SANITIZING OF MILK CASE WASHERS AND TRANSPORT CONVEYORS:

AN OVERVIEW OF CURRENT PRACTICES AND ADVANTAGES OF CHLORINE DIOXIDE USE

A PURELINE WHITE PAPER

SEPTEMBER, 2010

EXECUTIVE SUMMARY; THE ISSUES

There is a great need to review the process of cleaning and sanitizing of cases along with conveyor systems and filled product; after the recall of product and multiple cases of sickness caused by the lack of biocide and low vigilance in a milk processing facility recently, it would be a good time to review your own process and potential for a similar situation:

- **Cases need to be cleaned**; so long as soil is attached to the case, organisms can exist beneath the soil load
- **Cases need to be bacteria free**, empty cases can experience a multitude of conditions once emptied
- **The milk case and in-floor conveyor system is a channel bacteria can use to gain entry** to the most sensitive part of any processing plant, the filling room!
- Once the cases are filled with finished product, as seen in the Oregon recall, **contaminated cases can lead to contaminated containers**. These containers, once handled by consumers, can cause illness due to cross contamination from the containers to hands or food.
- **The conveyors that deliver these empty and filled containers need to be continually treated with biocide** as downstream of the fillers they will be potential sources of microbial growth and finished product contamination.
- **Also needing treatment are the tabletop conveyors** downstream of the filling point; look at the underside of your tabletop conveyors at the end of the day or week… is there a slimy biofilm noted anywhere? If so, you are hosting a population of microbes! These do not need to exist, are not to be tolerated and can be controlled easily.
- **Finished products should be sprayed with treated water** to ensure bacteria free packaging.

With a long history of use in municipal water treatment and food processing, ***chlorine dioxide*** is well known as a powerful biocide which is also safe and environmentally friendly.

"Gas stripped" chlorine dioxide provides overall best-in-class biocidal protection

The latest developments in small-scale production of ***gas stripped*** chlorine dioxide make it possible to ***inexpensively*** dose non-corrosive chlorine dioxide into case washer rinse water, conveyor biocide and finished product sprays, among other applications.

OVERVIEW OF CURRENT PRACTICES

Historically, product cases have been haphazardly treated; some operations clean with hot water with no sanitizer, some with varying levels of an alkaline cleaner with

or without a sanitizing rinse, some with just cold/ warm water. Each program has its potential weaknesses:

- Hot water/ no sanitizer; water heated above 140F is hot enough to kill the Salmonella bacteria found in the Oregon recall, however the conveyor systems that deliver the cases to the filling area will receive no biocide. Some conveyor lubricants contain small amounts of biocide but these can be easily washed away in the wet environments typical of these operations. Also, biofilms are tolerant of low levels of biocide and can persist due to the shielding action of the film. Any water splashing from the conveyor track onto the milk container could potentially contaminate that container with Listeria or any of a number of spoilage or pathogenic bacteria.
- Alkaline cleaner, rinse only; you are using a cleaner, congratulations! Ensure the concentration of the cleaner is appropriate to clean the soils that may be encountered. Be aware- the lack of an effective rinse prior to the sanitizing rinse may still leave you open to contamination as ALKALINE CLEANING SOLUTIONS ALONE DO NOT KILL BACTERIA.
- Alkaline cleaner with a sanitizing rinse; if you recycle the rinse water in the rinse section of your washer, the cleaner may raise the pH of your rinse water to a point that could make a sanitizing rinse INEFFECTIVE. This is due to the fact that many biocides are ineffective above a pH of 8; these include highly corrosive chlorine or expensive peracetic acid, quaternary ammonia and anionic acid sanitizers. What is the pH in your rinse tank? How much are you spending monthly and are you getting an acceptable result?
- Water only, hot or cold… take two aspirin and seek immediate professional advice! You are at risk.
- Tabletop conveyors; downstream of the filler, you have a great environment for microbial growth with a very wet environment, a food source due to spilt product and a warm environment.

THE CHALLENGE: A BIOCIDE THAT IS EFFECTIVE WITH THE FOLLOWING PROPERTIES

- Is a broad spectrum biocide, that kills aerobic and anaerobic bacteria equally well
- Excellent penetration ability to attack the bacteria typically protected by the biofilm
- Non corrosive due to the mild steel construction of many in floor conveyors and washers
- Works well at the alkaline pH levels found in the rinse tanks of the case washer
- Is effective at low concentrations due to the dilution taking place on the process floor

- That can be used in conjunction with conveyor lubricant to keep tabletops conveyors slime free
- Inexpensive; many plants are spending thousands per month on case sanitizer alone… can it be done well for less?

Table 1: Comparison of biocidal properties

	Peracetic	Hypochlorite	Quaternary	**PureClO2**
Effective at	no	no	no	**yes**
Penetrates	somewhat	no	no	**yes**
Corrosive?	no	no	no	**no**
Human	high	medium	medium	**low**
Environment	moderate	medium	medium	**low**
Cost	high	low	moderate	**low**

Chlorine dioxide provides overall best-in-class biocidal protection

PureClO2 has significant advantages vs. the typical ClO_2 molecule

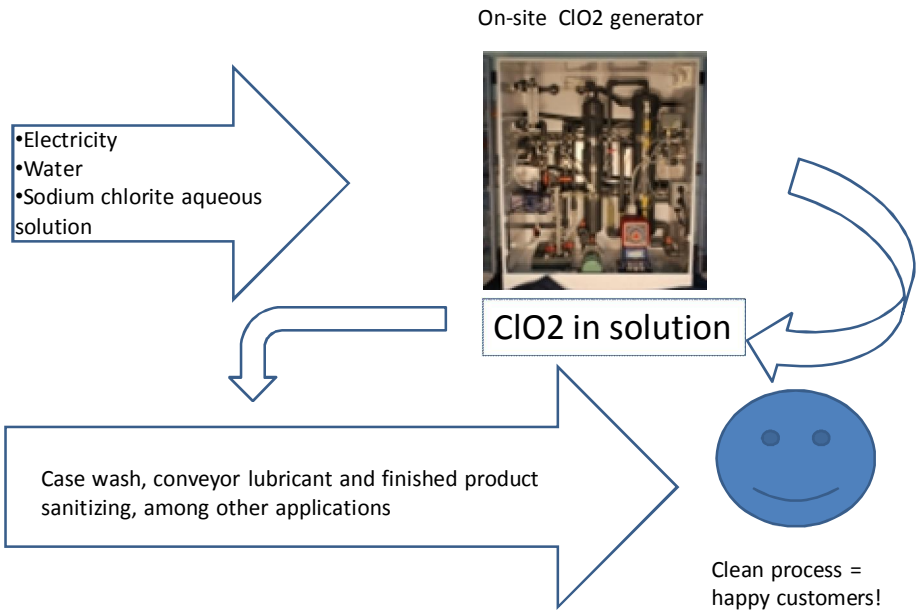
Pureline's patented gas stripping system is different than every other ClO2 generator in existence and makes a chlorine dioxide molecule that has no peer. Pureline creates a ClO2 molecule that is 99.5% pure ClO_2 at a pH of 7… pure, non-corrosive ClO2 at a neutral pH. This **highly effective, non corrosive** molecule has the characteristics to deliver what we are looking for!

Competing ClO_2 generators each create a chlorine dioxide solution that has at least some negative characteristics making them undesirable for the needs of processors today including:

- Acid; some generators use sulfuric, hydrochloric or citric acid as a precursor, these solutions will be corrosive and corrode washers and conveyors
- Chlorine; many generators use chlorine bleach or gas as a precursor. The resulting solutions will be corrosive with the added hazard should the chlorine and acid react forming poisonous chlorine gas!

Illustration 1: Schematic overview of onsite ClO_2 production

PureClO2 requires only one precursor along with water and a small amount of electricity



Using PureClO_2, many areas can be efficiently and economically treated with better results. **ClO2 is economical enough it can be added to the rinse water in the case washer** vs. a simple spray bar, delivering better results that are transported via the cases and conveyor system to the filling area. If used at the spray bar at the discharge end of the washer, similarly good results will be noted. Remember, ClO_2 is the only biocide that works in the alkaline range; even if your rinse water is alkaline good results will still be seen. The use of PureClO_2 vs. traditional biocides typically reduces the chemical costs of case and track sanitizing 75% or more vs. traditional treatment programs.

As illustrated above, the new generation of onsite chlorine dioxide production takes place in a containerized production unit with just three inputs: feed water, sodium chlorite liquid and electricity.

Feed water quality is not critical, as the unit includes particle filters and a reverse osmosis purifier. Sodium chlorite is delivered in containers as small as 5 gallons. An electrical requirement for the one lb. unit is 120v with a daily cost for electricity of less than $2.00/day.

The onsite unit produces chlorine dioxide in a 500 ppm concentration. This chlorine dioxide solution is then added to fresh water at concentrations varying from <1 to 5 ppm depending on the application.

CHLORINE DIOXIDE IN BRIEF

In concentrated form, ClO_2 cannot be transported and is thus always generated on site

Chlorine dioxide (ClO_2) is a gas that is well known as powerful disinfectant in municipal water treatment facilities and in food processing industries. It is also used industrially for bleaching wood pulp and flour.

The chlorine dioxide molecule is relatively small, volatile, and very energetic. It is stable in dilute solution, but unstable in concentrated form. Thus, chlorine dioxide is almost always used as a dissolved gas in water in concentrations that range from 0.5 to 5 grams per liter. Because transportation of concentrated chlorine dioxide is not safe, chlorine dioxide is almost always produced on site.

Chlorine dioxide differs from chlorine and other oxidizing biocides in that it doesn't hydrolyze in water. ClO_2 remains a true gas in solution, allowing it to be used at lower concentrations with a higher level of efficacy. This small molecule penetrates the biofilm wall where it degrades to two salts, chlorite and chlorate. When the chlorine dioxide/ chlorite has penetrated deep enough into the biofilm, it encounters acidic hydrogen sulfide, which reacts with the chlorite to form new chlorine dioxide, inside the biofilm. This action/ reaction with the chlorine dioxide degrading then being reformed into new ClO_2 inside the biofilm is the process that makes ClO_2 the best possible solution when dealing with biofilm issues. When the biofilm has been eliminated, a clean surface will be left behind; should a biofilm get a start, the residual chlorine dioxide at low concentrations will ensure its control.

A safe biocide with a broad range of applications

ClO_2 is highly stable in an aqueous solution, making it safe and stable for food processing applications

ClO_2 is a highly effective biocide that kills bacteria, viruses, algae, fungi and protozoa.

Used properly, ClO_2has little or no effect on humans, animals or fish cells and is safe to use. For example, ClO_2 has been approved for use in the processing of USDA organic and kosher foodstuffs.

ClO_2 is unsurpassed in disinfecting throughout a water system – also in "dead end" areas. For this reason, ClO_2 is often used to disinfect large and small chill water applications, municipal water systems and water systems in hospitals, where bacteria such as Legionella can prove to be stubbornly resistant to other biocides, chlorine in particular.

Furthermore, chlorine dioxide does not affect taste or form toxic chloramines or haloforms (THM). This is a characteristic that makes ClO_2 ideal for cheese curd wash water and other product contact applications (not in Canada however).

Chlorine dioxide is neither chlorine nor chlorine gas

A powerful yet safe disinfectant and biocide

Though similar in name to the element *chlorine*, the compound *chlorine dioxide* (ClO_2) has very different properties and applications.

Importantly, chlorine dioxide is highly soluble and is stable in dilute aqueous solutions.

Other key differences between chlorine and chlorine dioxide are:

- ClO_2 is a more effective biocide than the chlorine.
- Unlike chlorine or other oxidants, ClO_2 penetrates biofilm and has the power to kill the underlying anaerobic organisms without damaging the metal surfaces
- ClO_2 is effective at much lower concentrations than chlorine: <5 ppm
- Unlike chlorine, ClO_2 maintains its molecular form in a broad pH range. ClO_2 works at pH 2-10, while chlorine loses its sanitizing ability >pH7.5
- ClO_2 does not react with ammonia to form chloramines in water as does chlorine
- ClO2 does not give off chlorine taste or odors and has no effect on the flavor of food or beverages
- ClO2 is tolerant of high organic loads, while chlorine is rapidly consumed by these organics

$ClO_2$is a more effective biocide than the chlorine – and differs in many ways

For additional information, please contact Steve Eberhard with Pureline at 503-519-5100 or at steve.eberhard@pureline.com

---

This white paper draws on information from:

PureLine R&D staff

EPA Guidance Manual, Alternative Disinfectants and Oxidants