Are Water System Biofilms a Major flaw in Biosecurity Programmes?

Robert Wilson B.Sc. (Hons) W.M.Sco.

PEROXSIL Ag+

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Summary

Drinking water systems in poultry broiler houses could contain a biofilm, which can harbour dangerous pathogens that compromise the health of the chickens. Mortality is reduced and health greatly improved when this biofilm is removed.

A hydrogen peroxide based formulation containing silver, added continuously to drinking systems on 2 different poultry broiler house farms has produced consistent health improvements in the units where the treatment has been applied. This formulation removes and treats biofilm. The results of long term testing (6 crops) are tabulated in Table 1

Removal of biofilm and treatment of broiler house drinking water must be considered as a necessary part of any biosecurity programme. Experience indicates that water treatment using the formulation produces a return of up to 20 times the investment.

Introduction

Biofilms are thin films, which develop on the internal surfaces of most water systems. They can harbour dangerous pathogens, which breed and develop out of the main water flow. Biofilm growth is helped by poor water quality (systems fed from unclean header tanks are particularly vulnerable) and pipe work materials which provide nutrients. Plastic pipes, which transport water in most broiler houses, are particularly good for growing biofilms as temperatures within the house can be maintained at around 35°C for parts of the growth cycle

Biofilms, which develop best at broiler house temperatures, consist of bacteria, protozoa, and even viruses. The biofilms entrain salt and scale from the water and the secretions of the microorganisms (mainly polysaccharides)

The Danger of Biofilms

Dangerous pathogens like legionella, camphyllobacter, salmonella and even viruses present, as bacteriophage, can inhabit biofilms. These microbes can penetrate protozoa within the biofilm and breed to the point where the protozoa bursts and thousands of bacteria are released into the water flow.

Biofilms and Biosecurity

Water is a major input to a broiler house. A bird will drink twice the volume of feed during its lifetime. While growers will devote considerable resource to feed much less attention is paid to the quality of drinking water.

Some growers sanitise their water systems between crops. Our experience is that while this will have some effect on the biofilm it will not remove it completely and the biofilm can reform very quickly.

This lack of concern about water treatment may be because biofilm, its formation and its ability to harbour pathogens is poorly understood.
It may also be that there is no easy to use common chemical available, which can reliably treat and remove biofilm.

Over the past 2 years we have continuously treated livestock drinking water systems in poultry broiler houses with a silver catalysed stabilised hydrogen peroxide. These broiler farms each had 8 houses – the water supply to 4 houses on each farm was treated with stabilized silver hydrogen peroxide, the drinking water to the other 4 were not treated.
The trial was conducted over 6 crops - Within the first week of treatment starting there is generally a discharge of slime like material from the water system. This material can block drinkers and can result in time consuming unblocking of the water system. When all of the biofilm has been removed the water system thereafter produces water in the correct quantity and of the correct quality. Most farms where this continuous application has been applied realise an increased flow of water to all their drinkers.
It should be stressed that, at present, treatment is stopped for 24 hours prior to the addition of antibiotics, vitamins or milk powders through the system. We are investigating the stability of vitamins in the presence of the peroxide formulation.

The treatment produces healthier animals. In 2 successful poultry Broiler Houses (EFEP around 300) mortality was reduced by 1%. There was a 4% improvement in bird weight for each crop. (This was over a 12 crop-testing programme)

Efficacy of Treatment

The treatment chemical is a silver stabilised hydrogen peroxide. Unlike standard hydrogen peroxides the chemical is very stable and will only break down when it meets a microbiological challenge. While hydrogen peroxide is a weak biocide, our formulation is an effective biocide as the silver ion ensures that the normal defence mechanism (protein cloud) employed by bacteria against hydrogen peroxide is ineffective. The silver ion also improves the stability of the formulation. Our treatment formulation is effective against biofilm as it not only attacks it chemically in the way described above but also removes it physically by effervescing on the sidewall of the pipe.

The stabilised peroxide is easy to dose and is generally introduced in dilute form into the water flow using a pre-set Dosatron or peristaltic pump (if dosing into a header tank) The most common dosing set up is a Dosatron (fixed at 1%) sucking chemical from a 200litre drum of prediluted chemical.
The treatment is applied for the first week at a level of 150 ppm to ensure complete biofilm removal and then reduced to 30 ppm. The cost of treatment is 0.36 p per bird. The treatment reduces mortality and improves weight gain.

The treatment is suitable for drinking systems, which have either bell or nipple drinkers. On some farms initial dosing of the chemical removes a considerable

quantity of slime from the pipes and ideally the drinkers should be protected from a slug of solid microbiological mass coming down the line. In practical terms this slime tends to get caught behind the water regulating valve and can be removed easily When this slime has been removed the treatment ensures that biofilm formation will not recur.

Conclusions

1. While a lot of resource is spent on terminal disinfection and feeding regimes virtually no consideration is given to the development of a biofilm within the pipelines, which carry drinking water to growing farms.
2. A Hydrogen Peroxide formulation containing a silver, removes and treats the biofilm.
3. This treatment applied continuously to animal drinking water prevents a source of microbiological challenge from reaching the animals.
4. The result of the treatment is reduced mortality, healthier animals, less disease and a return on investment of up to 20:1

Appendix 1 Photographs Demonstrating Biofilm Removal

Photograph of pipe with valve containing well developed biofilm

Pipe following treatment with stabilised hydrogen Peroxide formulation

APPENDIX 1: SITE TRIAL CONDITIONS

Shed Type – Harlow
Birds in House at start of each crop – 25,000
Ventilation – 8 x24" fans on each side, 6 x24"fans on end
23 vents on roof (All fans and vents are manually operated)
Gas Heater (x2) Priva DA (Greenhouse type)

Shed Details

Length	70.1m
Width	18.29m
Total Area	1282.13m2
Maximum Stocking density	34kg /m 3
Feed Bins	2
Feed Bin Capacity	18 m_3
Feed Bin Type	Metal
Feeder Type	Pan
No of pans	355
Space Per bird (linear metre)	1.89
Drinker	Nipple
Number of Drinkers	1806
No of Birds per drinker	11.6
Brooding Method	Whole House

Table 1: Comparison of Results in Broiler Farm 1

Crop Number	EPEF	FCR	Average age	Bird Weight gain (g /day)	Mortality (%)	Comment
1992 Treated 1992 Untreated	- -	- -	49.5 48.9	119.2 116.8	3.4 4.4	Insufficient information to calculate
2000 Treated 2000 Untreated	310 281	1.81 1.98	49.6 48.8	116 113.6	3.5 3.7	
2008 Treated 2008 Untreated	304 290	1.91 1.98	49.5 50.4	114.2 114.3	3.3 5.7	Untreated Cock mortality high at 8.4%
2016 Treated 2016 Untreated	292 312	194 189	47.4 47.7	119 120	4.2 3.7	Spinal lesion problems in treated houses
At This point	it was	decided	to treat	all of	houses	on site
Crop no	EPEF	FCR	Average age	Average weight	Mortality (%)	Comment
2024 treated	314	1.86	47.03	2.8	3	Treatment introduced into all 8 broiler sheds
2032 treated	300	1.89	48	2.81	3	
2040 treated	320	1.84	46.5	2.77	2.8	
2048 treated	326	1.82	47.07	2.87	3.4	
2056 treated	299	1.91	47.9	2.78	3.1	Considered poor Compared with previous results – attributed to inferior egg quality

Table 2: Comparison of Results in Broiler Farm 2

Crop Number	EPEF	FCR	Average age	Bird Weight gain (g /day)	Mortality (%)	Comment
1985 Treated 1985 Untreated	325 316	1.85 1.88	48.9 49.05	121.7 110.8	2.35 2.95	
1993 Treated 1993 Untreated	311 n/d	1.88 n/d	48.7 50.8	119.1 114	2.7 3.75	Insufficient feed information to calculate EPEF and FCR
2001 Treated 2001 Untreated	316 295	1.86 1.94	48.6 49.2	117.3 115.9	2.2 2.4	
2009 Treated 2009 Untreated	314 313	1.84 1.9	47.4 47.7	116.5 115.4	1.65 1.75	
2017 Treated 2017 Untreated	322 298	1.88 1.94	49.25 48.3	120.8 119.8	1.65 1.85	

At This point	it was	decided	to treat	all of	Houses	on site
Crop no	EPEF	FCR	Average age	Average weight (kg)	Mortality (%)	Comment
2025 treated	320	1.87	46.8	2.85	1.8	Treatment introduced into all 8 broiler sheds
2033 treated	325	1.86	47.4	2.93	2	
2041 treated	316	1.87	46.3	2.81	4	Cock mortality high at 6% leading to poorer crop results
2049 treated	337	1.8	46.5	2.85	1.6	Possibly the best ever result on this broiler house

Notes

1. During the Initial trials of the chemical 4 houses (1-4) were treated with the stabilised silver peroxide and 4(houses 5-8) on an 8 shed site were not. The drinking water was treated initially with 150ppm for the first 2-3 weeks and the dose level was then dropped to between 30ppm and 50ppm.

2. Farm 2 has traditionally been better than Farm 1 in terms of EPEF and FCR.

3. Cost benefits were obtained from comparing mortality and weight gains between treated and untreated houses.