Sampling and Testing for Sewage and fecal contamination

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Introduction

Damage from flood water containing sewage and feces is a very common problem encountered by home owners and building managers. Environmental professionals are often called to address the problems. Sewage wastewater, if it contains fecal waste, may be contaminated with a wide variety of microbes, including viruses, parasites, bacteria, and yeasts. Many of these are pathogenic to humans. These microbes must be removed with sewage wastewater and the environment must be disinfected with appropriate biocides. Sampling and testing for these microbes is impractical because it may involve numerous species and kinds, and can become time-consuming and expensive.

In the event of sewage water contamination, cleanup, disinfection and testing are necessary to ensure that the cleanup and disinfection are successful and the living environment is free of contamination from sewage associated microbes.

This technical information sheet discusses how to handle sewage contamination, what sampling and testing should be performed, and how to interpret the results of various types of samples analyzed for total coliform, *E. coli*, and fecal coliform bacteria. The importance of new information and the need to test for *Entercoccus* in dealing sewage contamination are also discussed.

Why test for E. coli and coliform bacteria?

Conventionally, total coliform, *Escherichia coli* (commonly known as *E. coli*), and fecal coliform bacteria are used as indicators of drinking water quality. This means all drinking water should test negative for the three bacterial groups. Total coliform bacteria include many bacteria genera that are present in the environment and in the feces of all warm-blooded animals and humans. Fecal coliform bacteria include those of fecal origin, such as *Escherichia,* as well as genera that are not of fecal origin, such as *Enterobacter*, *Klebsiella*, and *Citrobacter.* Therefore, the detection of fecal coliform bacteria does not necessarily indicate the presence of fecal contamination. *Escherichia coli* is a major species among many fecal coliform bacterial species. Most *E. coli* bacteria are found in large number in the intestines of people and warm-blooded animals and are generally harmless. Some strains, particularly *E. coli O157:H7,* however, can cause serious illness. The presence of *E. coli* in a drinking water sample almost always indicates recent fecal contamination and is considered the best indicator of fecal contamination.

Why test for Entercoccus?

Studies of marine and fresh water bathing beaches indicate that the presence of *Entercoccus* provides a higher correlation than fecal coliform bacteria with cases of swimming associated gastroenteritis. This suggests that entercocci are a better bacterial indicator of water quality due to sewage/fecal contamination. Based on these findings, a federal standard for water quality at public beaches uses *Entercoccus* species in place of fecal coliform bacteria.

Members of the genus *Entercoccus* were classified as Group D *Streptococcus* until 1984 when DNA analysis indicated that a separate genus classification was appropriate. Enterococci are gram-positive cocci which often occur in pairs and are difficult to distinguish from streptococci on physical characteristics alone. Two species are common commensal organisms in the intestines of humans: *E. faecalis* (90-95%) and *E. faecium* (5-10%). Some *Entercoccus* species are clinically important because they cause infections, including urinary tract infections, bacteremia, bacterial endocarditis, diverticulitis, and meningitis.

In bodies of water, the acceptable level of contamination is very low and varies from state to state. For example, in the state of Hawaii, with among the strictest tolerances in the United States, the limit for water off its beaches is 7 colony forming units per 100 ml of water, above which the state may post warnings to stay out of the ocean. Water quality guidelines based on *Entercoccus* density have been proposed for recreational fresh water at 33 entercocci/100ml and for marine water at 35 entercocci/100ml. In 2004, *Enterococcus* spp. took the place of fecal coliform as the new federal standard for water quality at public beaches.

What to consider when deciding testing for E. coli and coliform bacteria v. Entercoccus

With the new paradigm in water quality microbiology, environmental consultants need to decide which test to use when dealing with a sewage wastewater contamination issue. Our recommendation is to sample and test for *E. coli* and coliform bacteria (both total and fecal), particularly in the absence of gastrointestinal disease such as gastroenteritis, because the tests take one to two days while *Entercoccus* tests may take up to a week. In the event that cases of gastroenteritis are reported, testing for both *E. coli* and coliform bacteria, as well as *Entercoccus,* should be done.

WHO Guidelines for Drinking Water Quality state that as an indicator organism *Escherichia coliform* provides conclusive evidence of recent fecal pollution. This suggests that *E. coli* can be used as an indicator in sewage cleanup.

Cleanup and remediation of sewage wastewater

The Institute of Inspection, Cleaning and Restoration Certification (IICRC) and other professional organizations have published documents on cleanup and remediation of sewage wastewater contamination. I would like to add additional considerations.

Environmental consultants should always consider secondary contamination issues when bacteria-containing aerosols or human foot traffic may spread sewage contaminants to other locations or into the HVAC system. Consider using isolation containment when sewage flood covers sufficiently large areas. Consider using mild biocide applications to disinfect contaminated surfaces. Check into rules and regulations of commercial biocide application in the State. A commercial biocide applicator license may be required in most states in landscaping, agricultural, floricultural, horticultural, and forestry industries. Its applicability in indoor mold and microbial control is not clear and may be subject to interpretation by each state. Finally, take swab samples for quality assurance testing of the cleanup and disinfection. Air sampling for bacteria and mold is optional.

For those who are interested in microbial remediation, please refer to the excellent book chapter, written by Dr. Philip R. Morey, below.

Yang, C. S. and P. Heinsohn. 2007. Sampling and analysis of indoor microorganisms. John Wiley & Sons, Hoboken, New Jersey.

Morey, P. R. 2007. Microbial remediation in nonindustrial indoor environments. Pp. 231-242. in “Sampling and analysis of indoor microorganisms.” John Wiley & Sons, Hoboken, New Jersey.

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