standards for commercial pools and spas, the National Spa & Pool Institute stated that ORP can be used as a "supplemental measurement of proper sanitizer activity" when chlorine or bromine are used as primary disinfectants. The recommended minimum reading under the NSPI standards is 650 millivolts, with no ideal and no maximum.

Measuring ASO® Oxygen Concentration in Water:

Using ORP as a measurement tool, in combination with mass spectrometry analysis in determining a baseline bioavailable oxygen minimum concentration, provides us with the data to establish an association curve.

ASO® was added in .25 mL increments into pure distilled water. An OAKTON Instruments microprocessor based ORPTESTR Double Junction (35650-02) ORP digital meter was used conforming to ISO 9001 standards. After the addition of each .25 mL of ASO® into the water, a reading was noted. A total of three (3) mL were added until the millivolt reading reached a relatively stable maximum level of 742 millivolts.

The ASO® used in this test was rated by BIO2 International as the company's highest concentrated solution. Mass spectrometry analysis, previously completed on samples of ASO®, established the oxygen content at 350,000 mg/liter or 350 mg/milliliter or 87.5 mg/.25 milliliter. Thus, it was previously verified that 87.5 mg of oxygen would be added for each .25 mL of ASO® added to the distilled water. The graph below described the data from this test.

How To Use This Data:

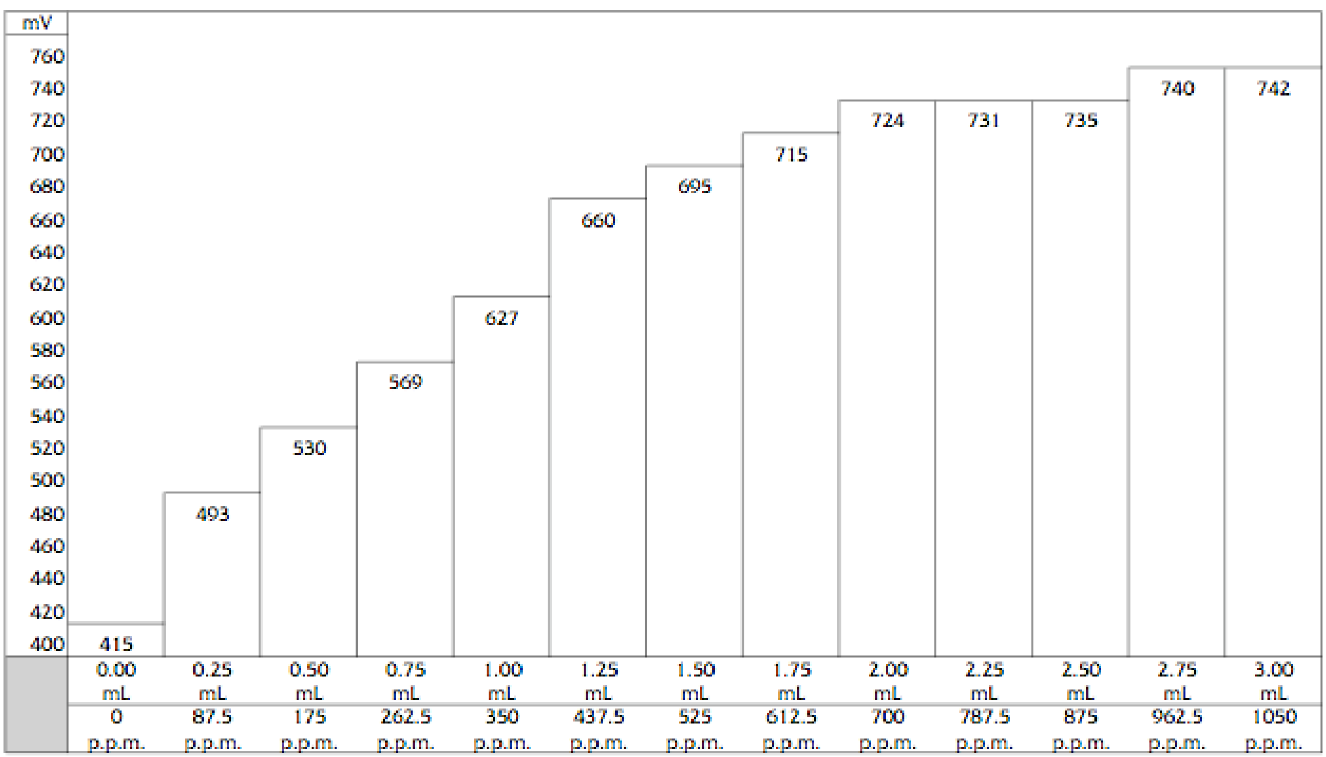
This data is valuable in maintaining a consistent quality control standard when using ASO® as a dietary supplement additive in bottled or packaged water. First a baseline standard measurement must be taken of the water being used. This measurement, in millivolts, establishes the “zero point” from which all further measurements are made.

In the above test, the “zero point” was 415 mV. After .25 mL of ASO® was added, the reading increased 78 mV to 493 mV.

If the water being used in production has a baseline “zero point” of 430 mV, then one should expect that after adding .25 mL of ASO® that the new ORP reading would be approximately 78 mV more or 508 mV. This would establish a bioavilable oxygen level of 87.5 mg/L (p.p.m.) for the finished water product.

In this manner, on-line production personnel can maintain a relatively consistent minimum level of bioavilable oxygen during the manufacturing and bottling process. In addition, because of ASO®’s stability, it should be possible to measure these same mV levels in the field in finished product.

ASO® Association Curve



The above information is only provided for technical and information purposes. The use of this information, in whole or in part, for any other purpose is strictly forbidden. This information is not intended to treat, cure, prevent or diagnose any disease or medical condition. ASO® is sold under the strict guidelines of the FDA's DSHEA regulations for Dietary Supplements. Individuals using ASO® as a dietary supplement should consult with a medical or health professional before using any dietary supplement, especially if pregnant, nursing or under a doctor's medical care.

For more information please contact:

glas®

glas water
Unit 200, 10125 199B St.
Langley BC, Canada V1M 3W9
T. 778.298.4527
F. 778.298.4530
service@glaswater.com