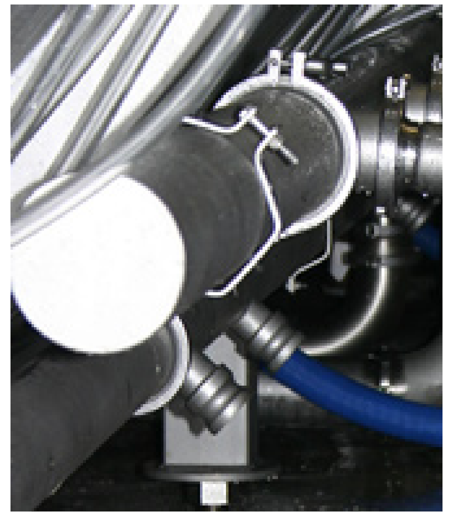
Technical Update

from Jones-Hamilton Co.

SAS Process Water Acidifier

Use of SAS for Chlorine Optimization in Meat and Poultry Processing Establishments

SAS is a patented food grade acid for pH control of process water in meat and poultry facilities. SAS is used in conjunction with chlorine to maximize the antimicrobial properties of chlorinated processing water and chill systems. In order for your processing plant's antimicrobial programs to be as effective as possible, it is important to understand how pH and chlorine work together to reduce the microbial load on meat and poultry carcasses.



What Is SAS?

SAS is a natural mineral acid salt approved for pH control of processing water in meat and poultry plants. SAS is manufactured under FDA's Good Manufacturing Practices and HACCP program. The facility is in compliance with ISO 9001-2000 and received a "Superior" rating from the American Institute of Baking. SAS purchased from Jones-Hamilton Co. includes a license for use in applications covered by U.S. patents 5,958,491, 6,132,792, and 6,620,445 B1.

Why Is SAS Used In Poultry And Meat Processing Water?

Chlorination of processing and chiller water is the most commonly used sanitation system in poultry and meat processing. Chlorine requires a pH of 5.0-6.0 in order for it to be in its most effective form (hypochlorous acid). In most processing plants, the incoming water is not in this correct pH range. SAS is used to keep the processing water at a pH of 5.0-6.0 in order to allow free chlorine to be in its most effective form.

Will The Use Of SAS Increase My Free Chlorine Levels?

No. Using SAS to control pH only determines what *form* the free chlorine is in and does not alter the *amount* of free chlorine present. The amount of free chlorine present is independent of the water pH.

Is SAS Compatible With On-Line Reprocessing Systems And Antimicrobial Rinses?

Yes. SAS can be used with all of the chemicals used in OLR or antimicrobial rinse systems. Because each of these chemicals alters the water stream in a different way, the amount of SAS needed will vary between systems.

What About Monitoring Antimicrobial Kill Potential With ORP?

ORP (oxidation reduction potential) is a trend indicator that measures the oxidizing potential of a system. ORP is best used only as part of the feedback loop in an automated delivery system. While it has become a popular method to monitor the antimicrobial properties of chiller water, it is very difficult to interpret in light of true bacterial kill potential. ORP measures everything in the system that is an oxidizer, not just Free Chlorine. Due to the high organic load in a chiller, many chloramines are formed when chlorine is added. ORP also measures the chloramines which are oxidizers but very weak in bacterial killing power. This is one of the reasons why you can have good ORP readings in the body of the chiller without having good bacterial killing efficacy.

Hypochlorous acid is the only form of chlorine that will provide a good bacterial kill in the conditions present in a processing plant, i.e. short contact time and high organic load. Small changes in the percentage of hypochlorous acid available can greatly alter its bacterial kill efficiency. Hypochlorous acid makes up 95-100% of the Free Chlorine present when the pH is between 5.0-6.0.

JONES-HAMILTON CO.
Agricultural Division
30354 Tracy Rd. | Walbridge, Ohio 43465-9792 | aginfo@jones-hamilton.com
Phone: 419.666.9838 | Toll Free: 888.858.4425 | Fax: 419.666.1817

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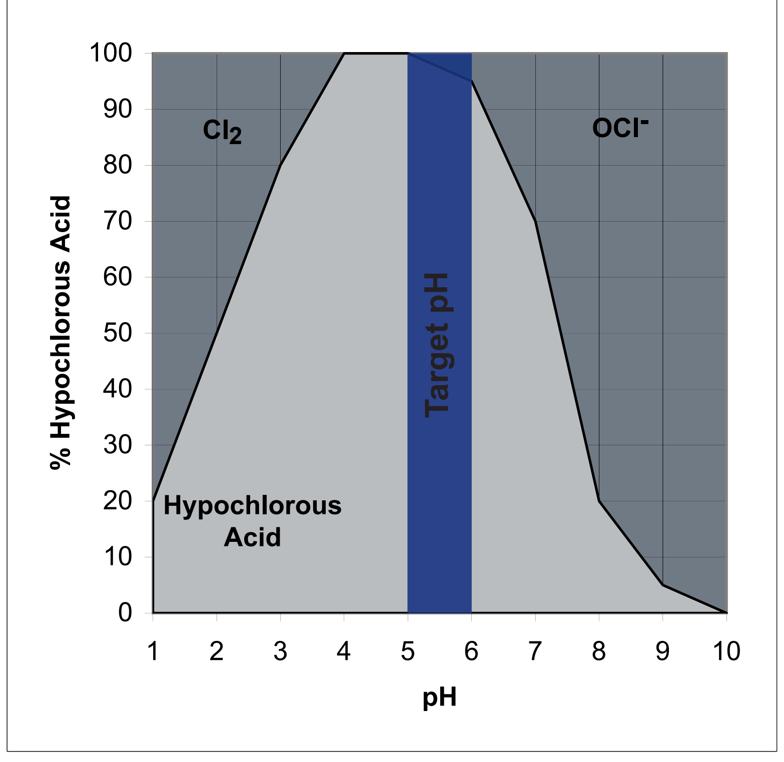
Basics Of Chlorine Chemistry

Why Is pH Important For Chlorine Germicidal Activity?

The disinfecting power of chlorine is dependent on the pH of the processing water. Too often, processing plants wonder why they have poor antimicrobial efficacy despite having proper levels of free chlorine. Usually, the pH of the processing water in these plants is above a 6.5, which reduces the disinfecting power of free chlorine.

When chlorine is added to water, it becomes either hypochlorous acid or hypochlorite ion depending on the pH. Hypochlorous acid is 100 times more effective at killing bacteria than hypochlorite ion. At pH 5.0 – 6.0, over 96% of the free chlorine is in the form of hypochlorous acid. At pH 7.5, less than 50% is hypochlorous acid. Unfortunately, free chlorine test kits record both hypochlorous acid and hypochlorite ion as free chlorine, so unless the pH of the water is also known, it is impossible to tell the percentage of hypochlorous acid present. At high pH levels, little or no hypochlorous acid is available, and therefore satisfactory disinfection can be difficult to achieve.

Figure 1: Forms of Free Chlorine



How Does Chlorine Work?

Chlorine is a bactericide that works to destroy the bacterial cell wall. Free chlorine is a measure of the combined amounts of hypochlorous acid ($HOCl^-$), and hypochlorite ion (OCl^-). The pH of the solution determines the ratio and form that free chlorine is in. Hypochlorous acid is 100 times more powerful at killing bacteria than hypochlorite ion. At pH 5.0-6.0, over 95% of the free chlorine is in the form of hypochlorous acid as illustrated in Figure 1.

It is generally thought that hypochlorous acid kills bacteria by oxidizing essential bacterial enzymes, thereby disrupting the metabolism of the organism. The germicidal efficacy of hypochlorous acid is due to the relative ease with which it can penetrate the cell wall. This penetration is comparable to that of water, and can be attributed to its modest size (low molecular weight) and its electrical neutrality (absence of an electrical charge). Hypochlorite ion (OCl^-) is a weaker oxidizing agent compared to hypochlorous acid and its negative charge impedes its ability to penetrate an organism's cell wall. Hence, hypochlorite ion is far less effective at killing bacteria.

Managing Water Chlorination Programs For Maximum Bactericidal Efficacy

In order to obtain the maximum bactericidal efficacy, total chlorine, free chlorine, pH, and organic load must all be managed continually. This applies anywhere in the processing facility that chlorinated water is being used.

What Should My Chlorine And pH Targets Be For Maximum Chlorine Efficacy?

Total chlorine should be provided in sufficient levels to achieve a minimum of 2-3 PPM free chlorine. The pH should be maintained between 5.0-6.0. Using this target range gives you a margin of safety if the pH drifts slightly above or below the target.

Chlorine can only be effective when sufficient free chlorine (2-3 PPM) is present and the proper pH (pH 5.0-6.0) is maintained. These two parameters occur independently of each other but both must be continually maintained for effective bacterial control. This is particularly important in chiller applications where the high amount of organic material and the low water temperature work together to limit chlorine's effectiveness.

Figure 2: Insufficient Free Chlorine

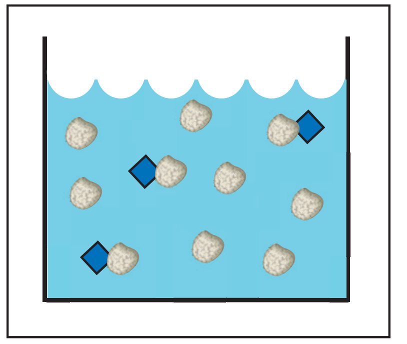
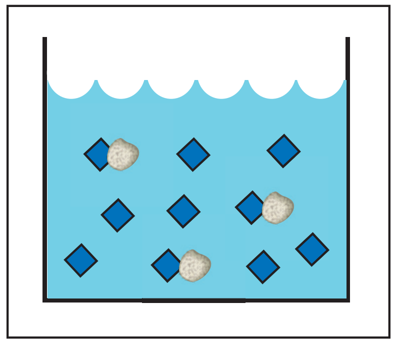


Figure 3: Sufficient Free Chlorine



Does Organic Load Affect The Amount Of Chlorine Needed?

When chlorine is added to water it creates what is called free chlorine. Free chlorine reacts with the organic matter including blood, fat, and bacteria. Once the chlorine reacts, it no longer has disinfectant properties. If there is more organic matter in the water than the amount of total chlorine being added, there will be no free chlorine present. See Figures 2 and 3. In order to increase free chlorine levels, more chlorine must be added to the system or more organic material must be removed.

How Do I Monitor The Antimicrobial Kill Potential Of My Chlorinated Water?

Total chlorine, Free Chlorine, and pH should be measured at a minimum of three locations in each stage of the pre-chiller and chiller. Bird entrance, middle, and bird exit are the preferred locations. This allows assessment of chlorine activity throughout the entire chiller. It is important to know the amount of hypochlorous acid the carcasses are actually being exposed to and for how long. Monitoring only the incoming water or the make-up water is not sufficient as this water is diluted in the chiller. These measurements should be taken on an hourly basis to accurately determine the conditions.