

ORP – Oxidation Reduction Potential

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OREGON PUBLIC HEALTH DIVISION INFORMATION BULLETIN

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INTERPRETATION MANUAL

POOLS/SPAS/ORP

INTRODUCTION

ORP stands for “Oxidation-Reduction Potential.” It is also known as “Redox Potential.” ORP measures the relative tendency of different substances to lose or gain electrons. In pools, it is a measurement showing a disinfectant’s potential to oxidize contaminants.

When chemists first used the term, the word "oxidation" meant "to combine with oxygen." We can see examples of oxidation all the time in our daily lives. Oxidation can occur at different speeds. When we see a piece of iron rusting, or a slice of apple turning brown, we are looking at examples of relatively slow oxidation. When we look at a fire, we are witnessing an example of rapid oxidation.

We now know that oxidation involves an exchange of electrons between two atoms. The atom that loses an electron in the process is said to be "oxidized." The one that gains an electron is said to be "reduced." The “reduced” atom no longer has lower electrochemical potential, and the “oxidized” atom loses its attraction to the rest of its parent molecule. Chemicals like chlorine, bromine, and ozone are all oxidizers. It is their ability to oxidize - to "steal" electrons from other substances - that makes them good disinfectants, because in altering the chemical makeup of unwanted plants and animals, they kill them. Then they "burn up" the remains, leaving a few harmless chemicals as the by-product.

ORP is the only practical method we have to electronically monitor sanitizer effectiveness. The World Health Organization (WHO) has determined that an electrochemical potential (ORP) of 650 mV will disinfect drinking water. Because much of the “work” of the disinfectant is to oxidize materials, in addition to disinfection, a minimum standard of 750 mV is used. This does not correlate to any particular part per million (ppm) measure, as there are many factors which effect the ORP reading.

ORP MEASUREMENT

Of all the factors involved in chemical maintenance, disinfectant residual and pH, are measured and adjusted most often. These can be measured by a pool controller using the measurements from two different electrode probes inserted into the water stream.

When measuring ORP, an inert metal electrode acquires the electrochemical potential of electrons. Platinum and gold are the most common ORP electrode materials. The

actual potential is measured between the metal electrode and a reference electrode. This measurement is the actual ability of the water and its components to oxidize; like a battery charged with stored disinfection and oxidation energy.

Newer probes, with more highly refined electrodes, have a better ability to measure small changes in the ORP. One company uses the term "high resolution redox" or HRR for their ORP probes. ORP and HRR essentially measure the same thing.

The oxidation potential for a pool should be maintained at 750 mV or higher.

pH DEPENDENCE

The chlorine ORP measurement is very pH dependent. As the pH of the solution rises, the ORP potential will decline. As we know, chlorine forms variable amounts of Hypochlorous Acid (HOCl - the active disinfectant) and Hypochlorite ions (OCl⁻ - inactive chlorine) depending on the pH. ORP measures only the active chlorine (HOCl), other oxidizing disinfectants are measured similarly.

ORP ELECTRODE CONTAMINATION AND CLEANING

Generally, an ORP electrode will rapidly measure the ORP of the water. The speed and accuracy is dependent on the condition of the electrode. The electrode will collect grease that can be cleaned off with a mild degreaser. Spray it on, brush if recommended, wait and rinse. Occasionally the electrode can collect some calcium deposits which can be removed from a platinum electrode with a mild solution of hydrochloric (muriatic) acid. Always degrease before acid cleaning. Cleaning the metal electrode with an abrasive material is not recommended. After chemical cleaning, the ORP electrode may exhibit unstable readings until it has stabilized. This stabilization may take a couple of hours.

ORP ELECTRODE CALIBRATION

Since ORP is a characteristic measure of redox equilibrium, the ORP electrode should not require standardization or calibration, though they do wear out or get dirty. The measured potential is absolute. However, it is desirable to check instruments for proper operations and contamination.

Unfortunately, at this time, only the wading pool rules require an ORP measuring device (as of January 1, 2011). When using ORP manual testing is still necessary. If the 750 mv. Reading or higher is maintained, the manual testing frequency can be reduced to once per day, after the pool has had a chance to rest and catch up.

It is fairly easy to use both manual testing and ORP readings together. By adjusting the pH up or down slightly, the ppm reading will fall and rise inversely, allowing you to adjust the tests to within the code requirement levels. Since ORP, read in millivolts (mV), is a better method of determining disinfectant effectiveness, the Public Health Division will try to accommodate, when possible, variations between the disinfectant levels in ppm and the ORP readings in mV.