University of New Hampshire

College of Engineering and Physical Sciences
Department of Civil & Environmental Engineering

Room 344 Gregg Hall
35 Colovos Road
Durham, NH 03824

V: 603.862.1449
F: 603.862.3957

jim.malley@unh.edu

Date: January 5, 2016
To: All Stakeholders interested in Ballast Water Management
Re: Performance Monitoring of BWMS (46 C.F.R. § 162.060-10(b)(1))

Based upon my academic and practical science and engineering experience amassed in the environmental field since 1980, it is clear that there are many disinfection options to effectively manage the concerns raised with Ballast Water. In addition, the literature is clear that all disinfectants have pros and cons. For example, chemical disinfectants often form unwanted by-products that exhibit significant effects on human and environmental health. One example clearly discussed in the Clean Water Act is the need to provide de-chlorination for wastewater effluents to avoid aquatic toxicity impacts on ecosystems. Similarly, there has been extensive research and practical applied efforts focused on the best methods for determining disinfection effectiveness. Both the Clean Water Act and the Safe Drinking Water Act research have wrestled with the issue of live/dead versus viable/unviable. As carefully explained in the USEPA UV Disinfection Guidance Manual (EPA 815-R-06-007 November 2006) and related research publications, there are many issues surrounding the use of vital stains to truly detect the live/dead or viable/unviable. There is no guarantee that vital stains reliably determine live/dead or viable/unviable. Vital stains essentially work by reacting with functional groups on intracellular molecules including proteins and enzymes. Therefore, if an organism's structure does not absorb the stain or if the intracellular molecules are not fully degraded by the disinfectant treatment then the stain approach cannot determine presence/absence nor live/dead nor viable/unviable. During the development of the USEPA LT2ESWTR (SDWA) which was in part driven by the ability to measure the viability of *Cryptosporidium parvum* it was clearly demonstrated that vital stains were not a scientifically valid approach to determining the safety of a treated drinking water supply for Cryptosporidium. Further, the research and deliberations surrounding the 6 year development of the LT2ESWTR concluded that a technology, like UV disinfection, which eliminates the reproductive capacity of a pathogen is equivalent to rendering that organism dead in terms of potential for growth, infection or colonization.

In addition to these factors, there is always the issue of significant biological/microbial variability in diverse environmental samples such as ballast water and hence the appropriate statistical testing needed to demonstrate treatment performance. Therefore, proven statistical approaches such as MPN testing based on growth have had good success reliably managing this uncertainty in bacterial monitoring for compliance with the Clean Water Act. In both the Clean Water Act and the Safe Drinking Water Act as well as amongst the experts that develop testing protocols (including myself) for USEPA, Standard Methods for the Analysis of Water and Wastewater (APHA, AWWA, WEF) and ASTM:Water it is consistent that the standard for measuring treatment effectiveness and environmental compliance involving disinfection involves a growth based method such as the determination of E. coli via growth based MPN techniques.

With these considerations in mind, when I reviewed the 12/14/2015 "Coast Guard Decision on use of Most Probable Number Method" summarized at the link (http://mariners.coastguard.dodlive.mil/2015/12/14/12142015-coast-guard-decision-on-use-of-most-probable-number-method/ ), I had several concerns that I wish to bring to the attention of the ballast water stakeholder community. First, I do not believe that the decision to preclude us of growth based MPN and rely solely upon vital stains as the benchmark measure of live/dead draws upon years of sound environmental science and engineering experience in disinfection (in fact it appears to ignore it). Therefore, it is unlikely that reliance upon vital stains will achieve the USCG stated goal to protect the environment from invasions of non-indigenous organisms by rendering them harmless (it could well do just the opposite). Second, drawing upon my 35 years of experience in environmental science and engineering including my work with chlorine, chloramines, chlorine dioxide, ozone and UV technologies it is my professional opinion that this action/decision will preclude key ballast water stakeholders from taking advantage of the societal, environmental, economic and technical benefits of UV disinfection that have been well demonstrated and proven in full-scale practice by USEPA and stakeholder groups to protect human health and environment from microbial risks found in wastewater, drinking water and water reuse applications.

If you have specific questions please do not hesitate to contact me at (603) 862-1449 or at jim.malley@unh.edu.

Sincere Regards,

James P. Malley, Jr., Ph.D.
Professor of Civil and Environmental Engineering
Chairman, CEPS Environmental Engineering Program
Director, ERG – The Environmental Research Group
{Chair, American Water Works Association Technical and Education Committee}
{Founding President, International UV Association}