DOWNLOAD PDF EVALUATION OF SIX METHODS TO ESTIMATE GIARDIA INACTIVATION

Chapter 1 : Predicting The Inactivation Of Giardia Lamblia A Mathematical and Statistical Model

Step 3: Calculate Giardia lamblia log inactivation Step 3-A: Determine CT required for Giardia lamblia 3 log reduction Determine Giardia CT from CT Table given Temperature = Â°C, pH = 6 s.u., Free chlorine residual = mg/L.

Full-scale implementation of the Cl2-NH3 process allowed an increase in ozone exposure level from 3. The increased exposure level is important as drinking water utilities strive to meet more stringent drinking water regulations such as Cryptosporidium inactivation. EPA is considering segregated flow analysis as an alternative calculation method to determine Cryptosporidium parvum inactivation credit in continuous-flow ozone contactors in drinking water treatment facilities. A computer method is presented in which C. In a series of computer simulations using typical ozonation conditions in a water treatment facility, inactivation predicted assuming complete segregation was 0. CFSTR-in-series model predictions of inactivation were between those of segregated flow analysis and micro-mixed analysis. It was concluded that segregated flow analysis calculations may result in significant over-prediction of C. A Semi-Batch C t Protocol for Natural Waters Preview Experiments were undertaken with the primary objective of developing kinetic relationships for the formation of cyanogen chloride CNCl , which could then be integrated into a multi-constituent water quality model. The use of ozone in combination with monochloramine has been reported in the literature to enhance CNCl formation. A procedure to determine C t, a surrogate used to estimate the level of microbial inactivation achieved, was also developed using a semi-batch methodology. A series of specific steps were then followed to simulate treatment at the Mannheim WTP as closely as possible at bench-scale. Three different levels of microbial inactivation were selected to simulate 0. Kinetic relationships were developed which described CNCl formation as a function of log Cryptosporidium inactivation, monochloramine concentration, and time. It was concluded that CNCl formation followed an exponential function of time that depended on both monochloramine concentration and microbial inactivation level. Volume 22 - Mathematical Modeling of Theoretical Cryptosporidium Inactivation in Full-Scale Ozonation Reactors Preview Conditions for theoretical inactivation of Cryptosporidium by ozone could be achieved at full-scale facilities if their design is appropriate. This paper discusses the basic equations the estimation of the disinfection efficiency of different ozone reacting systems. Available kinetic data have been integrated in a global model accounting for the hydrodynamics and mass transfer performances of the ozonation reactor. Thus the proposed method allows one to predict Cryptosporidium inactivation level in a given ozonation system. However, if a specified disinfection goal is to be achieved for Cryptosporidium with the developed model it is also possible to choose and optimize the design of the ozone reactor. Experiments were conducted in mL of 0. Animal infectivity using neonatal CD-1 mice was used for evaluation of oocyst viability after treatment. An ozone Ct product final residual and contact time product of 7. This was about one-third to one-fifth of that observed at room temperature using a similar Ct product. The above information is from http:

Chapter 2 : Use of Cobalt Irradiation for Inactivation of Protozoan Cysts - AUBURN UNIVERSITY

The C't values necessary to achieve % inactivation of Giardia cysts by various disinfectants and under various conditions are specified in EPA's SWTR, and C't values recommended for filtered systems, depending on the appropriate level of inactivation, are specified in the Guidance Manual associated with the SWTR.

Oysters contaminated with protozoan parasites have been reported from the Eastern coast of the U. It is proposed to evaluate microscopy based and PCR methods to determine the most sensitive technique for detecting parasites in laboratory contaminated shellfish and further compared using samples collected through surveys of the US East coast areas where protozoan contamination of oysters was previously reported. Surveys will also be performed in Peru, a Latin American country that exports shellfish and crustaceans into the U. These surveys will include the assessment of several environmental variables as predictors or indicators of contamination, such as season of the year, average monthly temperature and precipitation, ocean temperature and water salinity and turbidity. Inactivation of protozoan parasites will be evaluated using three shellfish sanitation procedures and disseminate the information with members of the shellfish industry and food safety community via workshops printed material and seminars. Project Methods The objectives of this project will be accomplished by: Evaluation of current isolation and detection methods of Cryptosporidium, Giardia, Toxoplasma, and Cyclospora in laboratory contaminated oysters. Survey shellfish at the points of harvest and sale to assess the presence of parasites and their viability. Validate the most efficient isolation and detection methods using samples collected from surveys of the Chesapeake Bay and the Georgia coast, and overseas. Evaluation of sanitation methods for reducing microbial loads in shellfish at high and low temperatures. Information gathered in this investigation will be disseminated through a yearly summer workshop to educate food safety professionals, shellfish producers or students to be held at the Center for Food Safety, University of Georgia. Establish an outreach program to disseminate information to producers and harvesters of shellfish on parasites associated to shellfish contamination and establish a training program for visiting scientists. A bilingual web site will be implemented with practical information about parasites in oysters. Shellfish have long been associated with foodborne illness; particularly when they are ingested raw. Bacterial and viral infections have been often identified, raising questions about the implications to public health. Protozoan parasites can be concentrated by oysters and have been described in oysters of the Eastern coast of the U. This study examines the presence of Cryptosporidium, Giardia, and Cyclospora. Shellfish hemolymph and meat washes are being examined by fluorescence microscopy and by PCR for identification of these parasites. These samples were grouped in 35 shellfish pools; one of the clam pools had Cryptosporidium hominis. One thousand two hundred and twenty four shellfish samples were examined for the presence of Cyclospora, Cryptosporidium, and Giardia. Of these 16 were positive for Cryptosporidium, 7 for Giardia, and 15 for Eimeria. Of the 12 positive for Cryptosporidium, three were from the Georgia coast sites and corresponded to the summer months. Of the Giardia samples, one was from the GA coast and 6 from the markets. Five were identified during the month of December and 2 during the months of May and July. Eimeria was identified in 9 GA coast samples and 6 from the markets. Of the Giardia positive samples, all were from oysters, whereas for Cryptosporidium 10 were identified in oysters and 6 in mussels. In addition to the parasitological examination, bacterial pathogens were also examined. Vibrio cholerae and Shigella were isolated during the summer from 3 of the 4 counties, and V. Other Vibrio species were also isolated. Aeromonas was isolated only during the summer sampling. Traditional food safety training activities are mostly focused on bacterial pathogens. Training which includes viral and parasitic pathogens are not widely provided. This project developed a workshop directed to scientists from academia and federal and state agencies. Parasitic and viral pathogen information was provided. Cryptosporidium-inoculated oysters were incubated at C for 1 and 7 days, C for 12 and 24 hr. At the end of this incubation period, oocysts were not infectious to neonate mice. Inactivation studies using larger number of oocysts are needed to conclude that temperature inactivation is an

effective alternative for parasite inactivation in shellfish. The globalization of food safety has raised several issues, particularly since most of the shellfish consumed in the US is imported. This project included the training of visiting scientists in the diagnostic tools available for foodborne pathogens, particularly in shellfish. They assisted with shucking shellfish. Fed and maintained oysters in tanks, and checked water quality. The technician was involved in shucking oysters and mussels, removal of meat and gills. She also isolated parasites from shellfish and assisted graduate student to determine viability studies in mice. Scheduled shellfish harvest, processing and purification of organisms. She tested shellfish for bacterial pathogens. Examined the effects of thermal inactivation of parasites when experimentally inoculated on and in oysters. Molecular testing for parasites in shellfish preparations. Positive samples were further characterized. The parasitology laboratory tested pooled samples for the presence of Cryptosporidium. This workshop was directed to federal and state laboratory scientists in food safety. Impacts Shellfish sold for human consumption and from the Georgia coast were surveyed for the presence of parasitic and bacterial pathogens. Parasitic and bacterial contaminants were identified. It is necessary to continue these studies, particularly in countries where shellfish is being produced and imported to the U. It is also necessary to determine whether these pathogenic parasites are viable in shellfish and infectious to susceptible hosts. Environmental factors influencing survival of Cyclospora cayetanensis. Protozoan parasites have been demonstrated to be concentrated by oysters from the Eastern coast of the U. Surveys of oysters and mussels sold for human consumption at farmers markets are being examined for the presence of Cyclospora, Giardia, Cryptosporidium, and Toxoplasma. In this study over two thousand samples were collected. Some were collected from coastal areas of Georgia and others from markets where shellfish are being sold for human consumption. Shellfish hemolymph and meat washes are being examined by fluorescence microscopy and by PCR for identification of these four parasites. Of a set of samples, by IFA, 10 were found to be positive for Cryptosporidium and 4 were positive for Giardia. The samples with Cryptosporidium were obtained from 5 of 9 markets surveyed, Giardia was found in 3 of 9 markets surveyed. In a second sampling, 3 samples were positive for Cryptosporidium from 2 markets and Giardia from one sample from one market. Of the samples collected from the Georgia coast, 3 samples of 2 locations were positive for Cryptosporidium and one with Giardia. Positive samples are currently being genotyped. In addition to the parasitological examination, bacterial pathogens have also been examined. Other Vibrio species have also been isolated. Serotyping of these bacterial isolates is pending. A workshop to disseminate and inform on parasites in shellfish was presented and attended by scientists from academia and federal and state agencies. Impacts Shellfish sold for human consumption and from the Georgia coast have been surveyed for the presence of parasitic and bacterial pathogens. Parasitic and bacterial contaminants have been identified and are currently being assessed to determine the public health significance of these findings. Shellfish have also been considered as biological markers of water contamination. Surveys of oysters and mussels sold for human consumption at farmers markets are been obtained quarterly. These samples are being examined for the presence of Cyclospora, Giardia, Cryptosporidium, and Toxoplasma. Cryptosporidium and Giardia have been isolated from these oysters and are been characterized. Oysters from 4 Georgia counties in a total of 23 sites were collected quarterly. Oyster collection will continue during in order to have a two year surveillance analysis. These samples are being examined for the presence of parasites. After these samplings are completed, bacterial and parasitic contaminants will be examined in association with environmental variables as predictors or indicators of contamination; such as season of the year, average monthly temperature and precipitation, presence of wild and farm animals, ocean temperature and water salinity and turbidity. Inactivation of protozoan parasites in shellfish is being evaluated using freezing temperatures. Half oyster shells were inoculated with C. These four treatments rendered non infectious C. As part of the extension component of this project, one scientist participated in the visiting scientist program at the University of Georgia where the scientist gained experience working with parasites. A workshop to disseminate and inform on parasites in shellfish has been presented and attended by scientists from academia and Federal and state agencies. Impacts Shellfish from the Georgia Coast is being monitored for the presence of parasitic and

bacterial pathogens. The safety of Georgia shellfish will be determined as well as the coast water quality. Surveys of oysters and mussels sold for human consumption at farmers markets have been obtained quarterly. Mussels and clams were also obtained from fisherman at three markets in Lima, Peru. These samples are being currently examined for the presence of Cyclospora, Giardia, Cryptosporidium, and Toxoplasma. Periodical collections every 4 months from 4 sites of the Georgia Coast have also been programmed. Inactivation of protozoan parasites will be evaluated using three shellfish sanitation procedures. One scientist participated in the visiting scientist program at the University of Georgia where he gained experience working with parasites. A workshop is scheduled for the summer of to disseminate the information obtained from the present project including foodborne parasites, shellfish and factors associated to environmental contamination. Impacts This project will provide an estimate of the presence of parasites in shellfish commercialized for human consumption and its association to the risk of acquiring the infection. Shellfish are also being used as indicators to determine the coastal water contamination by animal and human waste. Oysters contaminated with protozoan parasites were isolated from the Eastern coast of the U. This represents a potential public health concern, but also the potential of using shellfish as biological markers of water contamination. The objectives of this project include the evaluation microscopy based and PCR methods to determine the most sensitive technique for detecting parasites in laboratory contaminated shellfish. Samples from the US East coast and from Peru will be examined.

Chapter 3 : Cryptosporidium Inactivation | calendrierdelascience.com

However, when using a response-logit method to calculate ID 50 of G. lamblia cysts fed to the gerbils, the result increased to log cysts (cysts). This number is similar to Finch and co-workers' [26] result of log cysts (cysts).

In fact, NF membranes are sometimes referred to as "loose" RO membranes and are typically used when high sodium rejection, which is achieved by RO membranes, is not required, but divalent ions such as calcium and magnesium are to be removed Scott, Nevertheless, NF membranes are viewed by the water industry as a separate class of membranes than RO membranes and are discussed in this paper as such. NF membranes are commonly operated at pressures ranging from 75 to psi Lozier et al. NF membranes have been used successfully for groundwater softening since they achieve greater than 90 percent rejection of divalent ions such as calcium and magnesium. Several NF membrane-softening plants are currently in operation in the United States, with the first plant installed in Florida in Conlon and McClellan, It is estimated that approximately NF membrane plants existed around the world by , with a combined total capacity of approximately MGD Scott, Because most commercially available NF membranes have molecular weight cutoff values ranging from to daltons Bergman, ; Scott, , they are also capable of removing greater than 90 percent of natural Page Share Cite Suggested Citation: Identifying Future Drinking Water Contaminants. The National Academies Press. Therefore, they are also excellent candidates for the removal of color and, more importantly, disinfection byproduct DBP precursor material Taylor et el. Currently, NF membranes are being considered as a total organic carbon TOC removal technology in surface water treatment. The idea is to install NF membranes downstream of media filtration in order to maintain a very low solids-loading rate on the membranes. Although NF membranes have been designated by the U. To date, pilot studies have been conducted to evaluate the applicability of NF membrane filtration downstream of media filtration during surface water treatment with mixed results Reiss and Taylor, ; Tooker and Robinson, ; Chellam et al. The study reported by Chellam et al. This was supported by the study of Reiss and Taylor , which showed that conventional filtration pretreatment did not reduce the fouling rate of NF membranes to acceptable levels. Nevertheless, the Information Collection Rule includes data gathering on the applicability of NF membrane filtration for TOC removal from surface water sources. The majority of the data will be from bench-scale testing, which does not include information on long-term operational design and reliability, but some data will be obtained from pilot-testing programs. These data will provide additional input into the viability of NF membranes for surface water treatment. RO membranes have long been used for desalination of seawater around the world. These membranes can consistently remove about 99 percent of the total dissolved solids TDSs present in the water, including monovalent ions such as chloride, bromide, and sodium. However, for a long time these membranes were predominantly made from CA and required operating pressures at or greater than psi. Recent innovations in Re membrane manufacturing have developed a new class of Re membranes, called TFC membranes that can achieve higher rejection of inorganic and organic contaminants than CA Re membranes while operating at substantially lower pressures to psi. In addition, CA Re membranes commonly require acid addition to lower the pH of the water to a range of 5. TFC RO membranes do not hydrolyze at neutral or high pH and therefore do not require pH depression with acid addition. It should be noted that the need for pH depression for preventing the precipitation of salts on the membrane surface such as CaCO3 may still be necessary in some cases depending on the quality of the water being treated and the availability of suitable antiscalents. TFC RO membranes are currently being evaluated for water reclamation. Results from ongoing pilot studies have shown that TFC RO membranes can achieve greater than 90 to 95 percent rejection of nitrate and nitrite, compared to 50 to 70 percent removal with CA Re membranes. Page Share Cite Suggested Citation: The main obstacle to increased application of high-pressure membranes in municipal water treatment is their high cost. By nature of the current modular design of membrane systems, economies of scale are not recognized for large treatment plants. However, several membrane manufacturers are currently

modifying their membrane system designs to make them economically attractive at large scale. Two-Stage Membrane Filtration From the above discussion it is apparent that low-pressure membranes are highly effective for particulate removal, while high-pressure membranes are effective for dissolved matter removal both organic and inorganic. Conceptually, combination of the two membrane systems in series MF or UF followed by NF or RO would provide a comprehensive treatment process train that is capable of removing the vast majority of dissolved and suspended material present in water. Such a treatment train is commonly termed "two-stage membrane filtration. However, compared to existing treatment, a two-stage membrane filtration process possibly coupled with PAC addition would produce far superior water quality. The main concern about such highly treated water is that it may be more corrosive. Special corrosion inhibition measures for low-TDS waters of this kind require further development. Several studies have been conducted to evaluate two-stage membrane systems for surface water treatment Wiesner et al. The results of these studies have clearly shown that MF or UF membranes are excellent pretreatment processes to NF or RO membranes and that the combined particulate removal and organic removal capabilities of this treatment scheme produce excellent water quality that complies with existing and forthcoming regulatory requirements. The primary obstacle that a two-stage membrane treatment system needs to overcome is its cost. Low-pressure membrane filtration MF and UF is now replacing conventional filtration for surface water treatment at several locations in the United States. High-pressure membrane filtration both NF and RO is used primarily for softening and TDS reduction but is being evaluated for the removal of natural organic matter in water treatment. The main obstacle to large-scale implementation of membrane filtration is its capital cost. Ongoing innovations in the design of large-scale membrane systems are continually lowering their capital cost and making them increasingly cost competitive with conventional treatment processes. Ultraviolet Irradiation Technology Ultraviolet UV irradiation technology is primarily used in the water and wastewater treatment industry as a disinfection process that capitalizes on the germicidal effect of UV light in the wavelength range of to nm EPA, The process is commonly designed such that water flows in a narrow region around a series of UV lamps. The microorganisms in the water are inactivated through exposure to the UV light. The process is compact since the time of exposure which translates into hydraulic retention time is commonly measured in seconds. The process works on the principle that UV energy disrupts the DNA of the microorganisms and prevents it from reproducing. UV irradiation technology has been used since the s at approximately drinking water facilities in the United States, and more than 1, facilities in Europe Kruithof et al. However, the vast majority of the U. These are facilities that provide water to restaurants, highway rest areas, airports, schools, camps, factories, rest homes, and hospitals. In fact, UV disinfection technology in drinking water treatment is currently only promoted for small-scale groundwater systems. However, the process can certainly be scaled up to large-scale applications since it is currently applied at large-scale wastewater treatment plants for final effluent disinfection. For water treatment systems, a minimum UV dose is commonly set for UV systems. Several states, including New Jersey and Wisconsin, have specific criteria for UV systems in the form of a minimum dose Parrotta and Bekdash, All of these doses are based on the requirement to inactivate bacteria and viruses but not protozoans. The testing results conducted in distilled water are shown in Figure EPA has recently developed and published a guidance document for the application of UV technology for surface water treatment EPA, a. Published information on the cost of UV disinfection systems in drinking water treatment is limited to small systems. EPA has estimated the capital cost of a UV treatment system for a 1. The operations and maintenance cost of such a system is estimated at 1. This estimate is for a medium-pressure UV system, treating water with a 55 percent transmittance approximately 0. These cost values indicate that the application of UV technology to large-scale water treatment is cost competitive. There are four types of UV technologies of interest to the water industry: Another unique characteristic of low-pressure lamps is that they emit a monochromatic light at a wavelength of nm. The primary disadvantage is their low power, which results in the need for a large number of lamps for a small plant. Considering that a significant labor effort is required to clean and maintain UV lamps, the application of LP-LI UV technology at large scale is not desirable.

Therefore, a typical secondary wastewater effluent would now require only 20 to 24 lamps per MGD of capacity. MP-HI UV lamps operate at substantially higher gas pressure inside the lamps compared to low-pressure UV lamps and are characterized by a power output that varies from 5 to 30 KW. Contrary to low-pressure lamps that produce all of their light at approximately nm, medium-pressure lamps produce a polychromatic light, of which only 25 percent is in the germicidal wavelength range of to nm. This technology has been used in small-scale water treatment and industrial applications since the s. However, it was not introduced to the municipal wastewater market until Currently, more than MP-HI UV systems are in operation, with 70 of them operating at municipal wastewater treatment plants. Another drawback is its high capital cost. Nevertheless, considering the substantial savings in the number of lamps, both capital and operations and main- Page Share Cite Suggested Citation: Low- and medium-pressure UV technologies are past the research stage and have been accepted as reliable disinfection technologies. The cost of UV systems is also not prohibitive since the technology is less expensive than ozone and many other disinfection processes. The new UV technology under development is pulsed UV technology. In this process the energy is stored in a capacitor and then released to the lamp in a short, high-intensity pulse. The duration between pulses is approximately 30 milliseconds, and each pulse lasts for less than 1 millisecond. One manufacturer of this technology claims that the high energy emitted with each pulse is far more effective for the inactivation of microorganisms compared to the same level of energy emitted over an extended period of time. However, questions remain about the ability to accurately measure the UV dose emitted by a pulsed UV system. Regardless of the type of UV technology used, the obstacles against application of this technology in municipal water treatment can be summarized as follows. Data on UV inactivation of Cryptosporidium oocysts is even more sparse than that of Giardia cysts. If these results can be validated by others, they seem to emphasize the notion that UV irradiation does not kill an organism but only limits its ability to reproduce and thus infect a host organism.

Chapter 4 : Protozoan Contaminants in Shellfish - UNIVERSITY OF GEORGIA

Inactivation constants derived from the cell culture-TaqMan PCR and ATP assays over a wide range of environmental temperatures will provide a valuable framework for risk assessment and be particularly applicable for integration with hydrodynamic models to estimate the risk of infectious oocysts reaching the off-takes of reservoirs.

Pien, and Eleanor J. Environmental Protection Agency EPA to promulgate primary drinking water regulations a specifying criteria under which filtration would be required, b requiring disinfection as a treatment technique for all public water systems, and c establishing maxi- mum contaminant levels MCLs or treatment requirements for control of Giardia lamblla, viruses, Legionella, heterotrophic plate count bacteria, and turbidity. Many factors influence G. A model is developed to describe these interactions and to predict Ct values based on specific model Inputs. A strategy is proposed that uses the model to provide conservative C1 values for regulatory purposes. Introduction EPA has proposed surface water treatment technique requirements to fulfill the SDWA requirements for systems using surface waters. Additional regulations specifying disinfection requirements for systems using ground water sources will be proposed and promulgated at a later date. Under the proposed SWTR, all community and noncommunity public water systems would be required to treat their surface water sources to control G. The minimum required treatment for each surface water would include disinfection. In addition, unless the source water is well protected and meets certain water quality criteria limits on total or fecal coliforms and turbidity , required treatment would also include filtration. The treatment provided, in any case, would be required to achieve a Unfiltered systems would be required to demonstrate that disinfection alone achieve the minimum performance requirements. Filtered systems that meet certain turbidity removal and disinfection performance criteria and that comply with design and operating criteria specified by the State would be considered to be in compliance with these requirements. Much effort was made to develop an adquate model to describe G. This Project Summary presents an overview of the model development and parameter estimation process resulting from this project. The Ct Concept In comparing the biocidal effective- ness of disinfectants, major con- siderations are the disinfectant concentration and time needed to attain inactivation of a certain proportion of the population exposed under specified conditions. The application of this equation to disinfection studies requires multiple experiments where the effectiveness of several variables, such as pH, temperature, and the disinfectant concentration, are examined to determine how they affect the inactivation of microbial pathogens. The value of n is a very important factor in determining the degree to which data extrapolated from disinfection experiments is valid. Destroying pathogens by chlorination depends on a number of factors, including water temperature, pH, disinfectant contact time, degree of mixing, turbidity, presence of interfering substances, and concentrations of chlorine available. The pM, especially, has a significant effect on inactivation efficiency because it determines the species of chlorine found in solution. The effect of temperature on disinfection efficiency is also significant. Disinfection by chlorination can inactivate Giardia cysts, but only under the most favorable conditions. Researchers have concluded that 1 these cysts are among the most resistant pathogens known, 2 disinfection at low temperatures is especially difficult, and 3 treatment processes before disinfection are important. Studies on the use of in vitro excystation to determine cyst viability have shown that greater than Animal Infectivity Studies Much Giardia inactivation data are based on excystation techniques because few Giardia cyst inactivation data are available based on the use of animal infectivity as a measure of cyst viability. Some investigators compared mouse infectivity and excystation for determining the viability of G. Each of five gerbils was fed of the chlorine-exposed cysts subsequently examined for evident infection. It is impossible to deten the exact level of inactivation for t results. If, however, one to four ani were infected, it was assumed thai level of viable cysts were five per ar and that Table 2 summarizes data for different experimental condit examined. The studies on w these data sets were based characterized Table 3. The first que to arise is the statistical compatibilil the data sets. Because of the size o data set and the fact that it is base

animal infectivity, set 2 data v considered in all combinations. Interval 20 40 60 80 C Robert M. Cincinnati, OH see below ; Dennis A. Pien and Eleanor J. Read are with the Computer Sciences Corp. The complete report, entitled "Predicting the Inactivation of Giardia lamblia: PB AS; Cost: Risk Reduction Engineering Laboratory U.