Effective use of disinfectants in disease prevention and control

Cleaning and disinfection is not only part of an avian influenza prevention strategy, it should prevent any disease. Moreover, a good sanitation programme will improve production results, so it is economically very important. It should be perceived as an investment, rather than as a cost.

by Luc Ledoux, Business Unit Manager, CID Lines nv, Belgium.
www.cidlines.com

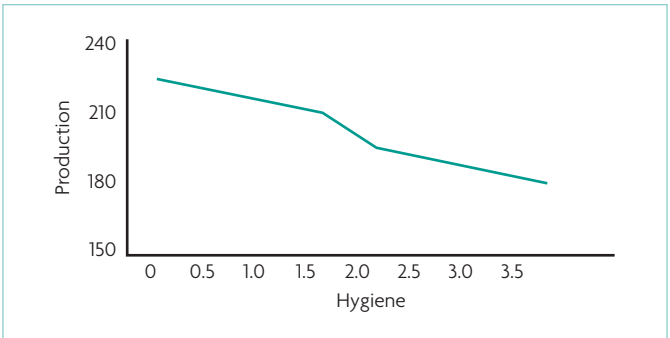

Fig. 2. The correlation between hygiene and production results.

Rule number one is: disinfection is impossible without cleaning first; you cannot disinfect dirt!

This should be applied in all links of the production chain: hatchery, trucks and farm. On farm, it applies not only to the house itself, but also to people (boot dips, hand hygiene, showers), crates, drinker lines, to feed and to drinking water. Hence, cleaning and disinfection forms a part of 'bio-exclusion' (keeping disease agents out). But, it does not end at the processing plant; it continues in the store and at home until the preparation of the meat. Biosecurity is a programme 'from farm to fork'.

Is hygiene important?

Hygiene and disinfection are partially overlapping notions. Hygiene is mainly related to cleanliness, to the management of dirt, but also in its microbiological sense.

'Sanitation' means to improve the hygienic circumstances. Terminal disinfection is strictly about eliminating possible pathogen micro-organisms by reducing them as close to zero as possible (or by a maximum log).

Both are actions aimed at removing possible causes of contamination that can affect your chick quality. Let's call the cleaning part 'macro' and the disinfection part 'micro'.

The macro part is the bulky part, that is mainly visible to the human eye. On the organic side, we can see the litter, the excrement, the contents of broken eggs, the fluff and meconium of day old chicks, and we know they contain micro-organisms.

On the inorganic side, we see the lime scale build up, caused by calcium (or other mineral) deposits of hard water. We know they can equally shelter micro-organisms.

So we can see if the organic and inorganic dirt has been removed and assume a lot of micro-organisms have gone with it. This is the cleaning part.

The question is, how many pathogens remain after the dirt has been removed? A rule of thumb in the hygiene industry is that a good cleaning job should remove at least 85% of the micro-organisms. So we consider 'sanitation' as a good cleaning job, not as a good disinfection job.

A good cleaning job will determine the microbiological result for >85%. The disinfection will contribute only <15%, as the 'cherry on the cake'. A bad cleaning job means that dirt (organic or inorganic) will still harbour micro-organisms that the disinfectant cannot reach.

The micro part is the abstract part. It is the fight against an 'invisible enemy'. We need to visualise this enemy through electronic microscopes or, in the case of bacteria and fungi, incubate them to become visible Colony Forming Units.

The HACCP (Hazard Analysis Critical Control Points) standard for disinfection is to reduce the micro-organisms by 99.99% or log 4. (Sterile is a 100% reduction and is required in certain surgery circumstances, for example). A good hygiene programme will also include operational or managerial measures to prevent contamination or to secure the health (and the life) of your livestock, be it breeders, hatching eggs or broiler chicks. Securing life (or 'bios' in Greek) is what biosecurity stands for.

Biosecurity is often defined as: 'measures designed to protect a population from transmissible infectious agents'.

Components of biosecurity

Biosecurity has three components: isolation (all in/all out), traffic control and sanitation (or cleaning and disinfection). The goal is to break the chain of infection. This chain is composed of pathogens that need a reservoir or source (people, other birds, rodents, insects or any organic material acting as life support for those microbes, say 'dirt') and that can get transmitted to (other) birds (the 'target'), again becoming a source for further transmission, etc.

The best way to avoid infection is obviously to have the environment (the incubator, the truck, the barn) free of disease-causing organisms.

This can only be achieved by thorough cleaning and disinfection (eliminating the original reservoir or source).

Bacteria can double by cell splitting every 20 minutes, so one bacteria can reproduce in less than a day to a number far greater than the number of people on earth (seven billion)!

Downtime is not possible in the

Fig. 1. The chain of infection.

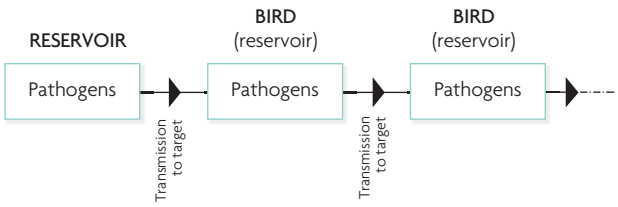

Table 1. CFU reductions at North Carolina State University test farms.

House status	CFU/sq	Reduction from previous step (%)
Dirty	3,000,000	–
Blown down (air)	2,900,000	3.4
Air out	2,000,000	31
Washed with water	500,000	75
Washed with detergent	100,000	80
Disinfected	<1,000	>99

Characteristics of detergents	
Wetting:	decreases surface tension
Dispersing:	splits up dirt particles
Emulsifying:	splits and suspends oil and fat
Suspending:	floats and carries away dirt particles
Sequestering:	dissolves salts

Table 2. Characteristics of detergents.

hatchery, so more stringent measures will be needed there. Even if you set eggs in 'single stage' (all in/all out, allowing to clean and disinfect the setters every 18 days in the case of chicken incubation) the hatchery as a whole will always be a 'multi stage' operation.

There is a matrix of different sources of contamination: vertical, horizontal, internal (within the house) and external (from outside vectors such as people and their vehicles).

Vertical transmission means that the infection has been transmitted by the parent stock through the hatching egg. Hence the importance of starting with a healthy breeder flock as a first premise for biosecurity. The breeder's health status should be maintained, so they should be protected from horizontal contamination, both internally and externally, which is basically the same principle as in the case of broilers (farm hygiene).

So, are cleaning and disinfection important?

Studies at the Institute of Poultry Research in Holland have shown that the better the 'hygiene score', the better the 'production figure', as shown in Table 1.

The hygiene result is according to the Dutch IKB or ICC (Integrated Chain Control) standard:

- 0 = 1-3 CFU.
- 1 = 4-9 CFU.
- 2 = 10-29 CFU.
- 3 = 30-90 CFU.
- 4 = ›90 CFU.

The production result is the EPF (European Production Figure) calculated as follows : ((Growth (kg) x survival rate) / FCR) x 100).

Cleaning first

Cleaning is the removal of dirt. A study at North Carolina State University stresses the importance of using detergents (and disinfectants afterwards). So, what do those detergents do to make the surfaces cleaner?

Table 2 shows the 'chemical' action of detergents. The action will also be determined by the pH. If the dirt is organic (fat, proteins, manure that is acidic) then an alkaline (pH›8) detergent will be needed. If the dirt is inorganic (lime scale from calcium or any other mineral deposit, that are alkaline), an acid (pH ‹6) detergent will be needed.

In total, there are four factors of cleaning:

- Chemical energy: pH and concentration, (alkaline detergents remove proteins and fat; acid detergents remove mineral deposits like scale).
- Thermal energy: fat starts to dissolve as from 35°C or 95°F.
- Physical energy: a high pressure washer (forget the broom; too tiring for operators).
- Contact time: this will enable the chemical energy to do its job.

Moreover, it is the only factor that does not cost any energy, it is free of charge.

If you increase one factor, you can save on the others. Since contact time is free of charge, this is the one we should maximise, in order to save water consumption, labour and energy, as shown in Fig. 3.

Disinfection

The goal of disinfection is to reduce the number of pathogens, ideally by log 4 (99.99%). Therefore, the disinfectant should comply with a number of characteristics. First of all, it should be compatible with the detergent, foam or gel cleaner. This means that if your cleaning agent contains cationic surfactants (= ions having a positive charge), your disinfectant should not contain anionic surfactants (= ions having a negative charge). Phenols and especially their derivate like cresols are known not to be compatible with non-ionic surfactants and cationic ones like quaternary ammonia.

Well formulated disinfectants should comply with a number of characteristics, such as COST – Composition, Opportunity, Safety and Tested.

Composition

How many different active ingredients compose the product, so that it assures a maximum synergy?

Does the product contain buffering agents (surfactants, wetting agents, sequestering agents, stabilising agents) so it works in contact with organic matter, in hard water, in cold water, in all pH, and assures a minimum two year shelf life in concentrate and several weeks in dilution?

The million dollar question: How many grams/L (oz/gal) or % active ingredients does the product have? And, is it expressed in terms of 100% ingredients (glutaraldehyde is sold in 50%: this amount should be halved to express the total number of gr/L glutaraldehyde); or in other words: how much water is there in the drum?

This concentration will determine the dilution. Unfortunately, we have seen disinfectants on the market that do not disclose their concentration of active ingredients. In this case, the customer is buying his 'wildest guess' and has no idea how much water there is in the drum.

Opportunity

Does the product have the full spectrum: bactericide, fungicide, virucide and sporicide?

Beware of 'statics', like bacteriostatic: they stop their development, but do not reduce their number.

Is it also versatile to be sprayed, foamed and fogged without any extra additives. Is it ready to use?

Safety

It is important that the product is safe for:

- The people (not containing carcinogenic substances like formaldehyde; complying with the Maximum Exposure Limit or MEL, with CLP, with REACH).
- The animals.
- The equipment (not corrosive on galvanised feeder lines and fans, or aluminium drinker supports).
- The environment (biodegradable and therefore not containing heavy metals such as tin, silver).

Tested

By international standards such as the ENE (European Norms-Normes Européennes) and the American AOAC (Association of Analytical Chemists, that work with 5% organic load and in 400ppm hard water) rather than only national standards (such as DEFRA, DVG, Afnor) that have been or may be replaced by the ENE.

The disinfectant should be 'full spectrum' (with proven efficacy on bacteria, virus and fungi) and be tested against at least one HPAI virus strain.

This acronym (COST) is more relevant than the perceived cost: the price per litre (per gallon) The real cost is the cost in dilution, determined by the concentration and the synergy. ■

Fig. 3. The effect of increasing contact time on water consumption, labour and energy.