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Peracids are highly effective sanitizing agents for control of pathogens and algae.

Water treatment series: Activated peracids can treat water

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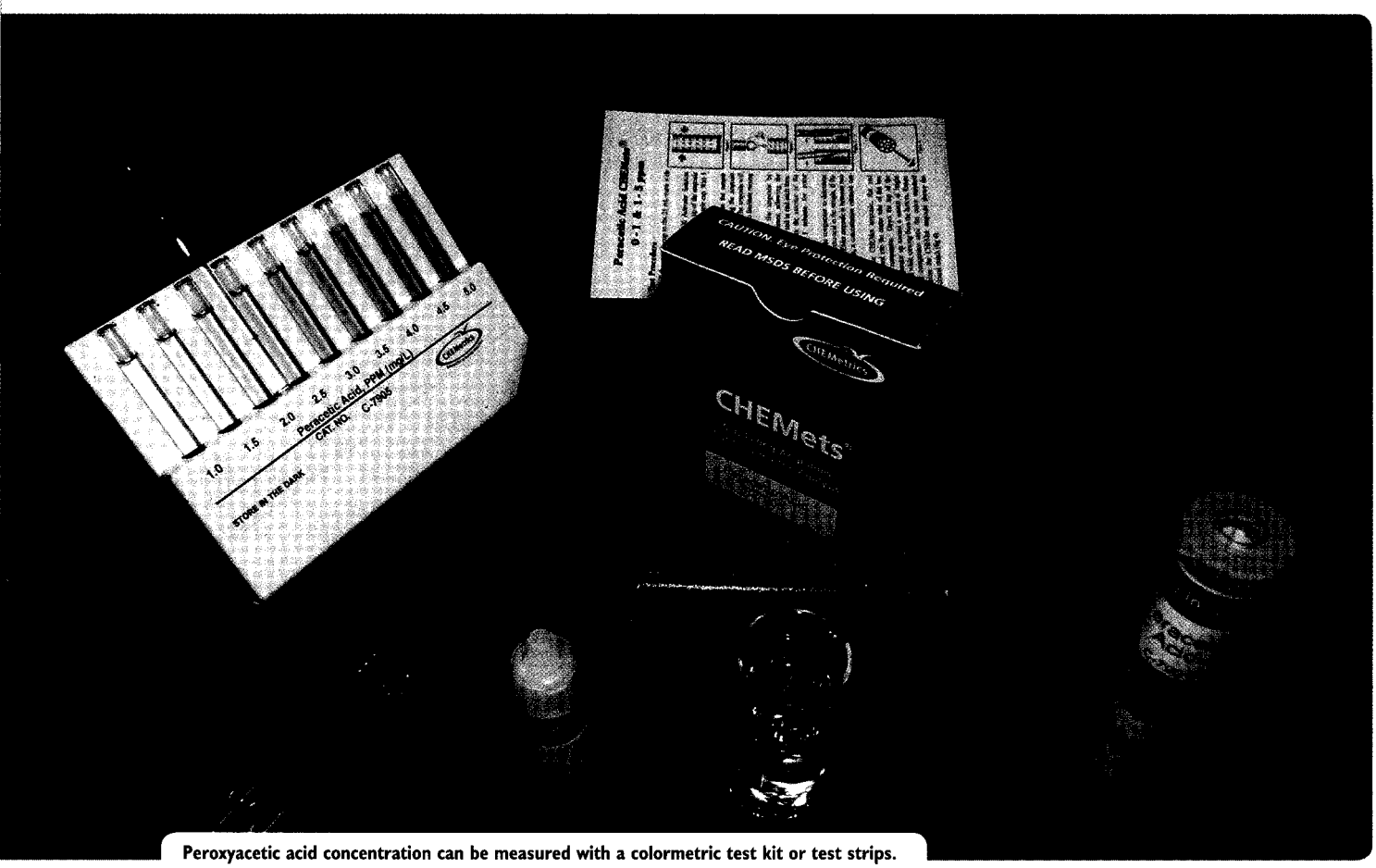
PERACIDS, ALSO CALLED ACTIVATED PEROXYGEN, are a formulation of hydrogen peroxide (H_2O_2 and acetic acid that produces a highly reactive product called peroxyacetic acid (PAA). While peracids share some of the characteristics of sodium hypochlorite (they are manufactured as liquid concentrates and are classified as oxidizers), they are different from chlorinated products.

Properties of peracids

Peracids use hydrogen peroxide as their base component. Hydrogen peroxide is a common chemical compound found in most people's medicine cabinets for disinfecting cuts and bruises, among other uses. Hydrogen peroxide is produced by the joining of two hydrogen molecules with two oxygen molecules.

The bonds that hold the two oxygen and hydrogen molecules



Peroxyacetic acid concentration can be measured with a colormetric test kit or test strips.

are generally weak, which makes hydrogen peroxide unstable. Store-brand hydrogen peroxide is packaged in brown bottles because even weak ultraviolet rays emitted from store lights can break the molecule bonds.

Peracids combine hydrogen peroxide and organic acids, typically acetic acid, to form peroxyacetic acid. This compound is an activated form of hydrogen peroxide and produces a much more stable and powerful oxidizing compound to treat pathogens and algae in water.

Peracids are acidic in nature. The typical pH value for most concentrates is 1.9. Concentrated material is highly reactive and is designated as both an oxidizer and a corrosive due to the acidity of the product.

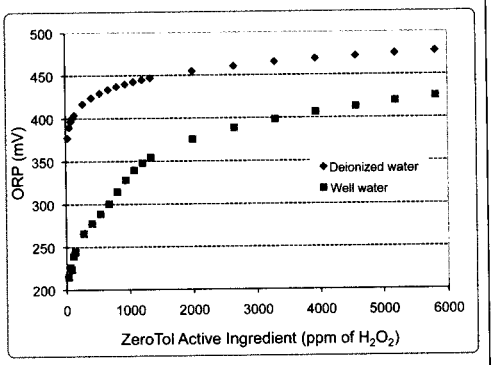
Peracids tend to be very tolerant of pH fluctuations and are effective at an elevated pH value of 8, although the optimum pH for peracids is 7.0 or lower. Because peracids acidify water, they can help to partially moderate problems of high pH or alkalinity in irrigation water.

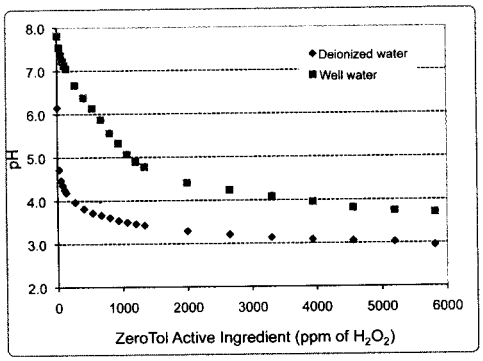
Peracid products

Peracids such as BioSafe Systems ZeroTol Algaecide /Fungicide and SaniDate 12.0 Micro biocide contain peroxyacetic acid and additional inert stabilizers, surfactants and buffering agents that help maintain the bonds of the peracid compound. These stabilizers make the peroxyacetic acid resistant to degradation by ultraviolet light. Formulated peracid products are in equilibrium between hydrogen peroxide and peroxyacetic acid chemical forms.

Increased concentrations of peroxyacetic acid allow higher dilution rates as well as increased stability and resistance to organic degradation. Typical peroxyacetic acid concentrations are 2 percent, 5 percent and 12-15 percent. ZeroTol is 2 percent peroxyacetic acid and SaniDate 12.0 is 12 percent peroxyacetic acid.

The applied concentration of peroxyacetic acid and hydrogen





Effect of ZeroTol concentration on Oxidation Reduction Potential (ORP) (top) or solution pH with deionized water or well water at 112 ppm alkalinity.

peroxide varies depending on the formulation and product use. For example, label rates for SaniDate 12.0 range from 1.2 parts per million (ppm) peroxyacetic acid (1:100,000 dilution) for continuous low level application to irrigation water to 200 ppm peroxyacetic acid (1:600) for treatment of greenhouse surfaces. ZeroTol label rates range from 1 ppm peroxyacetic acid (13.5 ppm hydrogen peroxide, 1:20,000 dilution) to 400 ppm peroxyacetic acid (5,400 ppm hydrogen peroxide, 1:50 dilution) depending on the product use.

Formulated peracid products are more stable than hydrogen peroxide and degrade principally through reactions with elemental metals, microorganisms and organic material. For example, a 2 percent formulated peracid (ZeroTol) was prepared at 150 ppm of hydrogen peroxide in a subirrigation tank in a greenhouse trial run by BioSafe Systems. The tank solution maintained its efficacy for up to three days of use in a flood floor system before losing strength. A preliminary trial

at the University of Florida confirms that the presence of organic matter is the main factor likely to decrease residual peroxyacetic acid and hydrogen peroxide in a ZeroTol solution.

Peracid concentration

The mode of action of peracids is by oxidation of cell membranes and penetration into cell structures of algae, bacteria and fungi. More specifically, peracids form free hydroxyl radicals (OH), which oxidize and disrupt thiol groups in proteins and enzymes.

Research by plant pathologist Robert Wick at University of Massachusetts found that a 1:2,000 dilution of ZeroTol (135 ppm hydrogen peroxide, 10 ppm peroxyacetic acid) killed zoospores of both Pythium aphanidermatum and Phytophthora parasitica. The number of viable chlamydospores of Fusarium oxysporum was also reduced by nearly 80 percent using a 1:2,000 dilution of ZeroTol. ZeroTol activity against Fusarium was not reduced by the presence of peat in the solution over a 30-minute period.

Test kits are available to measure peroxyacetic acid levels. Even though peracids work by oxidation, their concentrations cannot be accurately measured using an oxidation/reduction potential sensor, because oxidation/reduction potential is not very sensitive to peroxyacetic acid concentration.

Peracid greenhouse applications

Several features make peracids an excellent choice for agricultural and horticultural water treatment. Peracid products that have been specifically formulated for horticulture offer a high degree of safety with regard to phytotoxicity.

With formulated peracids, growers can easily adjust the concentration of active ingredient in the treated water to account for increased biological loading. This is important since many forms of bacteria and fungal organisms in their oospore life stages are very susceptible to low levels of peracids, but organisms such as *Pythium* require higher active ingredient levels. Peracid products can be used for sanitation of greenhouse surfaces, shock applications for water storage tanks and piping, continuous application at a low concentration, and also as a bactericidal or fungicidal application to plant foliage or roots.

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A further advantage is that when peracids degrade, the byproduct is oxygen, a safe and beneficial byproduct. Oxygen is released when the bonds holding the oxygen and hydrogen molecules are broken. This process occurs when hydrogen peroxide is applied as an antiseptic to treat an open wound. The bubbling is a result of the peroxide compound breaking apart when it reacts with the iron in the blood, along with other proteins and enzymes. The bubbling is a release of oxygen. The same reaction occurs when a peracid breaks down.

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Chemical names and trade names are included as a convenience. The use of brand names and any mention of commercial products or services does not imply endorsement by the University of Florida, nor discrimination against similar products or services not mentioned.

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