CRYPTOSPORIDIUM and GIARDIA

FACT SHEET

See related Fact Sheets: Acronyms & Abbreviations; Glossary of Terms; Cost Assumptions; Raw Water Composition; Total Plant Costs; and WaTER Program.

1. CONTAMINANT DATA

A. Chemical Data: *Cryptosporidium parvum* (crypto) and *Giardia lamblia* (giardia) are waterborne, pathogenic, parasitic, single-celled, animal-like organisms called protozoa. Both species are resistant to adverse environmental factors and can survive months under optimum environmental conditions, and are resistant to minor exposure to disinfectants.

B. Source in Nature: Crypto and giardia are naturally occurring in the intestines of most mammals, including humans. The highly contagious and infectious form, as found in water, is a hard-shelled cyst in the case of giardia, about 5-8 microns in diameter; and an oocyst for crypto, about 3-5 microns (which is pliable and capable of folding to 1 micron). Once ingested by a host, the hard shell is dissolved, releasing the organisms. Both then reproduce in the intestines, and form new cysts/oocysts which are passed from the body in the feces. Both are found in water contaminated by mammal feces. Surface (most common) and groundwater contamination can occur as a result of surface runoff through urban areas, woodlands, pastures, or feedlots; on-site septic tank/sewage disposal system leakage/failure; sewage treatment plant/disposal system overload or malfunction; or raw sewage deep well injection. Treatment plant process contamination can occur as a result of filter breakthrough; improper coagulation; use of recycled, concentrated backwash water; process overload; or improper maintenance. Distribution system contamination can occur as a result of cross-connection, broken or leaking waterlines, or back-siphonage.

C. SDWA Limits: TT MCLG for crypto and giardia is 0 cysts/oocysts per 100 mL sample of finished drinking water, using the Presence/Absence rule procedures for indicator organisms. Future amendments to the SDWA, and related rules, will further regulate contamination limits, and monitoring, detection, and enumeration methods.

D. Health Effects of Contamination: Cryptosporidiosis and Giardiasis are contagious waterborne diseases characterized by acute gastrointestinal illness, including diarrhea and abdominal discomfort; fever; weight loss; malabsorption; or anemia. Although not life threatening to healthy adults, both diseases can be fatal to infants, the elderly, pregnant women, and immunocompromised persons. Both diseases are transmitted through fecal-oral ingestion of the cysts/oocysts, through direct ingestion (i.e. drinking), primary contact recreation (i.e. swimming), or secondary contact (i.e. fishing).

2. REMOVAL TECHNIQUES

A. USEPA BAT: For community surface and groundwater (under the direct influence of surface water) systems, treatment technique is applied. In this case, the accepted TT is use of the conventional treatment processes of screening, coagulation and flocculation, clarification, filtration, and disinfection. Benefits: proven; reliable. Limitations: initial investment.

B. Alternative Methods of Treatment: Both species are generally resistant to most chemical disinfectants, like chlorine or iodine, at usual treatment doses, contact times, and other parameters (temperature, pH, etc.). Temporary, short term super chlorination (or iodine disinfection) with increased doses and contact time can be effective. UV and ozonation can be effective at controlled flows, high doses, and extended contact times. Distillation is effective. Commercially available microfilters are effective, but require careful operation and maintenance. Crypto can be removed by NSF approved filters which capture particles of less than 1 micron, and giardia can be removed by NSF approved filters which capture particles of 4 micron or less. The FDA recommends use of a 1 micron medical grade filter to remove both. Improving well casing/sealing or drilling deeper wells can improve groundwater quality. Boiling water for 1 minute (5 minutes at higher elevations) is the traditional POU treatment method. Bottled water may be used, although is not regulated for testing for microbial contaminants. Raw water quality can also be improved through complex planning of waste treatment/disposal methods, public watershed, and land management, especially during periods of high precipitation or heavy runoff.

C. Safety and Health Requirements for Treatment Processes: General industry safety, health, and self protection practices for process equipment should be followed, including proper use of chemicals and tools. When dealing with waterborne diseases, take precautions to prevent infection through open cuts/wounds, or illnesses from ingestion. Wear PPE and wash hands thoroughly.

3. BAT PROCESS DESCRIPTION AND COST DATA

General Assumptions: Refer to: Raw Water Composition Fact Sheet for ionic concentrations; and Cost Assumptions Fact Sheet for cost index data and process assumptions. All costs are based on *ENR*, PPI, and BLS cost indices for March 2001. General sitework, building, external pumps/piping, pretreatment, or off-site sludge disposal are not included.

Bureau of Reclamation, Technical Service Center
Water Treatment Engineering and Research Group, D-8230
PO Box 25007, Denver CO 80225 (303) 445-2260

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3A. TT:

Process - For community surface and groundwater (under the direct influence of surface water) systems, conventional treatment techniques, including presedimentation or screening, chemical coagulation and flocculation, final settling or clarification, filtration, and disinfection ensure protection of both surface and groundwaters prior to entering distribution systems. These TTs work to remove and inactivate pathogens before they enter the distribution system. Not all processes are required in every case, so actual process selection depends on careful review of overall raw water quality and characteristics. Presedimentation or screening consists of removing the largest/heaviest suspended solids from the raw water. Chemical coagulation and flocculation consists of adding a chemical coagulant ($Al_2(SO_4)_3$ and polymer) combined with mechanical flocculation to allow fine suspended and some dissolved solids to clump together (floc). Costs presented below include alum (230 ppm) as the coagulant, rapid mix for 30 seconds, and flocculation for 30 minutes. Final settling or clarification consists of settling of the floc matter. Filtration consists of final removal by dual media filtering (or membrane) of all floc; suspended; and, based on filtration method/size, most dissolved solids, including pathogens. These TTs result in lowering overall TSS/TDS and turbidity, which in turn allows greater disinfection contact time on remaining pathogens. Disinfection consists of chemical inactivation (killing) of pathogens, bacteria, and viruses, usually by chlorination. As a result of crypto/giardia occurrences, investigations into the effectiveness of various water treatment processes for oocyst/cyst removal/inactivation are continuing.

Maintenance - Proper monitoring, operation, and maintenance procedures, especially of the final filter, are essential to ensure the reliability of these TT processes. Recycled filter backwash or membrane cleaning methods may concentrate oocyst/cysts and result in a significant source of increased turbidity and crypto/giardia infestation. As a result, a period of filter-to-waste flow may be required after post-backwash/membrane cleaning periods. Because turbidity removal can parallel oocyst/cyst removal, finished water turbidity monitoring (<0.5 NTU) may be a useful tool for indicating the degree of pathogen removal. Depending on filtration process, recharging or clean installation of media is required.

Waste Disposal - Pretreatment waste streams and spent filters or filter material require approved disposal.

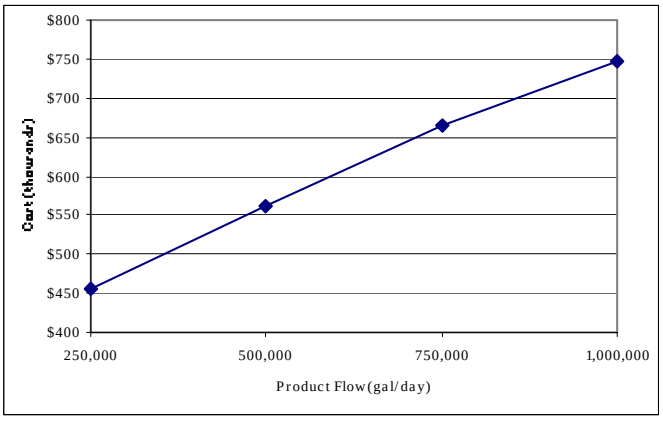
Advantages -

- Well established and reliable.
- Low operator requirements.

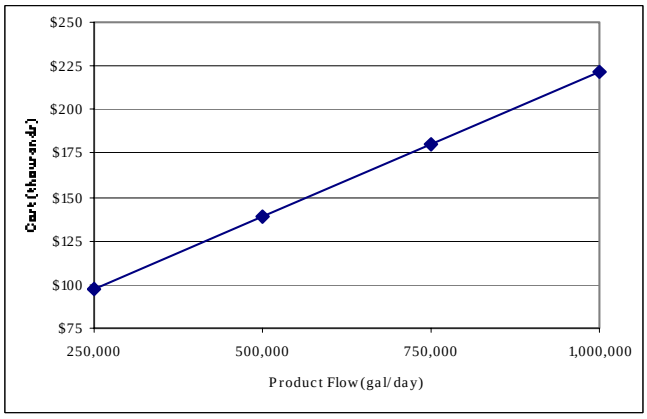
Disadvantages -

- Costly initial investment and land intensive.
- Lack of accepted testing and monitoring techniques may cause confusion.

BAT Equipment Cost*



BAT Annual O&M Cost*



*Refer to Cost Assumptions Fact Sheet. Does not include general sitework, building, external pumping/piping, pretreatment, or off-site sludge disposal.