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|  | **Free Chlorine and ORP**  http://www.pulseinstruments.net/freechlorineandorp.aspx  ORP or Oxidation-Reduction Potential is a measure of the oxidizing properties of the sanitizer in water. ClOH being more active that ClO- has a higher ORP value. As the pH increases, an ORP sensor shows a decrease in value which reflects the decrease in ClOH. Scientific and field studies in Germany and elsewhere have shown that ORP readings are better indication of bactericidal properties of chlorine than PPM Free Chlorine values.  Definition:  ORP or "e;Redox"e; stands for Oxidation-Reduction Potential. The two chemical actions involved, "e;oxidation"e; and "e;reduction"e;, always occur together. Although originally referred only to the action of oxygen, the term "e;oxidation"e; now refers to any chemical action in which electrons are transferred between atoms. The atom that loses an electron is said to be "e;oxidized"e;. The atom that gains an electron is said to be "e;reduced,"e; because in picking up that extra electron, it loses the electrical energy that makes it "e;hungry"e; for more electrons.  Sanitizing Effect of Oxidizers:  Chemicals like chlorine, bromine and ozone are all strong oxidizers. It is their ability to oxidize or to steal electrons from other substances, that makes them good sanitizers. The sanitizing action is caused by the alteration of the chemical makeup of unwanted organisms. Oxidizers literally burn off germs, bacteria and other organic material in water leaving as a by-product a few harmless chemicals. Of course, in the process of oxidizing, all of these oxidizers are reduced, thus losing their ability to continue oxidizing other things; eventually, they may combine with other substances in the water, or their electrical charge may be simply used up. To make sure that the chemical process continues to the very end, it is necessary to have a high enough concentration of oxidizer in the water to do the whole job.  Potential Energy:  "e;Potential"e; 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. Another word for potential might be electrochemical pressure. 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 energy 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 electrochemical potential or voltage.  Understanding ORP Readings:  ORP meter readings are very tiny voltages generated when a metal is placed in water in the presence of oxidizing and reducing agents. These voltage readings give us an indication of the ability of the oxidizers present in the water to keep it free from contaminants. An ORP role is really a millivoltmeter, measuring the voltage across a circuit formed by a measuring electrode (the positive pole of the circuit), and a reference electrode (the negative pole), with the water in between. The measuring electrode (+) of the probe, is usually made of platinum, although other noble metals (which do not oxidize easily), such as gold, could be used. When this platinum electrode is placed in water in the presence of oxidizing agents, electrons are constantly transferred back-and-forth on its surface, generating a tiny voltage. The reference electrode (-), usually made of silver is surrounded by a saline (electrolyte) solution that produces another tiny voltage. The voltage is the reference against which the voltage generated by the platinum and the oxidizers in the water is compared. The difference in voltage between the two electrodes is what is actually measured by the meter. As an oxidizer is added to the water, it "e;steals"e; electrons from the surface of the platinum measuring electrode, causing the electrode to become more and more positively charged. As you continue to add oxidizer to the water, the electrode generates a higher and higher positive voltage. When used with a chlorine-based sanitation system, an ORP measuring device will not specifically indicate the chlorine concentration in parts per million. It will however, indicate the effectiveness of the chlorine as an oxidizer. Also, ORP readings will vary as pH fluctuates. As the pH goes up, the millivolt reading on an ORP meter will go down, indicating that the sanitizer is not as effective. Bringing the pH down or adding more sanitizers raises the millivolt reading. That is why most ORP instruments also incorporate an electronic pH meter. With water, the meter measures the difference in electrical potential between the water sample and a sample of known pH that is contained in the meter in a small glass bulb.  ORP Standards:  Once the instruments and methods for measuring ORP were developed in the 1960s, researchers began working towards setting standards under which ORP measurements could be used as an accurate gauge of water quality. In 1968, a laboratory study by Carlson, Hasselbarth and Mecke of the Water Hygiene Institute of the German Federal Health Office showed that the rate of killing of E. Coli organisms in swimming pool water is dependent on ORP and not on the free residual chlorine level. The kill time is just a fraction of a second at a Redox level of 650 mV, but increases rapidly to several hours at lower ORP values. In 1971, the World Health Organization adopted an ORP standard for drinking water disinfection of 650 millivolts. That is, the WHO stated that when Oxidation-Reduction Potential (ORP) in a body of water measures 650/1000 (about 2/3) of a volt, the sanitizer in the water is active enough to destroy harmful organisms almost instantaneously. In Germany, which has about the strictest water-quality standards in the world, an ORP level of 750 millivolts was established by the Deutsche Institut fur Normung (DIN) Standard 19643, as the minimum standard for public pools in 1982 and DIN Standard 19644 for public spas in 1984. France and most other European countries have since adopted these standards.  Oregon Study:  The results of an extensive study on 30 public and semi-public spas in metropolitan Portland, Oregon, were presented at the 1985 meeting of the National Environmental Health Association (NEHA) by James C. Brown, of the Oregon Health Department and Professor Eric W. Mood of the University School of Medicine. Their conclusions should convince the most incredulous. "e;ORP has been shown to be monitoring parameter which takes into account the numerous water chemistry constituents that can affect overall bactericidal efficacy (i.e. pH, free chlorine residual, cyanuric acid concentration, organic and nitrogenous material loading, etc.) and converts them into a single value (i.e. millivolts) which can continuously and reliably indicate acceptable bacterial quality. A review of the data shows that whenever the ORP is 650 mV or more, the water is well within bacteriological standards. However, whenever the ORP is below 650 mV bacteriological contamination is evident. Brown (et.al.) found that: "e;Total and fecal coliform parameters proved to be unreliable indicators of bacteriological water quality (but) the oxidation reduction potential (ORP) was found to be a reliable indicator of bacteriological water quality."e; "e;Public Health officials should adopt a requirement for the maintenance of an ORP reading of at least 650 mV for all chlorinated or brominated spas and pools.  "e;Maintenance of a free chlorine residual or 2.0 ppm or more does not assure safe spa water."e; In its 1988 standards for commercial pools and spas, the Association of Pool and Spa Professionals (APSP), stated that ORP can be used as "e;supplemental measurement of proper sanitizer activity"e; when chlorine or bromine are used as a primary disinfectant. The recommended minimum reading under the APSP standards is 650 millivolts, with no ideal and no maximum.  The APSP also stated that "e;the use of ORP testing does not eliminate or supersede the need for testing the sanitizer level with standard test kits."e;  The above statement is not necessarily a matter of the APSP being cautious about endorsing ORP standards. It was issued in recognition of the fact that most health codes still specify that a measurable free, available residual - usually 1.0 part per million (ppm) - be present in the water of public pools and spas, as measured with a DPD test kit. |