

# PRINCIPLES OF CHLORINATION: PPM or ORP?

*If you're applying chlorination anywhere in your processes, you need to think again about how effective it may be.*

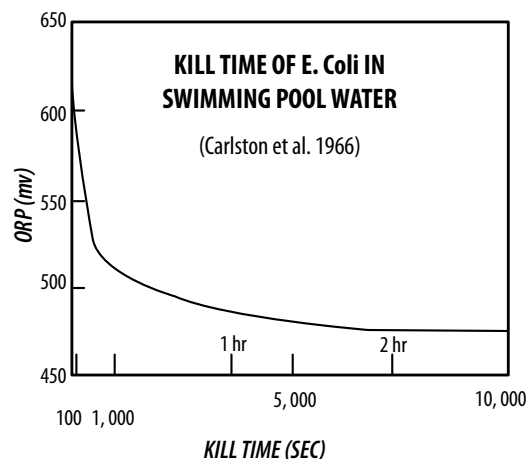
Conventional wisdom holds that as long as a free chlorine reading is maintained in a system, disinfection is complete. However, the scientific community no longer accepts this as valid or sufficient. The objective of all chlorination programs is to produce the active disinfectant Hypochlorous Acid (HOCl), but factors like system pH, total organic load and excess Nitrogen can result in chlorine forming other, less active compounds like the hypochlorite ion (OCl<sup>-</sup>) and chloramines, which are up to 100 times less effective. The problem arises in that:

**NO COMMERCIAL TEST KIT CURRENTLY AVAILABLE  
DIFFERENTIATES BETWEEN THE VARIOUS  
CHLORINE-CONTAINING COMPOUNDS. A FREE  
CHLORINE RESIDUAL THEREFORE DOES NOT EQUAL  
'DISINFECTION'**

The market is finally paying attention, and the new global trend is to measure the Oxidation-Reduction Potential or 'ORP' of chlorinated water. In contrast to PPM which merely tells the observer that chlorine is present in the water, ORP indicates whether organisms have been destroyed irrespective of pH or PPM levels. ORP is measured in millivolts (mV) and verifies *oxidation activity* in the water. Put simply, an ORP reading of above 650mV - 700mV is all that is necessary to reassure an observer that his chlorination program is effective. If readings are below these levels then underlying causes such as pH, chlorine dosing and water quality can be assessed and adjusted.

## WHAT SHOULD MY WATER ORP BE?

Once the instruments and methods for measuring ORP were developed in the 1960's, 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 the 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.



ORP (mV)	Kill Time E. Coli
650	0 seconds
600	10 seconds
550	100 seconds
500	1 hour
450	No kill

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

## HOW TO TEST ORP?

ORP is easy to measure with a simple, self-calibrating hand held probe.

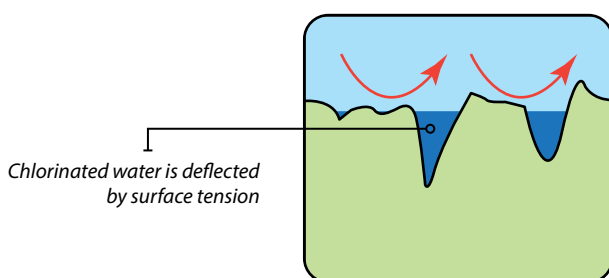


# PRINCIPLES OF CHLORINATION:®

## SURFACTANTS & FRESH PRODUCE DISINFECTION

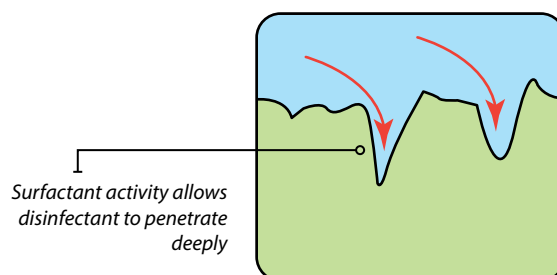
### *The Role of Wetting Agents in Enhancing Disinfection and Shelf Life*

The benefits of chlorination programs in fresh food production are well established. It is also widely understood that effective chlorination is fundamentally dependent on additional factors such as system pH and chlorine demand. Nevertheless, many food producers – even those who have sought to maximise the efficiency of their chlorination programs – often report sub-optimal results or experience a degree of variability in their results. In many instances, the underlying causes can be attributed to two factors: i) the rough nature of external food surfaces and ii) the surface tension of process water – both of which come into play at the microscopic/atomic level, preventing chlorinated water from penetrating the microscopic pits, crevasses and lesions that occur naturally on all food surfaces.



Many producers are not yet aware that it is possible to significantly augment and enhance their chlorination program through the addition of a food grade wetting agent/surfactant. In a study conducted on pears by Oregon State University\* it was demonstrated that the proper combination of surfactants and chlorine can significantly

enhance the statistical efficiency of the chlorination program\*. The study further concluded that: ***'Even when spores were placed directly into puncture wounds, chlorine plus various surfactant solutions reduced decay more than chlorine alone.'*** In addition, more recent research seems to indicate that the addition of a surfactant to a chlorine solution may also have a positive influence on the oxidation-reduction potential (ORP) of the blend.



#### WHICH SURFACTANTS SHOULD BE USED?

Not all surfactants are compatible with chlorine (ie they demonstrate a 'chlorine demand' of their own). When selecting a surfactant it is important to first ascertain not only its chemical compatibility but also its effect on system pH. Literature on the subject indicates that sodium silicate-based wetting agents fulfil the necessary requirements and are generally freely available. Other more economical solutions, including the combination of compatible solid surfactants with dry chlorine, are also currently in development.

\*[RA Spotts & BB Peters, Oregon State University (1982)]