Detecting and Managing Protozoa

QUICK FACTS

- Protozoa are a diverse group of microorganisms that live in soil and water
- Most protozoa are not harmful to humans
- Those protozoa that are pathogenic, such as *Giardia lamblia*, *Cryptosporidium*, *Naegleria fowleri*, and *Acanthamoeba*, are of great concern to the water industry
- Removing or inactivating protozoa is possible throughout the water treatment process

OVERVIEW

Pathogenic protozoa can originate from various sources. *Giardia* and *Cryptosporidium* are excreted by infected humans and other animals. *Naegleria fowleri* and *Acanthamoeba* occur naturally in surface waters.

Protozoa may enter the distribution system through failing or compromised infrastructure or inadequate treatment processes. Once in the distribution system, microbes can attach to pipe surfaces and form biofilms, which can protect them from disinfection and allow proliferation. Protozoa can also flourish in the premise plumbing of residences, hotels, and other buildings, including in hot water heaters and cooling systems.

People may be exposed to protozoa through fecal-oral contact, inhalation of aerosols, nasal penetration, or prolonged contact with eye tissue. Health impacts of protozoa infections range from mild gastroenteritis to severe diarrhea, respiratory disorders, and vision impairment. In most cases, protozoa do not cause serious illnesses. However, children, the elderly, and people with weakened immune systems may experience more severe effects and in some cases, exposure to *Cryptosporidium* or *Naegleria fowleri* can be fatal.
MICROBIALS | PROTOZOA

Methods are not equally effective for all protozoa, as many species can protect themselves by forming cysts that are resistant to certain disinfection techniques. It is important to assess the source water in order to develop a multiple-barrier strategy that sufficiently safeguards against specific microorganisms. Methods include the following:

Conventional Coagulation and Filtration
Because of their relatively large size, many protozoa are removed through these methods. However, incoming water quality and filter condition significantly affect removal. Some protozoa, Microsporidia in particular, are not significantly removed through the filtration/coagulation process.

Microfiltration and Ultrafiltration
Both can provide acceptable removal of Cryptosporidium and Giardia.

REGULATION OF MICROBIALS IN DRINKING WATER

Surface Water Treatment Rule (SWTR)
This Environmental Protection Agency (EPA) rule applies to all systems that use surface water or groundwater under the direct influence of surface water (GWUDI) and requires the physical removal of microbial contaminants by filtration. The purpose of this rule is to prevent waterborne diseases caused by microbes such as Giardia lamblia. This rule requires having sufficient treatment to reduce the source water concentration of Giardia lamblia by at least 99.9 percent. Additionally, a disinfectant concentration of ≥0.2 mg/L must be present at the entry point to the distribution system, and a disinfectant residual must be detectable at all other points in the distribution system.

Long Term 2 Enhanced Surface Water Treatment Rule (LT2/ESWTR)
This EPA rule supplements the SWTR, addresses Cryptosporidium treatment requirements for higher risk systems and prohibits uncovered finished water storage facilities. The rule applies to all surface water and GWUDI systems and requires 99.9 percent inactivation or removal of Giardia and 99 percent inactivation or removal of Cryptosporidium.

State of Louisiana Emergency Rule in Response to Naegleria fowleri Detections
In September and October 2013, Naegleria fowleri was detected in two drinking water systems in different parishes of Louisiana. In response, the State of Louisiana issued an emergency rule in November 2013 requiring mandatory disinfection at elevated levels and increased monitoring of disinfection residuals.

INACTIVATING AND REMOVING PROTOZOA
Filtration and coagulation can physically remove protozoa from water, while disinfection, such as chlorination, chloramination, ozonation, and UV radiation, can inactivate them. However, these methods are not equally effective for all protozoa, as many species can protect themselves by forming cysts that are resistant to certain disinfection techniques. It is important to assess the source water in order to develop a multiple-barrier strategy that sufficiently safeguards against specific microorganisms. Methods include the following:

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**Chlorine and Chloramines**
Both are effective at inactivating many microorganisms, including some protozoa. However, inactivation is dependent on pH, temperature, disinfectant concentration, contact time, and optimization for specific microorganisms. *Cryptosporidium* is particularly resistant to chlorine disinfection and typically requires additional treatment.

**Ultraviolet (UV) Radiation**
This is considered an effective component of the multi-barrier approach to control microorganisms in drinking water. UV can be categorized at Low Pressure (LP), Medium Pressure (MP), and High Pressure (HP). Currently, the majority of the UV applications are LP with dosages typically around 40 mJ/cm² for 3- to 4-log inactivation of most waterborne microorganisms. *Cryptosporidium* cysts are effectively inactivated under these conditions.

**Ozonation**
This can inactivate most protozoa, including *Cryptosporidium* and *Giardia*. However, temperature is a critical factor in the efficacy of ozonation; therefore, it may not be suitable in colder climates, especially for *Cryptosporidium*.

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**REFERENCES**


REFERENCES (CON’T.)


