Reflections on the properties of disinfectants used in hatcheries

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Choosing a hatchery disinfectant requires a knowledge about the disinfectant's efficacy, its user-friendliness and its effect on your equipment as well an assessment of any lasting environmental impact from its use. Some of the factors influencing a disinfectant's performance in a hatchery environment include hard water (salts and metals), the presence of organic matter, temperature, humidity, air flow and the pH of the disinfectant. These factors will influence the disinfectant's efficacy as well as its visual appearance on equipment after continued use.

Hygiene starts with the egg . . .

Common disinfectants

The vast majority of disinfectants used in hatcheries are quaternary ammonium compounds (QACs), synthetic phenolic compounds (phenols), glutaraldehyde, a combination of glutaraldehyde and QAC, chlorine, peracetic acid (PAA) and iodine.

It should be noted that sanitisers are not disinfectants.

The main difference between a sanitiser and a disinfectant is that at a specified use dilution, a disinfectant must have a higher kill capability for pathogenic bacteria than a sanitiser. There is no perfect disinfectant! Each of the above categories of disinfectants has advantages and disadvantages.

It is critical to establish when a disinfectant is being evaluated what is being compared to what. If one is not the exact formulation of the other disinfectant, but is of the same active ingredient category, their overall performance should not be accepted as equal.

Even if the active ingredients are similar in percentage terms, it is unlikely that the rest of that product contains the exact chemical characteristics, pH, surfactant system, chelating agents, solvents or co-solvents as the disinfectant it is being compared to. In other words, all QACs will not perform the same and all phenols will not perform the same. Each active ingredient category has characteristics that distinguish their performance.

Disinfectant manufacturers have been able to overcome an active ingredient's efficacy deficiency in some cases, by use of additional ingredients (both active and inert) within the disinfectant's formulation.

However, this is not always true as the examples below illustrate.

- QACs will not kill tuberculosis.
- Synthetic phenolic disinfectants will not inactivate a non-enveloped virus, such as infectious bursal disease (IBD), or a bacterial spore, such as that of Clostridium perfringens, the main cause of gangrenous dermatitis.

The mode of action of the active ingredient will not allow these types of disinfectants at any level of use to provide efficacy against certain micro-organisms.

A disinfectant considered for use cannot be effectively evaluated by looking only at the listed active ingredients it contains. All components of that disinfectant must be evaluated to determine if the 'total' product has the ability to chemically interrupt the targeted micro-organism's life cycle.

Hatchery disinfectants must be able to kill the widest spectrum of micro-organisms. It is not satisfactory for a disinfectant to be effective against only one micro-organism species that may be prevalent in this type of environment, such as Aspergillus fumigatus, when there are many different types of aspergillus each having a different resistance factor.

Hatchery management must recognise that every micro-organism has a different resistance level. Many micro-organisms within the same category, such as aspergillus, have many species which vary in their resistance to chemical action.

For this reason, the hatchery disinfectant chosen should have a past history of proven efficacy against the specific types of 'problem micro-organisms' which will most likely appear in the hatchery environment.

Efficacy and ease of use

QACs have been well documented for their efficacy and ease of use. They are generally inexpensive and usually will provide fair to good results in the hatchery environment. They are most effective at an alkaline pH. However, they do not perform well when challenged by organic soil at levels exceeding 5% or hard water exceeding levels of 400-500ppm.

QACs do not provide residual activity on hard surfaces.

A major problem with the use of QACs in the hatchery environment is their inconsistent efficacy against moulds, particularly aspergillus.

QACs do not exhibit uniform kill against all types of aspergillus. As a result, when hatcheries are targeting aspergillus as a problem source, the hatchery in most cases is unaware of the aspergillus 'type' and will consider using any QAC disinfectant which claims to be effective against aspergillus. This approach to the aspergillus problem is usually ineffective.

For example, if the disinfectant presently being used has proven efficacy against Aspergillus niger but has no proof of efficacy against Aspergillus fumigatus, Aspergillus glaucus, or Aspergillus nidulans, you cannot assume the disinfectant is effective against all of these aspergillus types. It should be noted that Aspergillus niger is commonly used for disinfectant approvals.

However, Aspergillus fumigatus, which is more commonly found in hatcheries, is considerably more resistant than Aspergillus niger.

Aspergillus challenge

QAC disinfectants used at manufacturers' recommended levels of use, usually will not kill Aspergillus fumigatus without the assistance of added ingredients (either active or inert) to the product formulation.

The addition of these other ingredients within the formulation, assist the QAC so that the 'total' product may provide efficacy against Aspergillus fumigatus.

These additional ingredients should be considered carefully as they may also provide other concerns regarding toxicity, especially to waste water treatment systems, cosmetic build-up (sticky or rock-like), evaporation problems which negatively impact the original disinfectant and potential corrosion problems.

One commonly used QAC based hatchery disinfectant contains an additional active ingredient included within the formulation to specifically address mould problems such as Aspergillus fumigatus.

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Regrettably, this active ingredient, tributyltin oxide (TBTO) is also classified as a marine pollutant and has been banned worldwide by the International Maritime Organization (IMO) so as not to expose marine life to this chemical. TBTO also has an extremely low OSHA (Occupational Safety and Health Administration) PEL (Permissible Exposure Level). This product is used and discharged everyday in hatchery drains.

This 'runoff' into the drains then proceeds to enter either the local public city water treatment system or the company's waste water treatment system.

Most of these situations, in which aspergillus persists has hatchery management trying to eliminate a type of aspergillus which is not affected by their 'usual' disinfectant.

Danger of increased levels

QACs have also had trouble in the hatchery environment with ever present micro-organisms such as E. coli, pseudomonas, as well as aspergillus. The typical reaction to this lack of consistent efficacy is to increase usage levels which is not the appropriate response to this problem.

Disinfectants, however they are marketed, are pesticides. When usage levels are increased to higher than manufacturers' approved recommendations, all of their -cidal and toxicity levels become unknown.

This is a critical point, especially when the disinfectants are being used in an environment which has the presence of baby chicks, embryos and employees.

While hatchery microbiological reports may indicate some additional efficacy, the increased usage will no doubt show up in sticky or hard chemical residues that cause equipment deterioration, lower airflow due to build-up on fan blades, continued inconsistent microbiological results and poor hatch performance from unknown toxicity.

These include blocked hatching egg pores, resulting in poor-to-no moisture exchange, resulting in reduced waste lost and ultimately embryonic death. This demotivates hatchery staff with the net result that the hatchery employees do not use the product as instructed, yielding inconsistent hatchery results.

QACs have been suspected in developing micro-organism resistance after long periods of repeated use. This situation is apparent when micro-organisms (typically E. coli, pseudomonas and aspergillus) initially eliminated by the QAC start reappearing and become more difficult to eliminate.

Efforts have been made by QAC manufacturers to eliminate this problem by adding additional carbon molecules, various alcohols and other solvents/co-solvents to the QAC.

New generation products

Manufacturers refer to these additions in their QACs as 'second', 'third', 'fourth' or 'new' generation' products. These newer QACs, while exhibiting added efficacy, also carry added toxicity. They also potentially have greater persistency and may increase problems in wastewater treatment systems.

Phenolic disinfectants have a fairly broad range of efficacy and usually perform well in the hatchery environment. Continuous use, if employees do not take necessary precautions, result in dry, itchy, and cracked skin due to the phenolic's mode of action.

Phenolics are generally more expensive and, due to their oil-based origin, provide a limited residual activity and exhibit efficacy in the presence of organic matter. They perform best at an alkaline pH.

Repeated non-rinsed use (residual activity can only be achieved by non-rinsing) on equipment in warm, humid conditions will result in a brown sticky residue, and as is the case with QACs, this will build up on fan blades (adding additional weight to the fan blades, which in turn lowers required airflow demands) walls in hatchers, setters, block pores on egg shells and block nozzles.

This problem originates from ingredients used within the formulation to make the phenolics water soluble, which will evaporate, thus reducing the product to its oil-base origin. If the hatchery drains into a water treatment system, the characteristics of the phenolic disinfectants' high pH and organic soil tolerance will actively destroy bacteria necessary to maintain the efficient operation of this system.

Phenolics have also been used as 'the cure all' when a hatchery using QACs detects a decrease in efficacy. Sometimes this will be an effective solution and sometimes it will not be! The results will depend on the efficacy of the individual phenolic chosen and if that phenolic has proven to kill the problem micro-organism. It is a false conclusion to assume that any phenolic disinfectant will automatically be efficacious against micro-organisms which QACs will not kill.

It should be noted that ortho-phenyl-phenol, one of the three commonly used phenolics in these various hatchery and poultry house disinfectants, has been recently classified by EPA as a carcinogen.

Glutaraldehyde, used in disinfectants as a single active ingredient, has had limited success in the hatchery environment due to several factors:

- Glutaraldehyde, as the single active ingredient, has an extremely sensitive optimum operating pH. A slight pH change of a glutaraldehyde solution, when used against a micro-organism such as E. coli, may take up to five hours to kill. This increased contact time is not realistic in hatcheries.
- Glutaraldehyde as a single active ingredient is not very effective against aspergillus, but at a proper pH is extremely effective against bacteria and hydrophilic or naked viruses. It has very good tolerance to organic matter.
- High levels of glutaraldehyde are extremely offensive to the user and the product will usually be found in the corner of the hatchery not being used for this reason! It can also 'brown' or 'caramelise' the user's skin at high concentrations.
- Glutaraldehyde, as a single active ingredient, is most efficacious at an alkaline pH (8.0-8.5) but is not stable and will degrade, losing active glutaraldehyde within 30 days in an alkaline pH.

Exceptional efficacy

The introduction of the combinations of QACs with glutaraldehyde has yielded disinfectants with exceptional efficacy.

Incorporating QACs with glutaraldehyde allows the optimum operating pH to be just under neutral. The pH, along with the proper level of use, permit the product to be stable and does not adversely affect wastewater systems or personnel using the product.

The pH in this type of product is important but not critical as with glutaraldehyde used as a single active ingredient or used as the majority active ingredient.

QAC, used as a surfactant (chemical to lower surface tension) allows the QAC to act as a vehicle to allow the glutaraldehyde access to the interior of the micro-organism, where it can then rapidly work. This combination has been used for such practices as sterilising dental and medical instruments.

. . . and finishes with the chicks.

Combining the best characteristics of the QAC with the best characteristics of the glutaraldehyde has yielded superior disinfectant efficacy.

This combination yields a synergistic effect between the QAC and glutaraldehyde. This combination of disinfectants is most efficacious when the ratio of QAC to glutaraldehyde is approximately 3:1.

It is worth mentioning each manufacturer's formulation of this combination product will differ in efficacy, toxicity, cosmetic appearance, smell and ease of use depending on the types and amounts of active and inert ingredients contained within the formulation.

There are many products on the market which have formulated this type of product using high levels of glutaraldehyde and low levels of QACs. Research indicates when the product is formulated in this manner, the same problems which exist when using glutaraldehyde as a single active ingredient, still exist; namely, inconsistent efficacy (little or no efficacy against mould) and extremely offensive to the user.

Formaldehyde has been used quite frequently as a 'when all else fails' product. Formaldehyde has extremely poor penetrating characteristics and its efficacy is greatly influenced by humidity and temperature.

Major poultry producers in the USA no longer rely on formaldehyde, a known carcinogen, because of health concerns and the potential disastrous media exposure relating to producing human food products, assisted with a known carcinogen, far outweigh any positive production results.

Whether one believes formaldehyde is a carcinogen or not, perception is reality and enough data is available for the media to give this issue an adverse slant.

Other types of disinfectants which are commonly used in the hatchery's environment are chlorine and hydrogen peroxide.

When considering the use of hydrogen peroxide, it should be noted that hydrogen peroxide, once diluted for use, will rapidly lose its activity. Some factors affecting this speed of activity loss are original concentration and mineral content, such as commonly found red iron, in the water used to make the solution. Unspecified levels of concentrations and exposure times required for specific micro-organism efficacy, such as Aspergillus fumigatus, have fast become a well known concern. Peracetic acid disinfectants (PAA), which contain high levels of hydrogen peroxide as well as organic acids and other stabilisers, make peracetic acid disinfectants a much better alternative.

Efficacy across a wide range of micro-organisms, shelf life and stability, speed of kill, no residues or chemical buildup and extremely low re-entry time requirements into misted/fogged areas, are just some of peracetic acid's advantages.

Caution and proper use in relation to staff and equipment is mandatory when working with peracetic acid disinfectants. Peracetic acid disinfectants have proven to be one hundred times more powerful than peroxide. Hatcheries, when using the above disinfectants, under proper care and targeted towards specific areas will find success in their use. Examples of use would include for hatchery equipment, evaporative coolers, final sanitising lines at the tray, buggy or box washers and peracetic acid for egg shell sanitising or iodine for foot dips.

Regular monitoring

The above mentioned products, once made into solutions should be regularly monitored for their active ingredients as they can be sensitive to heat, light and the presence of organic debris. This sensitivity to heat, light and organic debris destabilises these products resulting in their degradation or inactivation, negatively impacting their official listed efficacy. If they are over used there may be adverse effects on equipment and staff.

A sound hatchery sanitation program, using a proven disinfectant, with a continuous microbiological monitoring program, targeting surfaces, water and airborne contamination will provide the hatchery with the sought after superior results.

The use of proportioning or metering equipment to ensure exact and consistent usage of any disinfectant is highly recommended. ■