AHDB

Deep cleaning farm drinking systems

A shock water treatment guide

PORK

Contents

Water quality

Poor water quality can negatively affect pig health; factors such as the cleanliness of incoming supply water, poorly designed pipe extensions and aged pipework can all have an impact.

Where organic acids or other products, such as medication, are supplied via water, clean water is paramount for optimum product efficacy.

Water testing for microbiological contamination (e.g. total viable count (TVC), will provide an indication of water quality and its suitability for drinking and use as a mechanism for administering organic acids and medication.

Testing just after the borehole and at points along the system will identify which parts of the system need cleaning and to what extent.

Although header tanks are often a source of bacterial contamination, the problem may originate from an earlier point in the system, such as the primary or main pipe running through the farm.

For information on correct sampling techniques refer to AHDB's standard operating procedure (SOP): Water sampling for microbiology, minerals, flow rate and water temperature, and Water sampling for microbiology (farm assurance requirement). **www.youtube.com/watch?v=mZUOF147uc4**

Visual indicators of bacterial contamination include:

- Build-up of biofilm (slime) inside tanks, pipes and valves, or declining flow rate
- Water flow rate at the pipe can be extremely low at the end of the line of pressure is now sufficient or if substances such biofilm (slime) cause blockages
- The water at the end of line tends to be warmer than at the point of entry, which creates a favourable environment for biofilm (slime) to develop. This is where the contamination and infection risk will be the highest

For details, refer to the Water Regulations Advisory Scheme (WRAS) guidance, and for agricultural premises – Water Supply Systems: Prevention of Contamination and Waste of Drinking Water Supplies.

Water sourced from a private supply is often of varied composition and quality due to the source location and depth, water origin and other external influences. The responsibility for maintenance and repairs lies with the owner or user.

Microbiological contamination of water can occur at any point in the water supply system. This may be from bacteria, fungi, moulds, algae, viruses and parasites. Water systems carrying a high load of biofilm (slime) are likely to harbour many types of bacteria, often in large quantities, resulting in bacterial contamination of the water. This contamination builds up on the internal pipe surfaces.

Table 1. Acceptable drinking water parameters for livestock

Microbiological Measure	Acceptable Level
Total viable count (TVC)	<1000 CFU per ml
Coliform	<100 CFU per 100 ml

Source: Red Tractor Farm Assurance Pigs Standard, 2017

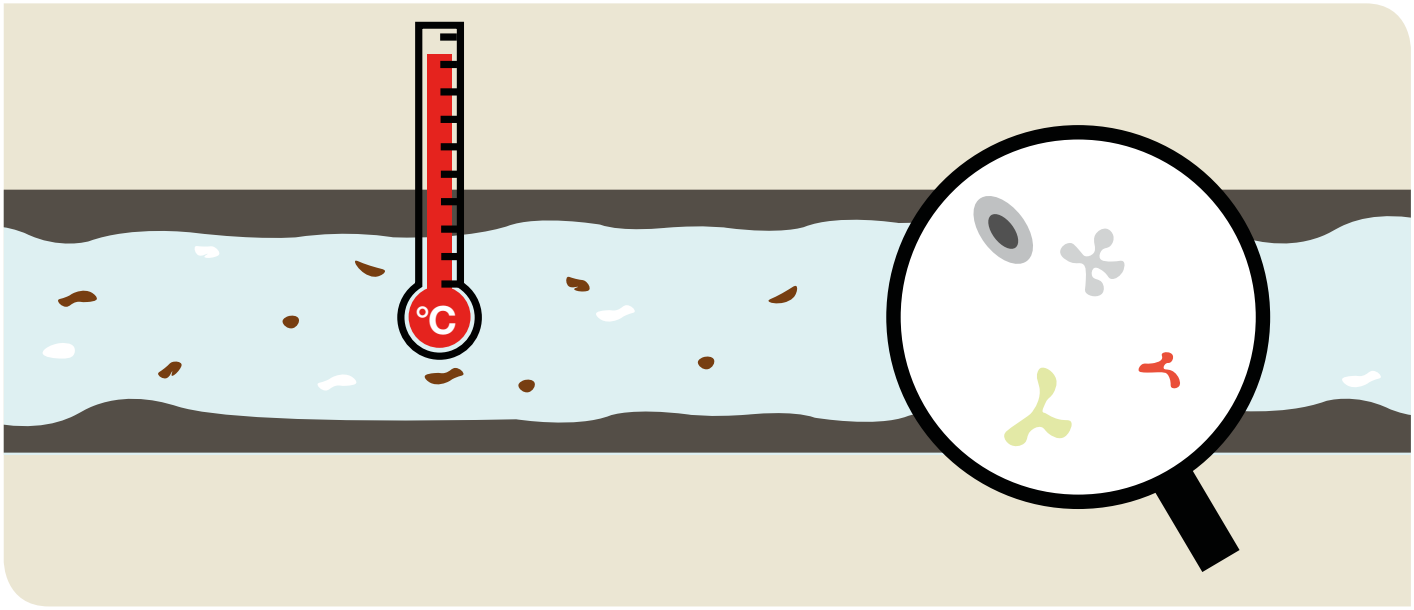


Figure 1. The formation and structure of biofilm

Figure 1 illustrates the formation and structure of biofilm (slime) as microorganisms adhere to the surface of a pipe. They then develop a framework that attracts and protects other types of unwanted microbes.

Figure 2. Biofilm build-up inside a water pipe after one batch of pigs

Protecting water supplies from bacterial contamination is critical to ensuring good water quality, but the build-up of biofilm will often occur (Figure 2) in untreated non-mains water, or where water can rest in pipes or tanks, especially in warm environments such as pig housing.

Once established, biofilms are difficult to eliminate. The growth of biofilms and bacterial contamination can be mitigated through correct sanitisation and cleaning methods. A deep clean (shock treatment) of the system will dislodge contamination and re-sanitise the system.

Biofilms can reduce antibacterial and disinfectant efficacy, leading to the persistence of infections in houses; surviving bacteria can reinfect pigs, or infect the next batch of pigs.

Treatment of water systems to remove biofilm (slime)

Microbes within the biofilm structure are more difficult to eliminate using chemical sanitisers than when present only in water.

Biofilm (slime) forms a coating and protects bacteria from disinfectants and have reduced antibacterial sensitivity, compared with those outside a biofilm compound.

The resistance of E. coli within a biofilm to treatment with chloride is 3,000 times more than when in water only.

For standard disinfectants to work effectively against target microorganisms, water needs to be relatively clean, with low organic matter levels and total dissolved solids (TDS) levels below 1000 UG per litre.

To dislodge biofilm and disinfect water systems, a shock treatment with a high concentration of a suitable chemical is recommended.

This process will dislodge material from pipes sufficient to block drinkers and ensures pigs continue to receive adequate water flow rates.

Shock dosing is suitable to treat specific areas of the unit, such as separate farrowing rooms and weaner areas, which are run on an all-in all-out basis, with treatment carried out during the empty period on isolated waterlines. This may form part of the routine room hygiene programme to ensure clean waterlines are maintained.

This treatment process will control, reduce and, in some cases, eliminate bacteria from water systems by dislodging material from the pipes.

This treatment should be carried out only when no pigs are present. Table 2 details the treatment methods used to control biofilm.

Always follow the suppliers' instructions and wear appropriate PPE, as indicated on the product label.

Use signs to indicate when a system is under treatment.

Table 2. Antimicrobial products that can be used to control biofilms, and the risk that biofilms pose to animal health

Biofilm type	Risk to animal health	Treatment
E. coli	High risk	Benzalkonium chloride, hexadecyltrimethylammonium bromide, sodium hypochlorite, peracetic acid, hydrogen peroxide, O-cresol, phenol
E. coli		Chlorine
Staph. aureus		Hydrogen peroxide, sodium dichloroisocyanurate, peracetic acid
L. monocytogenes		Chlorine, hydrogen peroxide, ozone
L. monocytogenes and Pseudomonas mixed biofilms	Medium risk	Chlorine, peracetic acid, peroctanoic acid
L. monocytogenes		Chlorine-alkaline solution, low-phosphate buffer detergent, dual peracid solution, alkaline solution, hypochlorite
B. cereus and Pseudomonas spp.	Low risk	Chlorine, chlorine dioxide, commercial detergent
B. cereus/P. flourescens single and mixed bioforms		Chlorine dioxide-containing sanitiser
P. putida		Sodium hydroxide, commercial alkaline cleaner
P. fluorescens		Glutaraldehyde, orthophtaldehyde, hexadecl trimethylammonium bromide, sodium dodecyl sulfate, chlorine solution, sodium hydroxide
P. fluorescens/ Acaligenes faecalis		Ozone, commercial chlorinated sanitiser
P. fluorescens, P. fragi and P. putida		Chlorine, ozone
Mixed species		Sodium hydroxide, nitric acid

Adapted from: Red Tractor Farm Assurance Pigs Standard, 2017

Shock water treatment

Shock treatment requires the entire system or network of pipes being treated to be exposed to a full dose of the chemical for a prescribed time, dependent upon the chemical being used. Always follow the supplier's guidelines.

Always refer to the individual supplier's instructions when using hazardous substances and ensure you are complying with company health and safety procedures. Appropriate personal protective equipment (PPE) must be worn and safety data sheets and COSHH data followed.

Shock dosing is most suitable for waterlines capable of being isolated from the rest of the system and areas of the unit that are managed on a batch basis, e.g. farrowing rooms and weaner areas, that are, at times, completely empty.

Farms or buildings operating on an all-in all-out basis provide an opportunity for treatment in the rest period.

The most common shock treatment method used in the UK is chlorination. If the product is administered correctly, it is a simple and inexpensive process, which successfully kills all bacteria in the pipe. Chlorination can be used to deactivate a variety of pathogenic bacteria in water, including those with health concerns, such as E. coli and *Staphylococcus* aureus.

Table 3. Benefits of using chlorine dioxide as an antimicrobial

Beneficial factors of chlorine dioxide
Effective over a wide pH range (4–10)
Less corrosive than simple chlorine chemicals
Effective at low dosing rates
Powerful oxidiser in water
Effective at removing biofilm in water distribution lines
Effective against Campylobacter
No formation of chlorinating by-products
Does not have the taste and odour issues of chlorine
Limits needs for antibiotics
Manages iron, manganese and sulphur bacteria

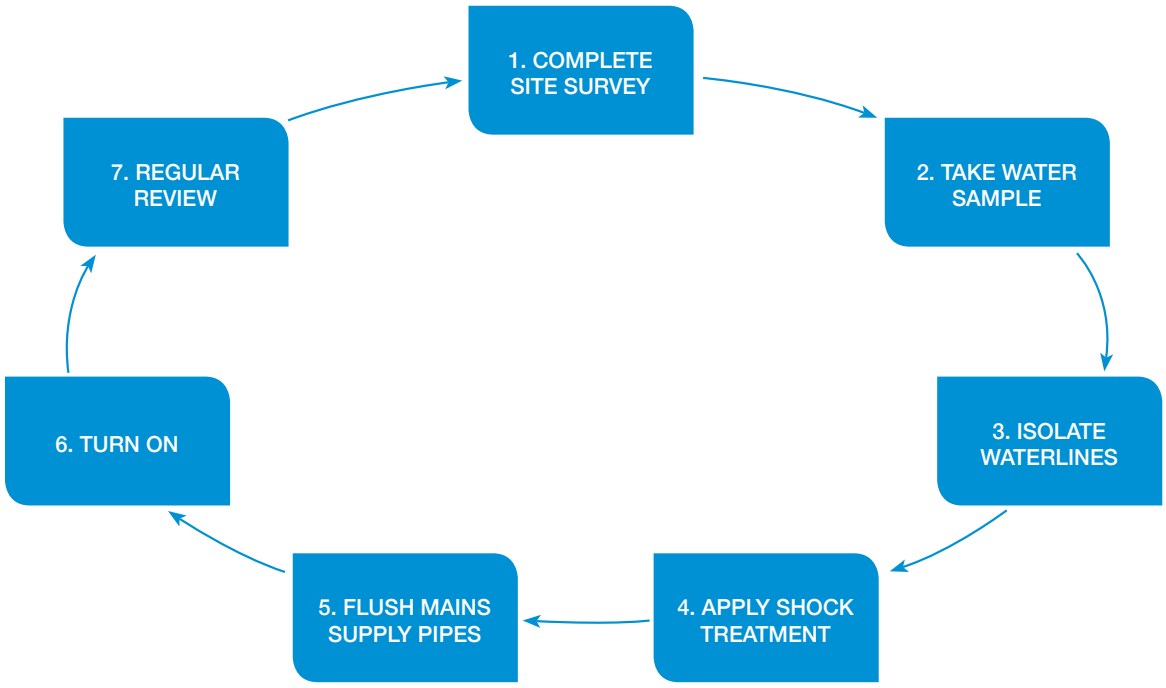


Figure 3. Example protocol for a shock water clean-up for an empty room

Example protocol for a shock water clean-up for an empty room

Header tank

1. Complete a site survey: Record the full layout of pipes from source to each drinker. Identify any dead ends, unused pipework or slow-flowing areas. This is the ideal time to familairise the operator with the nessesary training.
2. Take water samples: The frequency of testing the water is the most important factor to enable users to properly understand microbiological levels. Refer to AHDB Standard Operating Procedure (SOP): Water sampling for microbiology, minerals, flow rate and water temperature, or Water sampling for microbiology (farm assurance requirement).
3. Isolate waterlines and network preparation:

   A health and safety risk assessment must be conducted before cleaning tanks and systems. Working at height, working on pressurised systems and the need for PPE are particular areas to be assessed.

   Turn off, drain and disconnect the header tank. Inspect and pressure wash inside the tank and drain again to remove gross spoilage and sediment. Reconnect header tank and refill. Turn off supply to header and pipework again.
4. Apply shock treatment: Review material safety data sheets and COSHH data, and wear appropriate PPE.

   Handle pipes and treatment in accordance with good industrial hygiene and safety practice. Refer to AHDB Health and Safety for Pig Keepers.

   Fill header tank with suitable steriliser, at the correct concentration for the volume of water in the system following the manufacturer's advice. Suitability will depend on the degree of limescale or biofilm present. Refer to datasheets and seek professional advice from suppliers for the suitability of products for individual systems, also ensure all health and safety precautions have been considered.
5. Flush the system thoroughly: It is important to flush the main supply pipes, once the organisms have been dislodged or dissolved to remove them from the system.

   Empty the header tank of sanitiser. Flush the supply pipes at a high flow rate to help dislodge any biofilm. A flush valve at the end of the main line would aid in obtaining high flow rates through horizontal pipe runs. Large storage tanks should be emptied at least annually, if not after every batch, and sanitised, using a suitable water disinfectant, depending on the type and degree of contamination observed. Heavy sediments need to be physically removed from tanks.
6. Turn on water supply: Turn on water supply to header tank. Run clean water through the system to flush out the sanitiser. Check the system for leaks and that it holds water under pressure.
7. Review site and sample water regularly: A regular review of monitoring and treatment requirements is nessesary. Any change in sampling results should be kept on record for continuous planning.

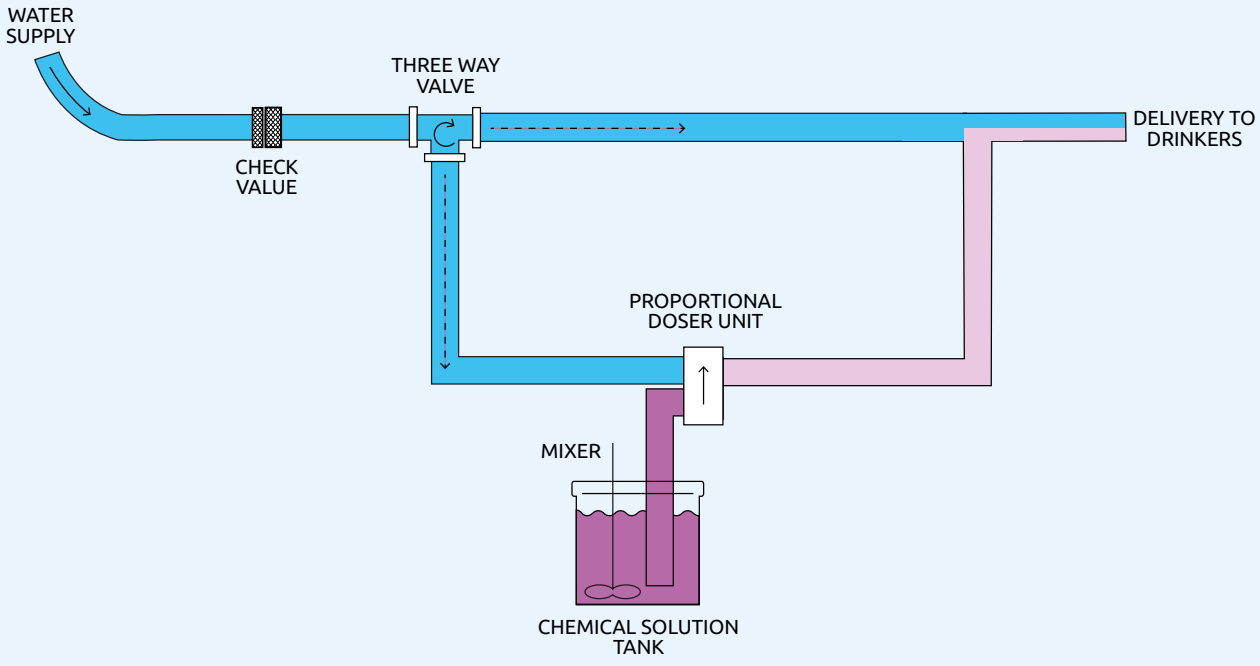


Figure 4. Water loop bypass system

Shock water treatment

Pressurised system

1. Complete a site survey: Record the full layout of pipes from source to each drinker. Indentify any dead ends, unused pipeork or slow-flowing areas. This is the ideal time to familairise the operator with the nessesary training.
2. Take water samples: The frequency of testing the water is the most important factor to enable users to properly understand microbiological levels. Refer to AHDB Standard Operating Procedure (SOP): Water sampling for microbiology, minerals, flow rate and water temperature, or Water sampling for microbiology (Farm assurance requirement).
3. Isolate water lines and network preperation: A health and safety assessment must be conducted before cleaning tanks and systems. Working at height, working on pressurised systems and the need for PPE are particular areas to be assessed.

   A permanent water loop bypass system is needed in each room. A proportional dosing pump should be installed to enable the recommended shock concentration of chemical steriliser to be added to the system. Turn off untreated supply to the empty room and drive the supply via pump. Install and prime the proportional pump.
4. Apply shock treatment: Review material safety data sheets and COSHH data and wear appropriate PPE.

   Handle pipes and treament in accordance with good industrial hygeine and safety practice. Refer to AHDB Health and Safety for Pig Keepers.

   Flush the main horizonal pipe with treated water. Fill each drop pipe and drinker/bowl/trough with treated water. Leave the system filled with sanitiser for a minimum of four hours, or according to manufacturer's instruction.
5. Flush the system thoroughly: It is important to flush the main supply pipes, once the organisms have been dislodged or dissolved to remove them from the system.

   Restore clean water supply. Flush pipes with clean water and check flow rate at each drinker. Ensure filter and or insert orafice at each drinker is free of debris.
6. Turn on water supply
7. Review site and sample water regularly: A regular review of monitoring and treatment requirements is nessesary. Any change in sampling results should be kept on record for continuous planning.

Always check individual supplier's instructions. Antimicrobial products of the same type can differ in product form, delivery method, frequency of treatments and concentrations between suppliers.

Consider seeking supplier's guidance or using another sanitising method if the building is in continual use, and waterlines cannot be isolated.

Key considerations for clean water management

Preventing the formation of biofilms

- Create a dry atmosphere in pig buildings by decreasing humidity, reducing leaks from pipes and improving poor drainage
- Ideally, pH correction would be achieved before sanitising pipes. Lowering the pH of the water can reduce growth of microbes. Bacteria such as E. coli and salmonella cannot survive at a pH lower than 4.5

Controlling biofilms

- Frequent sanitisation of the water system with a disinfectant, which also removes other organic matter, will remove the habitat suitable for biofilm growth
- Use ongoing appropriate filtration before disinfection. Multiple barriers will also allow some protection to remain, even if one process fails. No single method of treatment can be expected to remove all types of pathogens; a multiple barrier approach in the form of two or more sequential treatment processes is recommended
- Frequent monitoring and sampling of water quality would be advantageous in developing current, continued and future biofilm control methods

When shock treatment is recommended

- Implementation of any new drinking systems
- Every time a water distribution system is opened for repairs or maintenance
- Following any possible contamination, e.g. floodwater or surface run-off
- Between batches, when the room and water system remain unused for a small period of time
- Water systems that have not been cleaned for more than a year, where the risk of blockages and component failure is high

Operator understanding

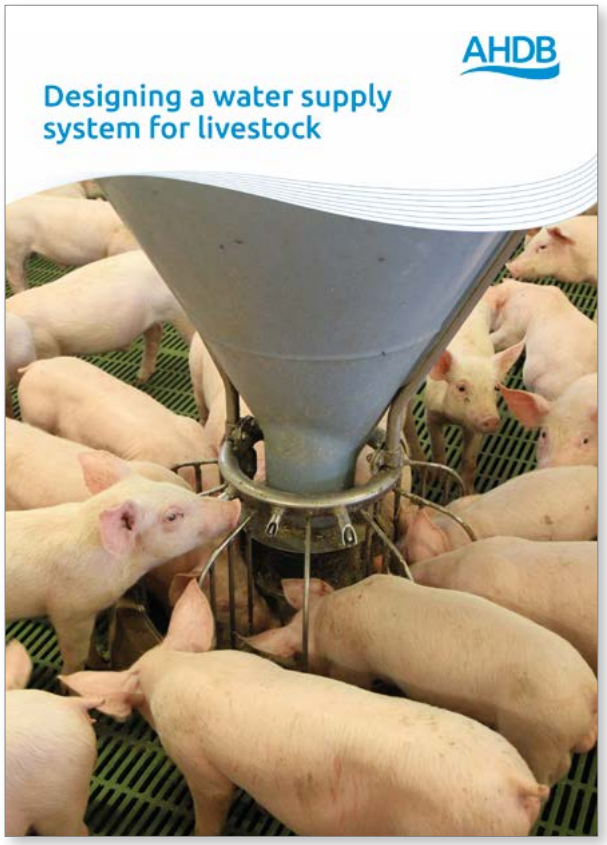
Poor operator understanding of the treatment method and control systems could negatively impact the effectiveness of sanitisation products. Seek advice from treatment suppliers, in line with water sample results. Ensure the operator has a good understanding of the Material Safety Data Sheets and COSHH data relating to individual products.

The Drinking Water Inspectorate (DWI) publishes a list of products and substances approved for use in the UK public water supply; this can be found at: **dwi.gov.uk/drinking-water-products/approved-products/soslistcurrent.pdf**

Ensure potential treatment suppliers are aware of the size and nature of the water supply. Operator understanding of the instructions of use, and ask supplier about any ongoing management and maintenance requirements.

Review the efficiency of infrastrucure to ensure pressure rates and minimum flow rates are achieved in accordance with the Defra Code of Recommendation of the Welfare of Livestock.

Refer to AHDB Designing a water supply system for livestock.



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