2021 Newsletter Compilation

HYPO SOURCE
ON-SITE DISINFECTANT GENERATION

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VOLUME 1

HYPO SOURCE
ON-SITE DISINFECTANT GENERATION

What is hypochlorous acid?

Hypochlorous acid (HOCl) is the strongest oxidizing and antimicrobial agent generated when chlorine gas dissolves in water. It has been used since World War I as a powerful non-toxic disinfectant and sanitizer. It is proven to be much more effective than bleach as a biocide, fungicide, and viricide. Hypochlorous is safe for foliar applications and is approved by the USDA as a leave-on synthetic substance for organic crops.

- **Near-neutral pH (5-7) won't impact water balance**
- **Very low total dissolved solids**
- **Does not clog lines, strong biofilm eliminator**
- **Made with four simple ingredients: water, salt, vinegar and electricity**
- **Safe for direct bare root contact, foliar application, pre- and post-harvest treatment**

Organic-friendly

Manufacture on-site

No certifications needed

Line Clearing

Removes biofilm and mineral buildup from water lines without harming the plants or the equipment. Recommended dosing: 2-4 ppm constant flow or 500 ppm flush

Propagation

Improve strike rates and germination by soaking seeds or dipping cuttings in hypochlorous acid before propagation. Recommended dosing: 2 ppm soak, 10 ppm dip

Root Zone Optimizer

Add hypochlorous acid to RDWC and NFT systems to keep the root zone clear from pathogens and biofilm buildup. Recommended dosing: 2 ppm in a circulating system

Growing Media Rinse

Soak or rinse growing media in hypochlorous acid before use to kill any residual pathogens and reduce risk of disease spread. Recommended dosing: 200 ppm soak and rinse

Prevent Algae Growth

Keep algae blooms under control, particularly during periods of high heat. Recommended dosing: 2 ppm constant flow or 500 ppm flush

Interested in making your own hypochlorous acid?

Get in touch! Visit our website to shop our line of hypochlorous acid generators at www.hyposource.com. Email us at support@hyposource.com or send us a text at +1 520-329-2635.

Kill Claims for Hypochlorous Acid

Pathogen	Kill Claim
Powdery Mildew	Reduced mildew by >40% when applied via electrostatic sprayer twice a week at 2 ppm
Phytophthora infestans, cactorum	Inactivated in 1.5 minutes at 3 ppm
Pythium aphanidermatum	Inactivated in 30 seconds at 2 ppm
Fusarium oxysporum	Inactivated in 6 minutes at 10 ppm
Rhizoctonia solani	Inactivated in 6 minutes at 12 ppm
Pythiaceae varieties	Inactivated in 6 minutes at 12 ppm
Downy Mildew	Controlled to below 5% incidence in 1.9 minute foliar spray once daily at 50 ppm
Botrytis cinerea	Inactivated in 6 minutes at 50 ppm

Quick Facts about Chlorine

- Chlorine is converted to chloramine when nitrogen is present. Always test your FAC / ORP after adding a nitrogen-based fertilizer to your system and top up on hypochlorous acid if needed.
- Ideal ORP range for a system dosed with hypochlorous acid is 500-600
- Low doses of chlorine will not harm plants, but it's always smart to do a susceptibility test on a few plants first!
- 2-4 ppm is the safe range for continual contact of chlorine with plants
- Applications of >10 ppm to bare roots or leaves should be followed with a rinse or flush

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A NOTE ABOUT CORROSION

One of the concerns around using hypochlorous is its corrosivity. Corrosion from hypochlorous acid may occur from two sources - the salt content in the solution and the acidic nature of the solution. It is thought that the great majority of corrosion comes from the salt, especially since our solution is a very mild acid at 6 pH or higher.

Corrosion is most likely to occur on unprotected metals where salts are allowed to accumulate. In other words, if a piece of unprotected metal is sprayed with hypochlorous every day and not cleaned, the accumulated salts and the daily wet/dry cycle will tend to accelerate corrosion.

The Hypo uses about 3.7 grams of salt per liter. The EcoOne uses about 2 grams per liter. Both are extremely light saline solutions - about 1/10 of sea water. But it is not so much the concentration of the salt, as its presence, which makes the difference. In other words, a concentration of 4 grams per liter will not necessarily create any more corrosion than 2 grams per liter.

So how can you protect against corrosion? Preventing accumulation of salts is the most important thing you can do. If you are spraying hypochlorous on unprotected metal on a regular basis, follow it with a water rinse.

Also, help your customers realize that all chlorine solutions will contain salt. Something like one half to one third of the salt used to create hypochlorite (bleach) or hypochlorous acid is actually converted into chlorine. Both have the potential to corrode, but because a much higher PPM is required in bleach to achieve the same disinfecting power as hypochlorous, bleach users may experience significantly higher corrosion. This is because bleach would require more chlorine concentration (with the accompanying salt content) to do the same job as hypochlorous.

It is interesting to observe the electrical efficiency curve in splitting salt and isolating chlorine. Once about half of the salt in a solution is converted to chlorine, it is no longer practical to continue the electrolysis process because the marginal return is so small.

PLEASE DON'T FEED THE FISH

Hypochlorous acid is safe for all animals--except fish! Chlorine can be incredibly toxic to fish (over 0.3 ppm is considered lethal). If you think about it, most fish already live in salt water that's perfectly suited to their biological needs. Adding in more salt (or oxygen) throws off that natural balance, creating toxic conditions for the fish.

Furthermore, many aquatic fish tanks use a reverse osmosis filter to remove any chloramines from the water before it reaches the fish. Adding chlorinators such as HOCl to the water could actually damage the reverse osmosis membrane. The salts present in chlorine slowly degrade the membrane, exposing the fish to dangerous living conditions.

This doesn't mean that hypochlorous doesn't have a place in aquatic settings. It can still act as a powerful liquid scale/biofilm remover for fish tanks and water lines. It can also be used to sanitize tanks and equipment prior to use. Just make sure to rinse out the equipment after it's come in contact with hypochlorous, and of course, remove any fish from the tank before cleaning :)

READING LINKS

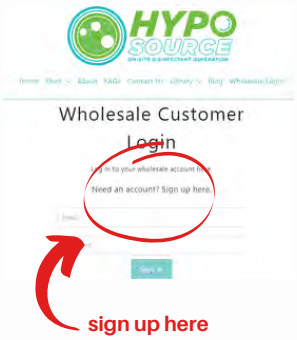
https://blog.hannainst.com/chlorine-in-aquariums-aquaculture-0

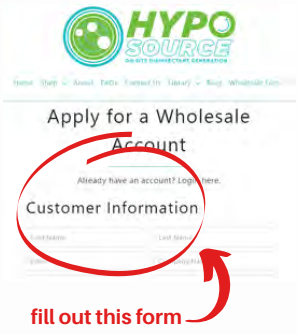
HELPFUL RESOURCES

Did you know we post all of our social media posts, videos, and infographics on our website, free for you to download? Head over to hyposource.com and click on "Library" > Downloadable Media Library in the top menu bar. You can share these graphics with your customers or use them for in-store displays and email marketing.

DEALER LOGIN

If you haven't already, head over to our website and sign up for a wholesale account. You'll then be able to login every time you visit our store and see the wholesale prices on all our products. Follow the steps below to get started!





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VOLUME 3 JUNE 28-JULY 2 2021

DO YOU NEED A LICENSE FOR THAT?

We are frequently asked whether our Hypo machine is registered or licensed with national authorities. Many of you have probably faced similar questions in your own countries.

A simple way to think about this question is to compare a coffee maker with a cup of coffee. If you manufacture or sell coffee makers, you should have some certification that ensures the machine is safe and won't shock the user. But as a machine manufacturer, you can't be responsible for the quality of coffee that the user makes! By the same token, if you are selling cups of coffee, then your local government will probably ask you to follow certain health protocols that would be expected of a café or a food seller.

As manufacturers or suppliers of a machine that can produce hypochlorous acid, we are like the suppliers of a coffee maker. Our Hypo machine is undergoing ETL approval to UL standards and we expect that mark to be issued later this month. This assures users that the machine is safe and that they won't be harmed while operating it. Importing countries are likely to accept the ETL/UL listing or a similar third-party test to assure the machine complies with their own safety standards.

In the United States, if you made hypochlorous acid and offered it for sale, you would need an EPA "N" number approving and authorizing you to sell the liquid. But if you make hypochlorous acid and use it yourself or in your own business, you don't need any license or permits. It is the same as serving coffee to your own family or workmates versus selling coffee to the public.

This important difference is one of the great advantages of on-site generation. You can control the quality of your own disinfectant, and you are normally exempt from regulation as long as you use it yourself.

Similarly, when we sell a machine, we do not make "kill claims" about the resulting hypochlorous acid, like a registered pharmaceutical might. The effectiveness of hypochlorous is well-documented over many years and that information is available in the public domain. We offer a machine that creates hypochlorous and invite the user to make their own determinations about how to use the end product.

In summary, as long as you are only using/selling the hypochlorous acid machine, you normally do not need to register with the EPA or equivalent agency in your own country. If you plan to sell and bottle the solution produced by the machine, then it will be your responsibility to have that solution registered and approved by the appropriate regulatory officials in your country.

And as a final note of interest, hypochlorous does enjoy a number of government approvals here in the USA. It is approved by the FDA for direct food contact, approved by the USDA for use on organic foods, by the US Coast Guard as a sewage treatment and is a regulated pesticide under the EPA FIFRA rules. (Federal Insecticide, Fungicide, and Rodenticide Act). Our Hypo 7.5 hypochlorous acid generator is registered under the EPA establishment number 082229-GA-001, which is printed on our label.

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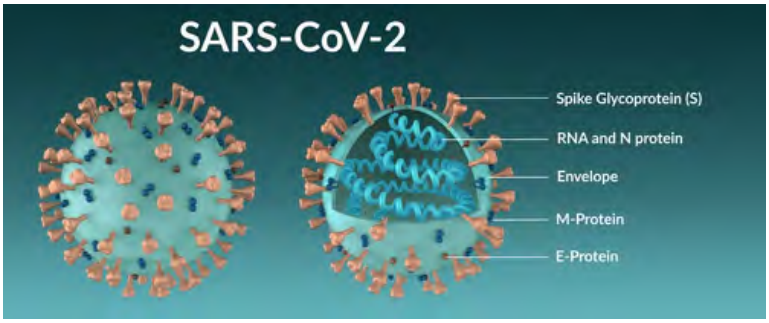
VOLUME 4 JULY 5-9 2021

ENVELOPED VS NON-ENVELOPED

If we've learned anything from this past year, it's that not all viruses are created equal! There are some viruses that are much more resilient (and thus more deadly) than others. This is in large part due to their physical and genetic structure. Understanding whether a virus is enveloped or non-enveloped is an important factor to consider when we talk about things like kill times, chlorine concentrations, and disinfectant efficacy.

First, let's cover the physical structure of a virus. The viral cell consists of genetic material (RNA or DNA) surrounded by a protein shell, similar to an egg. These proteins, also referred to as capsids, are arranged in specific geometric formations around the outside of the viral cell. The structural formations protect the virus and allow it to survive in hostile environments (such as your GI tract).



Some viruses are enveloped, meaning they contain an extra layer of phospholipids on top of their capsid shell. While it might seem logical that an extra layer of protection would make it *HARDER* to kill a virus, the reverse is actually true.

Enveloped viruses are easier to kill with disinfectants because their phospholipid layer is sensitive to denaturation by temperature and pH. Once that protective envelope is broken down, the viral material inside is exposed to the effects of the disinfectant. Furthermore, the qualities of the virus that make it infectious (fusion proteins) are contained in that envelope. Once it is destroyed, the virus is no longer able to reproduce.

Non-enveloped viruses, on the other hand, are more resistant to disinfectants. Their capsid layer is tough, allowing them to survive under harsher conditions. The fusion proteins that enable a virus to spread are also embedded within that capsid layer, making it difficult for the disinfectant to break in and inactivate the virus.

Think of it this way—if you walk around barefoot all the time, your feet naturally become tougher and less affected by the rough surfaces of the ground. However, if your feet are always protected by shoes, then you are more likely to be sensitive to rocks and thorns if you try walking with your bare feet.

The good news is that hypochlorous acid is effective against both enveloped and non-enveloped viruses. Strong oxidizing agents, such as hypochlorous acid, are considered to be most effective against non-enveloped viruses. This is because the hypochlorous acid molecule can oxidize the protein layers and attack the viral cell.

"The efficacy of disinfection decreases with an increase in pH, likely due to the decreased proportion of hypochlorous acid group present." (View Research Journal, May 2020)

This statement corroborates our claim that hypochlorous acid is much more effective as a disinfectant than sodium hypochlorite, which naturally resides at a higher pH. Quaternary ammonium compounds and isopropyl alcohol are also less effective against non-enveloped viruses.

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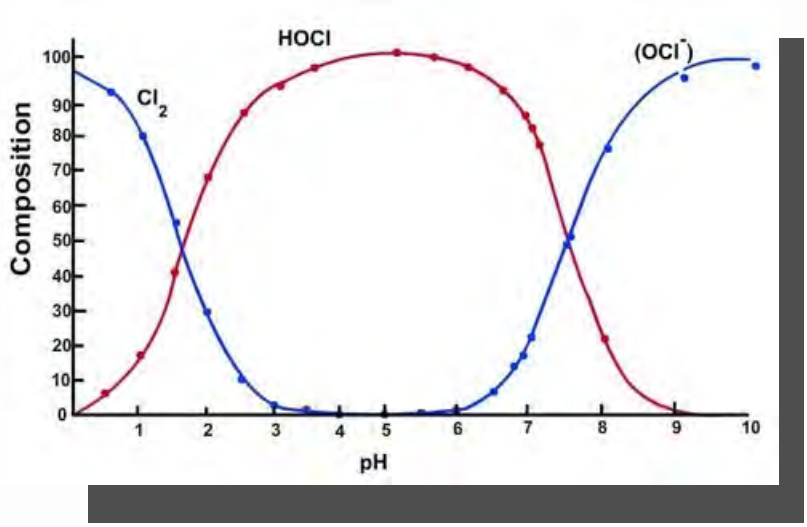
HYPOCHLOROUS VS BLEACH

Hypochlorous and hypochlorite (bleach) both come from the same family of chlorine-based disinfectants and share similar chemical structures. So what makes hypochlorous a better choice?

There are many reasons why hypochlorous is a far superior disinfectant than bleach, but one of the most fundamental reasons has to do with pH. Hypochlorous acid exists at a near-neutral pH (5-7). Bleach resides at a highly-alkaline pH (~8-13). The germ-killing properties of bleach are derived from the presence of hypochlorous acid. However, because of its high pH, the majority of the hypochlorous acid present in bleach ends up getting converted to hypochlorite, which is a less effective disinfectant.

The pH of a chlorine solution is crucial in determining its efficacy. At pH 5-6, the solution will be nearly 100% hypochlorous acid. As the pH increases above 6, hypochlorite (bleach) begins to increase.



White's Handbook of Chlorination states, "[Hypochlorous] is overall the most effective disinfectant of the chlorine species present in dilute solution at the pH values associated with water and wastewater treatment. The OCl- ion [bleach] is a relatively poor disinfectant because of its inability to diffuse through the cell walls of microorganisms."

Why can't bleach diffuse through pathogen cell walls? Both pathogens and bleach carry a negative charge, which means that when bleach encounters a pathogen, it repels the pathogen like two magnets.

Because hypochlorous is neutrally-charged, it can break past the pathogen cell wall and inactivate it from the inside out. This process is the same way our immune system fights off pathogens. In fact, our white blood cells produce hypochlorous acid during the immune response!

Other ways hypochlorous is far superior than bleach:

- Low odor
- More stable (diluted bleach loses efficacy after 24hrs)
- Less corrosive
- Safe for direct skin contact

APPLICATIONS FOR HOCI IN POULTRY CARE

When you have a large concentration of animals packed into a building there's the potential for mass disease outbreaks, and chicken farms are no exception! Large breeding and egg production operations can be hotspots for airborne and contact-spread pathogens. Hypochlorous acid provides an effective, multi-purpose solution to the disinfecting challenges faced by large and small-scale chicken farms.

A 2015 study published in the Avian Diseases journal found that hypochlorous completely inactivated Newcastle disease virus in newborn chicks at 100ppm. Newcastle disease can be transmitted via airborne particles and is highly contagious and lethal to chickens. The study found that aerosolized hypochlorous was effective in eradicating the virus, which strengthens the argument for cold-fogging hypochlorous in barns to keep airborne disease at bay. Plus, let's face it--a chicken farm doesn't exactly smell like roses. Cold fogging hypochlorous acid can help keep odors down in the barn by killing ammonia-producing bacteria.

Another study in the Journal of Veterinary Medical Science found that hypochlorous acid at 50ppm could inactivate E. coli and salmonella bacteria in water in only 5 seconds. Dosing chicken water sources has been proven to decrease mortality rates, improve chicken health and boost egg production.

Chickens aren't the only ones who stand to benefit from hypochlorous acid. Washing or spraying eggshells with hypochlorous acid prior to packaging can help prevent humans from being exposed to salmonella or other pathogens that live on the surface of eggshells.

FUN FACT

Did you know that eggshells have between 6,000-10,000 pores?
Similar to our own skin, these pores have the ability to absorb the chemicals, substances, and viruses in their environment.

As you might imagine, eggshells come in contact with numerous vectors of disease between formation, laying, and transportation to your local store. Bacteria such as salmonella and listeria can be transmitted via the shell itself or absorbed into the egg if the eggs aren't appropriately treated before packaging.

Before you run to the fridge to wash all your eggs, keep in mind that washing eggs in cold water can actually cause those pores on the shell to open, damaging the protective cuticle layer designed to keep pathogens out.

Some forms of sanitizer will destroy the integrity of that cuticle, allowing pathogens into the egg. Fortunately, hypochlorous acid isn't one of those sanitizers! A study done by the Universidad Nacional Autónoma de Mexico found that hypochlorous effectively killed *Listeria monocytogenes* on eggshells without damaging the shell or the cuticle.

READING LINKS

Avian Disease Journal study on hypochlorous acid and Newcastle disease virus

Journal of Veterinary Medical Science study of hypochlorous inactivation against E. coli and salmonella

Food Science and Nutrition Journal on using hypochlorous acid as a sanitizer for egg shells

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VOLUME 6 JULY 19-27 2021

SAY HELLO TO THE NEW HYPO 7.5!

We made a few adjustments to the Hypo 7.5 for our next production round! The ball valve is now shorter and comes factory installed for user convenience. We made this change so that the user does not have to screw the valve in, reducing the risk of leaks or over-tightening.

The new valve also has a hose pipe that clips in, rather than slides over a barbed fitting. This means that once the hose is installed, it won't slide off, which was an issue we had noticed in the previous design. Users will still have the option of trimming the hose to a length that best suits them.

We have also changed our user manual to say that the Hypo is capable of producing 1000ppm hypochlorous acid. This was previously part of the Hypo's "secret menu", as you could simply run the 500ppm cycle twice (40 minutes), add more vinegar and achieve the 1000ppm result. The ability to produce 1000ppm sets us apart from other manufacturers, particularly for a mid-size machine. The new machine is currently in production and the first units will be done this week. We can't wait to take it for a test drive!

GOOD TO KNOW

If you're looking for published research articles on specific pathogens that can be killed or inactivated by hypochlorous acid, check out www.ewco.com! The EWCO team has put together one of the best research libraries on HOCl in the world.

READING LINKS

Chlorine Disinfection Facts

White's Handbook of Chlorination

WHY DOES PPM MATTER?

PPM: parts per million; the measurement of the mass of a chemical per unit volume of water

When we're talking about generating hypochlorous acid, we often refer to the 'ppm' level a machine can make. Why is this important? The ppm is a measurement of the free available chlorine (FAC) that is present in the solution. Since chlorine is the primary disinfecting agent in hypochlorous acid, it's important to be aware of how much chlorine is available for disinfection in the solution you make.

The most common ppm levels for hypochlorous acid generators are 100, 200, and 500ppm. These are the levels that have been tested for inactivating the greatest number of viruses--for example, 200ppm is sufficient for killing COVID, E. coli, salmonella, and candida.

A ppm above 500, such as 1,000, would be useful in settings where there is a high concentration of organic material in the water (reducing the free available chlorine), such as removing biofilm in a water line. Other applications for high ppm solutions include when the surfaces being sanitized are very dirty or the solution is being transported as a concentrate. It can also be helpful to use a high ppm solution in a cold fogger to maximize the bactericidal potential of the mist coverage.

However, a high ppm doesn't always correlate with more effective killing power. For example, 2000ppm of hypochlorite (bleach) will only contain about 2% of hypochlorous acid, making it much less powerful as a disinfectant. A high ppm bleach will take longer to inactivate bacteria and it will require larger quantities of disinfectant than a much smaller ppm of hypochlorous.

You can test ppm with test strips, which work by detecting the chlorine present via a chemical reagent embedded in the paper's surface. There are also electronic probes that you can purchase for testing ppm if you're looking for increased specificity.

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STAYING OUT OF THE HAZARD ZONE

IS HOCl HAZARDOUS?

HOCl is rated as "0 0 0", meaning it does not have any associated health or environmental hazards. As you can see from the chart on the right, sodium hypochlorite does not fare so well! It is rated to cause 'extreme danger' to health. While both hypochlorous and hypochlorite are oxidants, HOCl doesn't receive the 'OX' classification.

Have you ever driven down the road behind a truck with one of those diamond 'hazard' placards and wondered what was inside it? The numbers on those placards correspond to different levels of risk and categories of danger. As you can see from the chart on the left, each number in the diamond can provide you with valuable clues about the content being carried.

SODIUM HYPOCHLORITE HAZARD RATING

Sodium hypochlorite is considered a poison and can cause coughing, stomatitis, nausea, pulmonary edema, circulatory collapse, and convulsions.

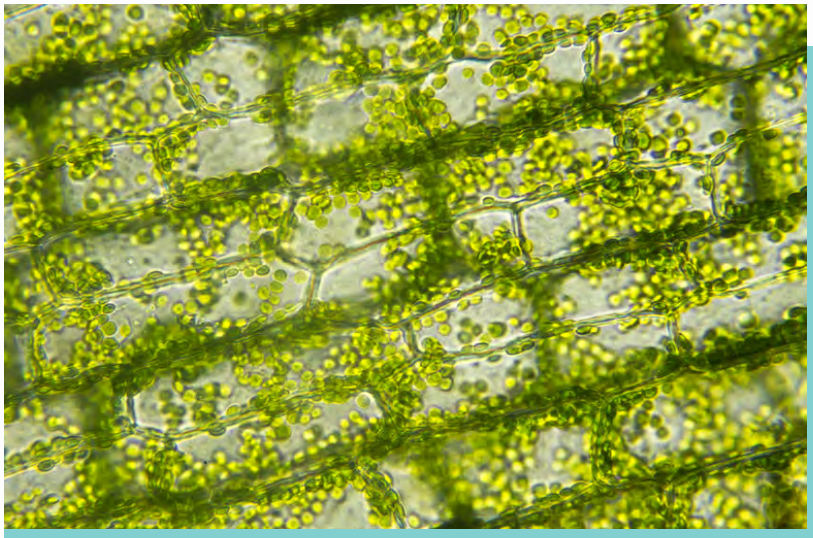
Hypochlorous acid is hazard-free!

BLEACH

HOCl

The NFPA defines an oxidizer as "*any solid or liquid material that readily yields oxygen or other oxidizing gas or that readily reacts to promote or initiate combustion of combustible materials and that can, under some circumstances, undergo a vigorous self-sustained decomposition due to contamination or heat exposure.*" Hypochlorous acid does not meet this criteria because it yields oxygen slowly and is not combustible. Hypochlorite, on the other hand, produces compounds that can react explosively.

BIOFILM: WHAT IS IT, WHERE DOES IT LIVE, AND HOW DO WE GET RID OF IT?



Biofilm is a colony of microorganisms that attach themselves to the surface of an object. It is a living, reproducing community that thrives in wet, organic environments where there will be plenty of nutrients to feed on. Many different varieties of bacteria exist as biofilm, but the one thing they share in common is that slimy, sticky layer that allows them to cling to the surface.

Biofilm exists inside drains and water lines, wounds, on the surfaces of rocks in stream beds, in swimming pools, on your teeth (hello, plaque), and many other places. While biofilm isn't necessarily always a bad thing, it can cause issues when it starts to impact the function of the surface it's growing on, or harbor dangerous organisms (like mold spores). Clogged pipes, tooth decay, eye infections, and green swimming pools are all a result of biofilm.

Getting rid of biofilm can prove challenging thanks to the slimy protective coating the bacteria forms. These colonies are stronger in numbers and have an upper hand against most disinfectants and sanitizers. In order to break through the protective barrier and destroy the biofilm, the disinfectant needs to be able to invade and inactivate the cells themselves.

As we know, hypochlorous acid is best suited for this process because of its neutral charge, which allows it to enter negatively-charged cells. Other disinfectants, such as quaternary ammonium, are not effective against biofilm.

You can dose hypochlorous acid continually into water lines to keep the biofilm away, irrigate wounds with it to prevent infection, spray it on shower curtains and other surfaces that are regularly in contact with water, and add it to hydroponic tables to keep algae down.

Other words for biofilm include liquid scale, deposition, bio barrier, deposits, build-up, slime, or biomaterial

READING LINKS

Guide to the NFPA Rating System

Chlorine Chemistry & Definitions

Research study on HOCl and biofilm elimination in greenhouses

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VOLUME 8 AUGUST 16-20 2021

BLEACH: THE WORST OF BOTH WORLDS

We often get asked why diluting bleach down to a neutral pH isn't the same as making hypochlorous acid in a generator. This is certainly a valid question; if hypochlorous acid is the disinfecting agent in bleach and it resides in the highest concentrations at a neutral pH, then it would seem logical that adding water or vinegar to bleach to bring the pH down would be a quick DIY way of generating HOCl. Indeed, there are plenty of internet accounts of people doing this with seemingly harmless results.

So why do you need a machine? And why make hypochlorous acid instead of just using bleach? First of all, adding vinegar to bleach results in a chemical reaction that produces toxic chlorine gas. Even at levels of 5 ppm, chlorine gas causes irritation to the mucus membranes in your respiratory system. At levels above 400 ppm, chlorine gas can be deadly within minutes. Aside from the safety hazards this creates, this reaction also means that your chlorine (the main disinfecting agent) is leaving the bleach solution. This leaves you with a very weak disinfectant, even if the pH is at 7. Not only is this method ineffective--it's also highly dangerous, and falls under the category of 'DO NOT TRY THIS AT HOME'!

Adding water to bleach will not result in the same chemical reaction, although some chlorine will still be lost in the form of chlorine gas. Diluting bleach with water is not a new concept and can be a lifesaver in situations where drinking water needs to be rapidly disinfected. One tablespoon of bleach added to 1 gallon of water creates a solution of 50-200ppm free available chlorine (FAC). However, this solution is not stable and the chlorine will begin to disappear from the solution in the form of chlorine gas within 24 hours.

Bleach is much less effective as a biocide, so it needs have a very high FAC in order to achieve the same results as hypochlorous acid. A high FAC means more salt, more chlorine generation, and thus more corrosivity. Not only will bleach break down your equipment, it's also the least effective chlorine-based disinfectant and it comes with significant health and environmental risks. When you use bleach, you're essentially getting the worst of both worlds—low efficacy and high risk.

Hypochlorous acid, on the other hand, is highly effective as a biocide and routinely outperforms bleach in kill claims for pathogens. It comes with no toxic side effects and actually has powerful healing properties as well. Because it can sanitize more efficiently at a lower FAC, the salt and chlorine content is reduced, which in turn means lower corrosivity. Making hypochlorous acid onsite with a machine reduces supply chain dependence and the ingredients are affordable and accessible.

Switching your home or business's cleaning protocols over from bleach to hypochlorous acid may seem like a change, but it's very simple. If you're using a 0.5% bleach solution (about 5,000 ppm FAC), 500 ppm hypochlorous acid would be a suitable replacement. At this rate, you're getting 10% less chlorine and a disinfectant that's been proven to be up to 80 times more effective at eradicating E. coli bacteria. We've created a sample chart below that shows appropriate hypochlorous acid replacements for standard bleach amounts. As you can see, the amount of hypochlorous acid you'd need is always far less.

If you are using sodium hypochlorite (bleach)	Consider hypochlorous acid
0.5% sodium hypochlorite (5,000 ppm)	500 ppm hypochlorous acid
0.05% sodium hypochlorite (500 ppm)	200 ppm hypochlorous acid

FOLIAR APPLICATIONS FOR HYPOCHLOROUS ACID

If you're a hobby gardener, a horticulturalist, or a house plant owner, you're likely familiar with plant pests. They come in many shapes and sizes--powdery mildew, spider mites, aphids, root rot, you name it. Pest management for plants can get complicated, especially if you're growing edible plants or working in an enclosed space.

Most pesticides contain a long list of harmful chemicals, and often the ones that don't aren't very effective. Even so-called natural pest controls can lead to problems such as pesticide resistance or harmful runoff effects.

How do you treat a pest infestation without poisoning your plants, your pets, or yourself? I'm sure you know where this is going! Hypochlorous acid works well as a pesticide against powdery mildew, gray mold, algae growth, and other fungal infestations. It may also work against small insects such as fungal gnats--there is anecdotal evidence which suggests hypochlorous acid could enter the cell walls of soft-bodied insects and oxidize them, causing death, but peer-reviewed research for this claim does not exist.

Fungal diseases can spread like wildfire in a greenhouse, and once they've taken root, they are virtually impossible to control. Hypochlorous acid works best as a preventative measure to stop outbreaks from ever occurring.

A study done by the University of Georgia showed that hypochlorous acid reduced powdery mildew on gerbera daisies in a commercial greenhouse setting by over 40% when applied multiple times a week. While hypochlorous is safe to spray on plants and add to their water sources, it is important to monitor the chlorine levels. Chlorine concentrations of over 4ppm can have detrimental effects on the plant system, and long-term exposure of 2ppm hypochlorous can also be toxic to plants. A study by the University of Guelph found that chlorine concentrations of 2ppm were strong enough to eliminate Pythiaceae pathogen variants. This is great news for anyone in the commercial greenhouse or hydroponic industry, as hypochlorous acid provides you with a three-in-one product: fungicide, line cleaner, and root zone enhancer all at once.

READING LINKS

University of Georgia study

University of Guelph study

Shelf life of bleach

Hypochlorous acid and bed bugs

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VOLUME 9 AUGUST 23-27 2021

ORP: WHAT IS IT AND WHY SHOULD I CARE?

We talk a lot about measuring your pH and ppm strength when making hypochlorous acid, but ORP is another indicator of the disinfecting strength of your solution. ORP stands for oxidation reduction potential, or the oxidizing power of the chemicals once they have been added to a solution. Oxidation is the process of electron exchange--pairs of molecules, known as redox pairs, gain and lose electrons. The oxidant is the chemical that gains electrons, and the reductant is the chemical that gives up electrons.

In practice, this means that hypochlorous acid, which is a strong oxidant, pulls electrons away from the negatively-charged pathogen cells, breaking them down. When hypochlorous acid is added to water with a high amount of organic material, it begins pulling away electrons from the chemicals present there, thus reducing the ORP level as it consumes electrons. Low ORP can be an indicator of a less potent solution, either due to an initial low free available chlorine content, environmental factors such as exposure to heat/sunlight, or a high organic load.

ORP is an arbitrary form of measurement that does not distinguish between what type of oxidant is present in the solution. Thus, using ORP to determine whether or not you are making hypochlorous in your machine is not an accurate form of measurement, but it can be used in tandem with pH and ppm tests to determine the oxidizing strength of the solution you've made.

Testing ORP is not required for HOCl generation but it can be a useful tool. The recommended ORP range for hypochlorous acid is 800-900, but this can vary based on the factors listed above.

Source: https://www.awt.org/pub/?id=00D69B4E-E0EC-A6B9-C9B2-B72F08526A0D

REPLACING BLEACH WITH HOCI

Making the switch from bleach to hypochlorous acid is an excellent choice, but it may mean changing your cleaning protocols or operating procedures. For example, cleaning the area with regular soap and water first to remove the bulk of organic material present allows your sanitizer (hypochlorous acid) to disinfect much more effectively. Otherwise, the chlorine in the HOCl gets used up trying to break down the organic matter, instead of focusing on killing the more resilient pathogens.

We've put together some answers to a few common questions we get asked, including the following: How much hypochlorous acid do you need to use instead of bleach? What should the strength of my hypochlorous acid be? How long do I need to leave the hypochlorous acid on the sanitized area to fully disinfect from all pathogens?

Hypochlorous acid is much stronger as a disinfectant than bleach, but it actually has lower pH, salt content, and parts per million of chlorine. You can use less hypochlorous acid and still get the same (or better) effect as you would with bleach.

Think of it like the difference between two currencies. If the euro is stronger than the dollar, then an item will cost less in euros than it will in dollars.

In the table below, you can see comparisons between the kill claims for hypochlorous acid and bleach. In full disclosure, the information presented here is based on a review of the available peer-reviewed literature for kill claims on both hypochlorous acid and sodium hypochlorite. The studies were done independent of each other and thus the selected ppm and pH of each chemical tested was left to the deliberation of the researchers.

Studies that compare the two disinfectants head to head are rare, so this graph is not meant to be used as an exact guide for replacing HOCl with bleach. It's purpose is to give the reader a general idea of the differences in chlorine content and disinfecting power between the two solutions. The current body of research suggests that 200 ppm HOCl is potent enough to inactivate the majority of enveloped viruses within a range of 0.5 - 5 minutes.

Pathogen	Bleach or HOCl	PPM (based on test evidence)	Contact time for >2Log$_{10}$ reduction
E. coli[1]	Bleach	200	10 minutes
E. coli[2]	HOCl	100	5 seconds
COVID-19[3]	Bleach	1,000	1 minute
COVID-19[4]	HOCl	62	30 seconds
Salmonella[5]	Bleach	100	1 minute
Salmonella[6]	HOCl	100	5 seconds
Mycobacterium tuberculosis[7]	Bleach	10,000	1 minute
Mycobacterium tuberculosis[8]	HOCl	80	30 seconds
Norovirus[9]	Bleach	5,000	3.2 minutes
Norovirus[10]	HOCl	50	1 minute
Avian Bronchitis[11]	Bleach	5,000	30 minutes
Avian Bronchitis[12]	HOCl	62	30 seconds

References

[1]https://www.sciencedirect.com/science/article/pii/S0168160500003 69X
[2]https://www.jstage.jst.go.jp/article/jvms/78/7/78_16-0075/_article/-char/ja/
[3]https://www.tandfonline.com/doi/full/10.1080/01478885.2020.1734718
[4]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7837568/
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THE CLEAN HYPE

HOW STABLE IS HYPOCHLOROUS ACID?

Bleach is notorious for losing its disinfecting strength after 24 hours of mixing with water. But what about hypochlorous acid? How stable is the HOCl solution you generate in your machine?

All chlorine-containing solutions are unstable by nature. Chlorine atoms have unpaired electrons and thus are constantly searching for an electron to bond with. This is what makes them oxidizing agents.

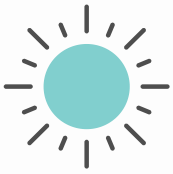
When hypochlorous acid is generated, the available electrons head out in search of other molecules (electrons) to attach to and oxidize. This is how HOCl works as a disinfectant, but as these electron pairs form, the amount of free available chlorine also decreases. Therefore, the more organic material present in your water or the container holding the HOCl, the shorter its "shelf life" will be. While we cannot guarantee a specific shelf life for the solution you make, when following the prescribed practices listed below, we've found no degradation for 2 weeks and low degradation for several months.

Tips to keep your hypochlorous acid stable for longer:

- **Keep it in a cool room**
- **Use an airtight container**
- **Generate using clean water**

OTHER FACTORS THAT AFFECT STABILITY

SUNLIGHT



UV light splits chemical bonds, breaking down HOCl into hydrochloric acid and oxygen.

TEMPERATURE

At temperatures above 77 degrees Fahrenheit (25 C), HOCl begins to degrade.

PPM

The higher the ppm, the longer it will take a solution to completely lose FAC

ON OUR MINDS THIS WEEK

USING HOCl AS A LEAVE-ON SANITIZER FOR PRODUCE

Proper sanitation of produce post-harvest is an essential component of food safety practices. Many of the harmful pathogens encountered on or in food (ie; E. coli or salmonella) are transmitted during the packing, processing, and transportation stages. In particular, the rinsing of fresh produce with contaminated water sources after harvest has been linked to outbreaks of foodborne illnesses.

While rinsing produce with potable water is the first step to a safe cleaning regimen, sanitizing the produce afterwards is equally important. Ideally, this should happen after the produce has been rinsed of excess organic material (if present) and is ready for shipping. Leave-on disinfectants are the preferred choice because they cut down on processing time and decrease the likelihood of pathogen spread.

HOCl can be dosed directly into recycling drench tanks and wash tables

Hypochlorous acid is certified by the USDA as an organic leave-on sanitizer for fresh-cut produce. It keeps produce fresh for longer without having negative effects to the quality, taste, or appearance of the product. And, as it is a non-toxic substance, you don't have to worry about rinsing it off or accidentally poisoning anyone (which is always an extra bonus).

The amount of hypochlorous and the strength you should use depends on the type of produce you're sanitizing. For leafy greens like lettuce or spinach, a ppm of ~100-150 is sufficient to inactivate most pathogens. For fruits with a very thin skin, like a nectarine or a plum, 75 ppm will suffice. The dwell time is immaterial for large-scale produce operations, as HOCl is a leave-on sanitizer. If you are rinsing your own produce at home to eat, allowing the HOCl to sit on the product for 10 seconds is a good rule of thumb to follow. For more detailed information on the appropriate dosage for agricultural uses, check out the last article in our reading links for this issue!

We just received a shipment of the updated version of the Hypo 7.5! The new Hypo 7.5 features an improved spigot that comes pre-attached to the machine, as well as a slimmer hose and updated labels that explain how to make 1,000 ppm. Place your order now on our website!

Reading Links

HOCl Stability Study

Chlorine Chemistry

Chlorine Dosing for Food Production

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THE CLEAN HYPE

CONTINUING THE CONVERSATION ABOUT STABILITY...

Last week, we discussed some simple steps you can take on your own to prolong the life of the hypochlorous acid you generate. But some manufacturers selling bottled hypochlorous acid claim long shelf lives due to their own proprietary formulations. What does this mean? Do they have a secret recipe?

The short answer is "sometimes". Many HOCl manufacturers have patented their formula, so the general public doesn't know exactly which ingredients are going into the HOCl solution. One manufacturer claims to have a 24-month shelf life on their HOCl product and has received FDA approval. The ingredient list for their HOCl gel solution is: Electrolyzed Oxygenated Water (H2O) (99.94%), Sodium Chloride (NaCl) (0.048%), Hypochlorous Acid (HOCl) (0.01%), Sodium Hypochlorite ion (NaOCl) (0.002%). The only difference between this and the HOCl you generate with a Hypo 7.5 is the slight addition of oxygenated water, which is water that has had extra oxygen added back into it during the bottling process. There have been claims made that this type of water has boosted healing properties, but there is very little peer-reviewed research available that corroborates this claim.

The general consensus seems to be that the "purer" the ingredients used to make hypochlorous acid, the more stable it will be. There are also some research studies that suggest a pH of between 3.5-5 can increase HOCl's stability. One US company even applied for a patent for their own method to produce stable hypochlorous acid, which included using water softeners, pure sodium chloride (salt), and reverse osmosis water to generate an HOCl solution that would last for up to 2 years at room temperature.

The bottom line is, if you have a machine and can generate hypochlorous acid on site whenever you need it, then there's little reason to worry about making a solution that is going to last for 2 years. Even if your solution lasts for 2 weeks, you can always make more when you need it. We designed the Hypo 7.5 to be rugged and handle varying degrees of salt and water, so that you can create hypochlorous when and where you need it. When you can generate your own hypochlorous on site, you don't need to worry so much about supply chains and storage.

ON OUR MINDS THIS WEEK

HYPOCHLOROUS ACID AS A POWERFUL WOUND HEALING AGENT

Hypochlorous acid gets a lot of attention for its role as a disinfectant, but it acts to heal wounds and prevent infection. This lesser-known use for hypochlorous acid has been studied and tested for years. In fact, it's been used by our own bodies as a healing agent since the dawn of time.

In mammals, hypochlorous acid is produced by neutrophils in response to injury or infection in a process called myeloperoxidase. Hypochlorous oxidizes infection-causing microbes, speeds up the coagulation of tissues around wounds, helps grow new cells, and prevents odour-causing bacteria from growing.

A 2014 study that tested the efficacy of hypochlorous acid versus povidone iodine in healing septic trauma wounds found that at day 14, 90% of the wounds treated with HOCl were ready for surgery, as opposed to 0% of the wounds treated with povidone iodine. HOCl also drastically reduced the wound's odour, discharge, and pain.

There are many other studies that corroborate these results, especially in the treatment of diabetic foot ulcers. A 2010 study showed that 90% of foot ulcers treated with HOCl were fully healed in 6 months time, as compared to only 55% of those treated with povidone iodine.

Hypochlorous acid is not only highly effective in preventing infection, it also acts quickly. A study of 1249 venous leg ulcers found that within 6 months, 100% of the wounds had healed completely. Patients without comorbidities healed completely in as little as 5 days. The implications of this research for hospitals and clinics is substantial. When hospitals have the ability to generate a powerful wound healing solution onsite, they are prepared against supply chain shortages, natural disasters, and fluctuating budgets. Furthermore, patients benefit from a safer, more effective treatment method with no risk of adverse reactions.

Reading Links

HOCl Stability and Low pH Study HOCl Patent Application Treatment of Venous Leg Ulcers

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HOCI SUCCESS STORY: FAME HOSPITAL IN KARATU, TANZANIA

The Foundation for African Medicine and Education (FAME) operates a not-for-profit clinic and hospital in Karatu, a rural district in Tanzania. The hospital has 14 inpatient beds, two operating rooms, a laboratory and a 24/7 emergency room. The hospital also has a 10-bed isolation ward for COVID patients and a 24-bed maternity ward.

Several months ago, Hypo Source approached FAME about purchasing the Hypo 7.5 hypochlorous acid machine. Egbert Chogo, the hospital's pharmacist, lead the effort to integrate HOCl in the hospital.

Staff at FAME Hospital are trained in how to prepare hypochlorous acid in the Hypo 7.5.

Prior to switching to hypochlorous acid, the hospital cleaning staff was primarily using JIK, a local brand of bleach (3.5%strength), which cost about $0.85 per liter. Because of the increased patient load and sanitation concerns brought on by Covid 19, the hospital was using about 100 liters of Jik or about 700 liters of dilute bleach solution each week. In other words, they were spending about $85 per week on bleach. This included bleach used in the cleaning solutions as well as for general sanitation.

Egbert said that during the first wave of the pandemic, the hospital experienced difficulties in procuring bleach due to supply chain shortages. Even after the supply chain had stabilized, the prices of bleach remained high due to increased demand. But with the Hypo 7.5, Egbert and his team can now make 7.5 liters of hypochlorous in 8 minutes at a cost of about $0.02 USD per liter. After reviewing cleaning protocols, Egbert reports that they are now using 500 liters of hypochlorous per week. At 2 cents per liter, the hypochlorous costs about $10 per week, compared to the $85 they were spending for Jik. In other words, an 800% cost reduction.

Now, the hospital uses hypochlorous produced onsite in the Hypo 7.5 each day to disinfect all areas after they have been given a preliminary cleaning with soap and water. The raw materials for the hypochlorous are easy to find, protecting the hospital against future supply chain disruptions. Bleach is now only used to whiten the hospital linens.

Switching the hospital's cleaning protocols from bleach to hypochlorous wasn't difficult, Egbert said, but it took some time for the staff to become accustomed to the new cleaning procedures and reduced disinfectant use. He hopes to introduce the hospital to using hypochlorous for wound care in the future, once staff have had a chance to get more familiar with the machine.

FAME Hospital is a great example of why we designed the Hypo 7.5. Our vision for this machine was to give clinics and hospitals, particularly in rural areas or with vulnerable populations, the ability to increase their self-sufficiency and improve sanitation conditions. We look forward to seeing the progress of Egbert Chogo and FAME!

WHAT HYPOCHLOROUS ACID CAN'T DO

We talk a lot about the vast number of benefits that come along with hypochlorous acid, but we don't always discuss the things hypochlorous acid can't do. As a company, we are committed to only distributing and promoting peer-reviewed information and research that has been held to a high scientific standard. We define these standards as research that has been peer-reviewed, published in a recognized scientific journal, properly annotated, and is not funded by a party with a clear conflict of interest.

There are plenty of myths and snake oil claims out there about hypochlorous acid. This misinformation only undermines HOCl's legitimacy and weakens consumer trust. To that end, we thought we'd try our hand at myth-busters and address some of the most common claims about hypochlorous acid. The table below contains common rumors about what HOCl can do and peer-reviewed research which confirms or disproves the rumor.

Rumor	Peer-reviewed research available?	Prove or disprove?
HOCl can cure acne	A very small study (9 participants) showed that HOCl was effective in treating acne.	Proven, but needs more substantial evidence.
HOCl kills bedbugs	There is no research done that tests this theory with HOCl. A Purdue University study found that bleach was relatively effective in controlling bed bug infestations in chickens but was ineffective against bed bug eggs and did not completely eradicate the infestation.	Yet to be confirmed
HOCl gets rid of allergies	There is scientific evidence which indicates HOCl can be used to manage rhinitis (the symptoms of an allergy attack), but it hasn't been proven to be any more effective than common treatment methods.	Proven to a small extent but needs more robust research
HOCl removes stains in clothes	Several HOCl manufacturers claim HOCl removes stains, and anecdotal evidence has shown that HOCl will not bleach or lighten fabrics.	Unproven and untested
HOCl kills mites and aphids	There are no peer-reviewed studies that prove HOCl efficacy against aphids. The only research done on the correlation between HOCl and mites is specific to Demodex mites, an ocular skin condition. This research has not proven that HOCl is significantly effective against Demodex mites.	Disproven and untested
HOCl reduces wrinkles	Some skincare companies marketing bottled HOCl make this claim, but there are not peer-reviewed studies to back it up.	Unproven

STUDIES REFERENCED (LINKED)

Acne management | Bedbugs in chickens | Rhinitis(Allergies) | Demodex mites

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HAVE A SAFE FLIGHT! HOCI IN THE AVIATION INDUSTRY

During the COVID-19 pandemic, many airlines had to adopt new methods of sanitizing between flights in order to ensure passenger safety and comply with government travel regulations. They were faced with the challenge of finding a disinfectant that could act quickly, disinfect effectively, and would not pose any health risks to staff or passengers.

Hypochlorous acid became a popular choice among airlines (and other industries) because it is innately non-toxic, while also being a highly powerful disinfectant that can eradicate COVID-19 in under 30 seconds. Hypochlorous is completely safe for vulnerable populations, such as the elderly, children and infants, and people with high sensitivities to chemicals.

Additionally, it does not require the use of full PPE or complicated chemical handling certification, making it an efficient choice for employers. With onsite generation, businesses were further able to save money by replacing many of their expensive bottled products with hypochlorous acid, made simply from water, salt and vinegar.

The applications for hypochlorous acid in the aviation industry are widespread, from the airport terminals to the plane cabin and beyond. Hypochlorous's versatility allows for it to be cold-fogged for air disinfection in the cabin and the terminals, sprayed on as a mist to disinfect seats or common areas, dispensed as a hand sanitizer for passengers during the boarding process, and dosed into drinking water in the aircraft. Major airlines around the world have already adopted hypochlorous and more are likely to follow. Here are a few examples we were able to find in the media!

Delta Airlines and Canada's SkyService use ULV cold foggers and hypochlorous to disinfect their airplanes and facilities.

Air Culinaire Worldwide, a global aviation catering service, fog hypochlorous into their kitchens each night as a leave-on disinfectant. Because hypochlorous is food-safe, they don't have to worry about going back to wipe the surfaces down.

Southland Waters, a manufacturer of hypochlorous acid generators, has sold machines to airports around the world for the purpose of water disinfection. These large-scale systems generate hypochlorous continually to purify the potable water used in aircraft, as well as in the terminal, water truck tanks, and cooling towers.

DRINKING TO YOUR HEALTH?

You've heard us talk about how hypochlorous acid is non-toxic, and maybe you've even been tempted to drink it to prove it. But should we drink hypochlorous acid? And if so, how much is considered safe?

The research on intentional ingestion of hypochlorous acid is limited, possibly due to the fact that there doesn't seem to be much application for drinking hypochlorous. However, it has been tested in many studies as an oral rinse in dental applications. While this isn't the same as drinking large quantities of hypochlorous, it does show that some small oral ingestion is generally harmless. Hypochlorous is highly effective as an oral care solution, particularly in controlling the growth of periodontal bacteria such as S. mutans and P. gingivalis. Its antimicrobial and antifungal properties offer a safer solution to oral care than chlorhexidine or chlorine bleach, two other commonly used solutions with harmful side effects. Hypochlorous levels as high as 500 ppm have been tested as a mouthwash on human subjects with no deleterious effects.

The only peer-reviewed study which focused specifically on drinking hypochlorous acid (as opposed to a mouthwash) was conducted on mice. Their drinking water was replaced with 5ppm hypochlorous for 12 weeks and various health markers were assessed. The experiment concluded there were no harmful effects to the mice after sustained ingestion of hypochlorous acid.

For all the Princess Bride fans- no, HOCl won't help you trick your opponent and rescue Princess Buttercup.

Of course, we already know that chlorine is safe for human ingestion at low levels, as it is the primary means of water purification throughout the world. Conversely, we also know that high levels of chlorine, such as those found within bleach, can be lethal. Hypochlorous generally has a lower ppm than bleach, and thus the possibility of chlorine toxicity is greatly reduced.

Now, just because it is probably not harmful to drink hypochlorous doesn't mean you should. Your body already naturally produces hypochlorous as part of the immune system response, and there isn't enough scientific research to show compelling health benefits for the daily consumption of hypochlorous.

Non-peer reviewed human studies have been conducted that test the ingestion of 5ppm free available chlorine with no harmful effects. If accidental ingestion of HOCl occurs at a higher ppm level, the likelihood of harmful side effects is very low. However, if you are concerned or begin to feel ill, contact your local poison control center or emergency services.

READING LINKS

HOCl vs Chlorhexidine in dental care

Reduction of periodontal bacteria via HOCl

Safe chlorine levels for human consumption

HOCl as drinking water for mice

Hypo 7.5 Update

The first Hypo 7.5 machines arrived in Nigeria this week, accompanied by our managing director. Our local partner there has already successfully deployed over 40 units of the EcoOne as Nigeria comes to appreciate the many uses of hypochlorous!