

Controlling Contamination in Water Treatment Equipment

Part 4

By Greg Reyneke, CWS-VI

There are several important areas to be addressed in an effective disinfection action plan.

Threat assessment

Assessing the level of bacterial contamination includes observing odor and appearance of contact surfaces, as well as plate culture, to determine presence of pathogens.

Physical cleaning

After the initial assessment, cleaning is the next step and must be thoroughly performed before applying disinfectant. Experts agree that cleaning alone can remove over 90 percent of bacteria from surfaces, significantly enhancing the efficacy of disinfectant compounds and minimizing chances of regrowth/colonization.

This initial cleaning step involves scrubbing, brushing and scraping to physically remove as much gross dirt, biofilm, debris and organic material as possible from all contact surfaces. Cleaning is also important since many disinfectants may be inactivated or ineffective in the presence of organic debris or waste.

Disposal of debris into dumpsters should only occur if there is no zoonotic risk of disease transmission. All personnel should wear appropriate protective clothing and footwear. If a zoonotic disease is suspected, enhanced personal protective equipment should be used according to National Institute for Occupational Safety and Health (NIOSH) protocol.

Surfactant wash

Washing or sanitizing further reduces the number of microorganisms in the area to a safer level. Educt an anionic or non-ionic surfactant into treatment equipment, allow sufficient contact time and then rinse vigorously to remove organic and other material. Although cleaning may appear to remove all debris, microscopic biofilm may remain on surfaces and interfere with disinfection efficacy.

Biofilm is a complex aggregation of bacteria adhering to surfaces in an exopolysaccharide matrix, resulting in a thin residue that could remain after cleaning. These bacteria are highly resistant to disinfection. Surfactant detergents, mechanical scrubbing, brushing and scraping during cleaning helps reduce biofilm. Adding phosphoric acid to the surfactant mixture can

The purpose of this series is to discuss factors to consider when developing and implementing an effective disinfection protocol. It includes chemicals used for disinfection, their advantages and limitations; steps for developing an effective disinfection protocol; and procedures for maintaining ongoing system cleaning and disinfection. Part 4 of this series deals with developing a disinfection action plan.

be quite efficacious in reducing biofilm accumulation.

Multiple bed volumes of fresh water should be rinsed through the system to ensure complete removal of surfactants and contaminants. Some disinfectants can be inactivated by soaps and detergents.

Disinfection

Selection of the proper disinfectant will depend on the microorganism suspected, as well as environmental factors and safety issues. Always read the entire product label and follow dilution instructions explicitly to ensure the safest, most effective concentration is applied.

To achieve effective disinfection, surfaces must be thoroughly wet and clean; properly mixed disinfectant should be applied at a rate of 0.1 to 0.4 L/minute (0.1 to 0.42 quarts) or according to manufacturer specifications. Dilution ratios of disinfectant will vary according to type of disinfectant and the specific application.

Disinfectant should remain for the appropriate contact time, which will vary with the product and particular application. Equipment should be thoroughly rinsed before returning the system to service.

Evaluation

To verify that all pathogens have been destroyed or reduced to acceptable levels, a follow-up evaluation of the equipment should be conducted. While visual inspection of cleanliness is important, bacteriological samples should be obtained to determine the true effectiveness of the cleaning and disinfection protocol.

Failure of a disinfection program usually results from the selection of an ineffective disinfectant, careless use of an effective disinfectant or environmental factors, such as water hardness, heavy metals, pH, additional contaminants and water temperature. The timing of sample collection is important.

The best time to sample is two to three days after disinfection. Surface samples for small, smooth areas can be collected by wiping or swabbing a sterile swab across a non-porous surface. Commercially available methods include RODAC™ and Petrifilm™ Plates (3M).

These small, flat, sample-ready plates allow on-site microbial testing and are commonly used for food processors. They are

available for a variety of specific microorganisms or classes (aerobic count plates, coliform count, environmental *Listeria*, etc.) as well as yeast and mold counts and can also be used for direct-contact or swab applications.

Other methods of environmental sampling include surface samples collected by ultrafilter membranes. Each step of the disinfection action plan (assessment, cleaning, washing/sanitizing, disinfection) should be evaluated for problems encountered and usefulness or efficiency of the cleaning or disinfection techniques.

Sample disinfection protocol #SP-5000

Every location is different, with varying water-usage patterns and expectations of water quality. The annual service and disinfection model is clearly deficient, so service intervals should be based upon the aggregate amount of hardness and other inorganics processed by the system.

Many industry experts agree that a system should be serviced and completely disinfected after processing approximately 1,000,000 grains or at least every 12 months, whichever is sooner. Disinfection frequency should be increased if there is any suspicion that the influent water supply is not microbiologically safe.

Industry standard employee safety precautions should always be taken before implementing this or any other disinfection protocol.

While every possible effort has been made to ensure the efficacy of this protocol, you are still ultimately responsible for the microbiological safety of the equipment in your facility. You should completely familiarize yourself with the advantages, disadvantages and liabilities of this or any other protocol before applying it. Proceed with caution at your own risk.

References

(for all four parts of the series)

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Disinfection of contaminated water treatment equipment

Quantities, types and concentrations as per manufacturer instructions

Chemicals required

- Anionic surfactant concentrate
- Detergent
- EDTA
- Deionized water
- Concentrated biodegradable disinfectant

Tools required

- Appropriate protective equipment (eye protection, respirator, gloves)
- Mechanical scrubbing apparatus
- Approved waste disposal materials

Procedure

- Discard all salt from regenerant tank in an environmentally friendly manner.
- Disconnect regenerant tank and scrub until clean with detergent until residue is removed.
- Rinse detergent from regenerant tank in an appropriate manner with clean water.
- Apply concentrated detergent to all contact surfaces in regenerant tank.
- Allow detergent to remain in contact with regenerant tank for at least 20 minutes.
- Rinse regenerant tank with clean water.
- Replace all regenerant tank tubing and fittings and reconnect to system.
- Safely bypass and depressurize water treatment system.

Periodic disinfection procedure

Quantities, types and concentrations as per manufacturer instructions

Chemicals required

- Anionic surfactant concentrate
- Detergent
- EDTA
- Deionized water
- Concentrated biodegradable disinfectant

Tools required

- Appropriate protective equipment
- Mixing apparatus

Procedure

Surfactant injection

- Mix surfactant and deionized water to appropriate concentration and volume.
- Educt 0.1 bed volumes of surfactant solution into pressure vessel.
- Allow five minutes of contact time.
- Rinse at least two bed volumes or until no surfactant residual remains.

EDTA injection

- Educt 0.1 bed volume of EDTA into

- Open pressure vessel and inspect for evidence of bacterial overgrowth.
- If evidence of overgrowth is found, all media should be discarded.
- Reassemble pressure vessel and pressurize with clean water.

Surfactant injection

- Mix surfactant and deionized water to appropriate concentration and volume.
- Educt four bed volumes of surfactant solution into pressure vessel.
- Allow 10 minutes of contact time.
- Rinse at least eight bed volumes or until no surfactant residual remains.

EDTA injection

- Educt 0.5 bed volume of EDTA into pressure vessel.
- Allow five minutes of contact time.
- Rinse at least four bed volumes or until no EDTA residual remains.

Disinfectant injection

- Mix disinfectant and deionized water to appropriate concentration and volume.
- Educt two bed volumes of disinfectant solution into pressure vessel.
- Allow 60 minutes of contact time.
- Rinse at least four bed volumes or until no disinfectant residual remains.

Testing and evaluation

- Swab inside of regenerant tank and culture as per instructions.
- Draw sample of effluent water and culture as per instructions.

pressure vessel.

- Allow five minutes of contact time.
- Rinse at least two bed volumes or until no EDTA residual remains.

Disinfectant injection

- Mix disinfectant and deionized water to appropriate concentration and volume.
- Educt 0.25 bed volumes of disinfectant solution into pressure vessel.
- Allow 10 minutes of contact time.
- Rinse at least two bed volumes or until no disinfectant residual remains.

Prophylactic application of disinfectant

- Mix disinfectant and deionized water to appropriate concentration and volume.
- Add disinfectant solution directly to regenerant tank.
- Initiate delayed regeneration/cleaning of water treatment equipment.

NOTE: Surfactant, EDTA and disinfectant can be blended together to improve on-site efficiency if performed within manufacturer's specifications and according to industry best practices.

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