

The ORP and pH Disinfectant Relationship

What is ORP?

ORP stands for **Oxidation Reduction Potential** (it is also commonly called Redox and sometimes rH) **Oxidation Reduction Potential** is the voltage potential required to transfer electrons from the oxidant to the reductant and is used as a qualitative measure of the state of oxidation in water treatment systems. An ORP meter is used to measure in millivolts (mV), the oxidation-loss or reduction-gain of electrons.

In layman terms, oxidation-reduction potential has been described as the oxidation, or activity level, of an oxidizing agent in the water.

The German DIN Standard - 19643, is recognized throughout the world as one of the most comprehensive guidelines for swimming pool and spa operation. In this standard a minimum of 720mV ORP is required to be maintained at all times in conjunction with a minimum FAC of 0.5ppm. Research has indicated that bacteria can not survive at an ORP of 700mV and above.

In aquatic facilities, ORP dosing control systems are an extremely cost effective alternative to Free Chlorine control.

In swimming pools, ORP is measured on a scale in millivolts using an an ORP electrode (probe). The ORP electrode transmits a signal to an automatic dosing controller and if there is a difference between this value and the value set into the controller (by the operator) as the setpoint, the controller sends a signal to the dosage pump to increase the level of oxidant, thus raising the ORP.

How pH affects disinfectants

When a chlorine product is added to water the chlorine dissociates to form hypochlorous acid (HOCL) and hypochlorite ion (OCL⁻). HOCL is the active component of chlorine. The concentration of HOCL for a given amount of chlorine is pH dependent (see **Table 2**).

Table 2

Approximate % HOCL (hypochlorous acid)	pH	Approximate % OCL (hypochlorite ion)
73	7.0	27
71	7.1	29
66	7.2	34
60	7.3	40
56	7.4	44
50	7.5	50
45	7.6	55
40	7.7	60
36	7.8	64
30	7.9	70
24	8.0	76

Example 1

If 1ppm of chlorine were to be added to water at pH 7.0 the result would be as follows:

0.73 ppm HOCL and 0.27 ppm OCL

Example 2

If 1ppm of chlorine were to be added to water at pH 8.0 the result would be as follows:

0.24 ppm HOCL and 0.76 ppm OCL

How pH affects ORP

pH is the most critical factor affecting the chemistry of water in a swimming pool environment. The control of chlorine levels in a swimming pool or spa utilizing automatic dosing based on ORP is entirely dependent on pH stability. Part of the reason for this is the relationship between pH and HOCL v OCL⁻, as demonstrated in **How pH affects Disinfectants**.

pH at high levels (8.0 and above) changes the ORP of swimming pool water so dramatically that there may be negligible relationship between ORP and disinfectant levels. On the other hand, if the pH is kept stable at 7.5 an almost straight-line relationship will exist between the ORP and disinfectant level. Simplified, this means that a given quantity of disinfectant will equate to a corresponding ORP level.