Comparison study

15 October 2009

WHAT ANTIMICROBIALS ARE BEING USED IN THE MARKET TODAY?

Conventional disinfectants

Bleaches

Sodium Hypochlorite

Chlorine Dioxide

Chlorine bleach must NOT be used to kill mould or disinfect mouldy areas. It is not an effective or long lasting killer of mould and mould spores. Bleach is good only for changing the color of the mould and watering the roots of the mould.

Chlorine bleach is ineffective in killing mould for these reasons:

1. The object to killing mould is to kill its “roots”. Mould remediation involves the need to disinfect wood and wood-based building materials, all of which are porous materials. Thus, chlorine bleach should not be used in mould remediation as confirmed by OSHA’s Mould Remediation / Clean Up Methods guidelines. The use of bleach as a mould disinfectant is best left to kitchen and bathroom countertops, tubs and shower glass, etc.

2. Chlorine Bleach does kill bacteria and viruses, but has not been proven effective in killing moulds on non-porous surfaces. Bleach itself is 99% water. Water is one of the main contributors of the growth of harmful bacteria and mould. Current situations using bleach re-grew and regenerated mould and bacteria twice the CFU counts than were originally found before bleaching, within a short period of time. Bleach is an old method used for some bacteria and mould. It is the only product people have known for years. The strains now associated within Indoor Air Quality issues are resistant to the methods our grandmothers employed to clean-up mould.

3. What potential mould 'killing' power chlorine bleach might have had is diminished significantly as the bleach sits in warehouses, on store shelves or inside your home or business. A 50% loss in killing power occurs in just the first 90 days inside an unopened jug or container. Chlorine constantly escapes through the plastic walls of its containers.

4. The ionic structure of bleach prevents Chlorine from penetrating into porous materials such as drywall and wood - it just stays on the outside surface, whereas mould has enzyme roots growing inside the porous construction materials, however the water content penetrates and actually FEEDS the mould. This is why a few days later you will notice darker, more concentrated mould growing (faster) on the bleached area.

5. Chlorine Bleach accelerates the deterioration of materials and wears down the fibers of porous materials.

6. Chlorine Bleach is NOT registered with the EPA as a disinfectant to kill mould. You can verify this important fact for yourself when you are unable to find an EPA registration number for killing mould on the label of any brand of chlorine bleach.

7. Chlorine bleach gives off gases for a period of time. Chlorine gas can be harmful to humans and animals. It has been known to cause pulmonary embolisms in low resistant and susceptible people.

8. Chlorine bleach will evaporate within a short period of time. If the area is not dry when the bleach evaporates, or moisture is still in the contaminated area (humidity, outside air dampness) you could restart the contamination process immediately and to a greater degree.

9. Chlorine is a key component of DIOXIN. One of the earliest findings of dioxin's toxicity in animals was that it caused birth defects in mice at very low levels. This finding led to dioxin being characterized as "one of the most potent teratogenic environmental agents". The first evidence that dioxin causes cancer came from several animal studies completed in the late 1970's. The most important of these, published in 1978 by a team of scientists from Dow Chemical Company, led by Richard Kociba, found liver cancer in rats exposed to very low levels of dioxin. This study helped establish dioxin as one of the most potent animal carcinogens ever tested and, together with the finding of birth defects in mice, led to the general statement that dioxin is the "most toxic synthetic chemical known to man."

What is dioxin?

Dioxins and furans are some of the most toxic chemicals known to science. A draft report released for public comment in September 1994 by the US Environmental Protection Agency clearly describes dioxin as a serious public health threat. The public health impact of dioxin may rival the impact that DDT had on public health in the 1960's. According to the EPA report, not only does there appear to be no "safe" level of exposure to dioxin, but levels of dioxin and dioxin-like chemicals have been found in the general US population that are "at or near levels associated with adverse health effects."

What is Chlorine Dioxide?

During recent years, the use of chlorine dioxide has become more popular with water intrusion experts, duct cleaners, and indoor air quality consultants. That’s because chlorine dioxide works exceptionally well on a wide range of microorganisms in a very short time. In addition, chlorine dioxide breaks down to a simple salt, eliminating any chance for toxic residue to exist.

Don’t be confused into thinking that chlorine and chlorine dioxide are the same. They are separate chemicals that react differently. In addition, their chemical by-products have little in common.

Chlorine reacts by "adding" chlorine atoms. This can create trichloromethanes and dioxins, both known to be powerful carcinogens. In addition, the concentration of chlorine that is needed to be effective is too high to use safely.

Chlorine dioxide typically reacts with organics through the addition of oxygen. When chlorine dioxide reacts, it is reduced to the chlorine ion, which is part of the salt found in seawater and table salt.

Other Technologies

Phenol's claims for treated articles or substances are limited, as qualified by a typical statement like: "This product contains a preservative (e.g., fungicide or insecticide) built-in or applied as a coating only to protect the product. An example of an acceptable label statement would be: Antimicrobial properties are built-in to inhibit the growth of bacteria that may affect this product.

OrganoSilane, more on this

Silver ions are slowly released when moisture is present to interrupt the dna/growth/cell activities of the mould. The mould must come into contact with the silver to be affected. The ionic properties of Axenohl allow us to formulate a product with higher stability and efficacy as compared to colloidal silver products on the market today. It is believed that the ionic size and charge associated with the silver ions in Axenohl, coupled with the stabilizing effect of an organic acid allow the ionic silver to remain in solution without precipitating. The increased biological availability of these stabilized silver ions in solution contributes to the outstanding effectiveness of Axenohl against a wide range of gram-negative and gram-positive bacteria, fungi and viruses.

What is a disinfectant?

Disinfectants are the chemical agents that either inhibit microbial activities and growth or are lethal and kill the microorganisms. In man's struggle to control the microbes responsible for disease and illness many organic and inorganic chemicals have been found to be toxic to microorganisms.

Which microorganisms are we trying to kill?

Disease-producing microorganisms are known as pathogens. Bacteria, fungi, protozoa, as well as viruses are the pathogenic microorganisms we attempt to control.

<u>Bacteria</u>

Bacteria are microscopic single cell living organisms.

<u>Fungi</u>

Fungi are more advanced multi-cellular organisms which can be infectious.
Mould and *Mildew* are types of fungi which cause deterioration.

<u>Protozoa</u>

Protozoa are small unicellular animal microorganisms. Some are parasitic and others can live free of a host. The most common protozoan diseases would include malaria and amebiasis.

<u>Viruses</u>

A virus is a microscopic organism that lacks the capacity to reproduce itself unless it gains entrance into a cell of another living organism. Once within the cell of another organism the virus utilizes the host cell's protein making abilities to reproduce itself. Disease is the result of the chemical damage done to the host cell by the virus' use of it. Some of the most well known diseases caused by viruses are the common cold, influenza, hepatitis A and B, measles, mumps, rabies, rubella, herpes simplex I & II, and smallpox.

How do disinfectants work?

Disinfectants work by adversely affecting the microbe's cell by either disrupting its physical makeup or by blocking its energy-yielding or synthetic processes. It is important to remember that disinfectants are consumed or expend their ability to affect the microorganisms during this process.

A brief history of disinfectants

The first disinfectant, carbolic acid, better known today as phenol, was introduced into the operating room by Joseph Lister in the late 19th century. As a result post operative infections were dramatically reduced and the science of disinfectants was born. Man's desire to end disease has led to the development of many different chemical compounds that kill pathogenic microorganisms.

What different chemical compounds are used in manufacturing disinfectant products?

Halogens are a family of elements, the most common being fluorine, chlorine, bromine, and iodine. The very reason that these elements make food disinfectants is also their biggest drawback. They attack cells and destroy their structures. They are, however, non-selective and can also be aggressive and corrosive to human skin or other environmental surfaces.

Chlorine is the most aggressive and commonly used of the halogens. It is very corrosive and generally associated with bleach. Bromine is not as abundant in nature, making it far more expensive than chlorine and less practical to use. Fluorine is not used because of the extreme toxicity associated with fluoride compounds.

Iodofors (iodine-containing compounds) are used primarily for the skin and have undesirable staining properties which make them impracticable for cleaning solutions.

Phenol, originally extracted from coal tar, was known as carbolic acid and is produced synthetically today. In its raw form phenol is a white poisonous corrosive crystal. Phenolics kill pathogenic microorganisms through a chemical reaction which disrupts the proper functioning of the cell wall.

Pine Oil has often been referred to "Nature's own disinfectant." Pine oils are effective against microorganisms in the same way as phenols, wherein they have a chemical action which disrupts the cell wall. This chemical action is not nearly as strong as that of phenols, so cleaning solutions must contain a considerable amount of pine oil to be effective.

Quaternary Ammonium Compounds (Quats) were first introduced in 1935. Quats do not work by being corrosive or by an aggressive chemical action as do other disinfectants compounds. Quats are effective disinfectants because they are attracted to the protein coating (cell wall) of the microbe and therefore are considered selective in their aggression.

There have been four significant advances in the development of quats over the years and today most quaternaries are classified as first generation through fourth generation products.

First generation

Generally speaking, first generation quat products are identified by the chemical compound name n-alkyl dimethyl benzyl ammonium chloride and are often referred to as ADBAC quats.

Second generation

The first significant improvement came in 1955 with the second generation quat compounds and the addition of an ethyl group to the formulation: n-alkyl dimethyl ethyl benzyl ammonium chloride. Also, the original ADBAC quats underwent a modification to the chemical chain improving the tolerance to environmental conditions. Other industries also contributed to the continuing improvements in quaternaries. Nonionic detergents were being developed with far greater cleaning power than natural soaps. Combined with quats, a truly superior detergent-disinfectant was ready to emerge.

Third generation

Twin chain quats, the most significant advance in quaternary technology, brought the third generation of quats to the field in 1965. Twin chain quat compounds normally contain any combination of the octyl decyl dimethyl; dioctyl dimethyl; or didecyl dimethyl ammonium chloride groups.

Fourth generation

Seeking ways to reduce the amount of active chemical ingredients and still maintain peak performance, chemists developed the fourth generation of quaternary compounds by combining the twin chain quats with the earlier ADBAC quats. These newest quats remained active under even the most difficult conditions but with almost 50% fewer active chemical ingredients than ADBACs alone. Additionally, they promised lower toxicity, improved convenience, and greater economy.

Will hard water affect the performance of disinfectants?

Hard water has long been considered a major problem facing disinfectants. Whether a quat, phenolic, or an iodophor, the metallic ions in hard water bond to disinfectants reducing their biocidal activity. Modern quats however, are capable of withstanding water of up to 90 grains of hardness.

Why do disinfectants have different kill claims?

Often, questions arise regarding the kill claims of certain quat compounds. Why does one products claim bactericidal activity while other claim fungicide and virucidal as well? To answer this question it is important to remember that the EPA was formed in the early 1970's and since that time all registrations for disinfectants have fallen under their control.

Test protocols were established for consistent testing and products had to be submitted for testing to prove their kill claims. Since the fourth generation products were more economical and maintained a higher activity under adverse conditions most manufacturers have only

submitted these formulas for the more expensive and time consuming testing that allows them to make these higher kill claims.

To establish testing standards, ppms (parts per million) were used to measure the amount of disinfectant in a solution required to provide efficacy data for kill claims. Figuring the ppms of a particular product is achieved by multiplying the total amount of quaternary in the product by 10,000 and dividing that answer by the recommended dilution.

How do I determine what type of disinfectant to use?

Bleach. Generally speaking, bleach (*Chlorine*) kills just about everything due to its highly corrosive nature. It is very harsh on everything it comes in contact with, so where it is used is very important. Chlorine is an excellent oxidizing agent (such as its use in swimming pools) and because of this is very unstable which makes for a very short shelf life.

- *Chlorinated products should be stored in colored container to reduce their exposure to light which increases the decay rate.*
- *Remember to never mix bleach with any other compound, it is highly reactive and easily reacts to form other compounds most of which are dangerous to you!*

Phenols are not as corrosive as chlorine, but again they are non-selective and attack all surfaces. Phenolic disinfectants are still the preferred product by some health care institutions as these are also effective against pathogenic, spore-forming bacteria such as tubercle bacillus. Spore-forming bacteria are more difficult to disrupt since they are able to produce a shell (spore), usually associated with its dormant stage.

Pine Oil products require such a high amount of oil that you'd better really like the smell of pine. And again their solvent action is non-selective in that it attacks everything. Cost today is again a factor in these products because they must contain a high percentage of pine oil to be effective. In today's marketplace the cost of pure pine oil is rather steep.

Quats are by far the most popular choice of disinfectants today because of their low cost and selective aggression. They have broad spectrum effectiveness against a range of microorganisms and provide the highest overall value to the customer.

Quats are formulated with a variety of detergents for more specific applications. For example, a highly alkaline degreaser disinfectant or a pH neutral disinfectant for damp mopping high gloss floor finish, can be made using the same quat compound.

Quats are used as sanitizers and deodorants in a number of formulas as well. There may be times when your concern for total kill will outweigh the negative impacts of the product used. Many kennels use bleach to control parvo virus and some health care institutions will demand phenolic cleaners against tuberculosis.

Product / properties matrix

Disinfectant group	Product	Properties						
		EPA approved	Non-leaching	Non-adaptive organisms	Non- mutative organisms	Non-flammable	Non-hazardous storage	Safe to handle
1. Organosilane	Germ Solutions	X	X	X	X	X	X	X
2. Poisons	Amicor					X	X	X
	Byotrol					X	X	X
	Chlorine bleach	X				X		
	Chlorine Dioxide	X				X		
	Fiberloc					X	X	X
	Microban	X				X	X	X
3. Silver Ion group	Aglon					X	X	X
	Axenohl	X				X	X	X
	Envirocare	X				X	X	X
	Fosshield	X				X	X	
	PCG					X	X	
4. Coatings impregnated with disinfectants	Camden	X				X		
	Forticel	X				X		
	Fosters	X				X		
	Microban	X						
	Mould Block	X				X		

1. OrganoSilane Technology

2. Leaching (poison) technology:
    a. Bound
    b. Unbound

3. Silver Ion (or heavy metal) Technology:
    a. Bound
    b. Unbound

4. Antimicrobial coatings & sealers.