

Water Contaminant of the Month

Viruses are microorganisms, minute infectious agents that range in size from about 0.004 micron to 0.1 micron in diameter. They are about 100 times smaller than typical bacteria. They are parasites considered to be incapable of growth outside the presence of the living cells of a host organism. Viruses are made up almost entirely of proteins and nucleic acids.

Viruses can enter surface water from point or non-point contamination sources, including agricultural, municipal, residential and industrial wastewater sources. Recreational waters can be contaminated by infected individuals through direct contact. The extremely small size of viruses allows them to infiltrate soils and reach groundwater aquifers. Depending on many factors (rainfall, soil structure, macropores, etc.), viruses can move considerable distances underground. They have been found to have migrated to depths as great as 200 feet through soil, have traveled as much a ¼ mile horizontally through glacial till (gravelly soil deposits), and have moved nearly 1 mile in a fractured limestone aquifer. One study found that enteric (intestinal) viruses are shed in enormous quantities from fecal matter, from 10 billion to 100 billion viruses per gram of feces, while a dose of tens to hundreds of viruses is typically all that is required to cause an infection in humans.

Viruses cause a wide range of diseases in humans. Some of the more notable, and potentially deadly viruses that can be transmitted through water (and their associated diseases) are: Norovirus (gastroenteritis); hepatitis A and E (hepatitis); poliovirus (paralysis); rotavirus (gastroenteritis); echovirus (meningitis and encephalitis); coxsackie virus A (meningitis, respiratory disease, fever); and coxsackie virus B (myocarditis, congenital heart disease).

The US EPA maximum contaminant level (MCL) for viruses requires a *4-log* (99.99%) removal or inactivation level in public water systems by treatment technique. The EPA maximum contaminant level goal (MCLG) for viruses is zero.

Treatment to deactivate viruses includes disinfection methods such as chemical oxidation (chlorine, ozone, etc.), ultraviolet irradiation, and distillation. Finer filtration methods, including reverse osmosis and nanofiltration will remove viruses to the *4-log* level. Many forms of ultrafiltration will also significantly reduce/remove viruses.

(Source: *Water Technology* 32:8; September, 2009)