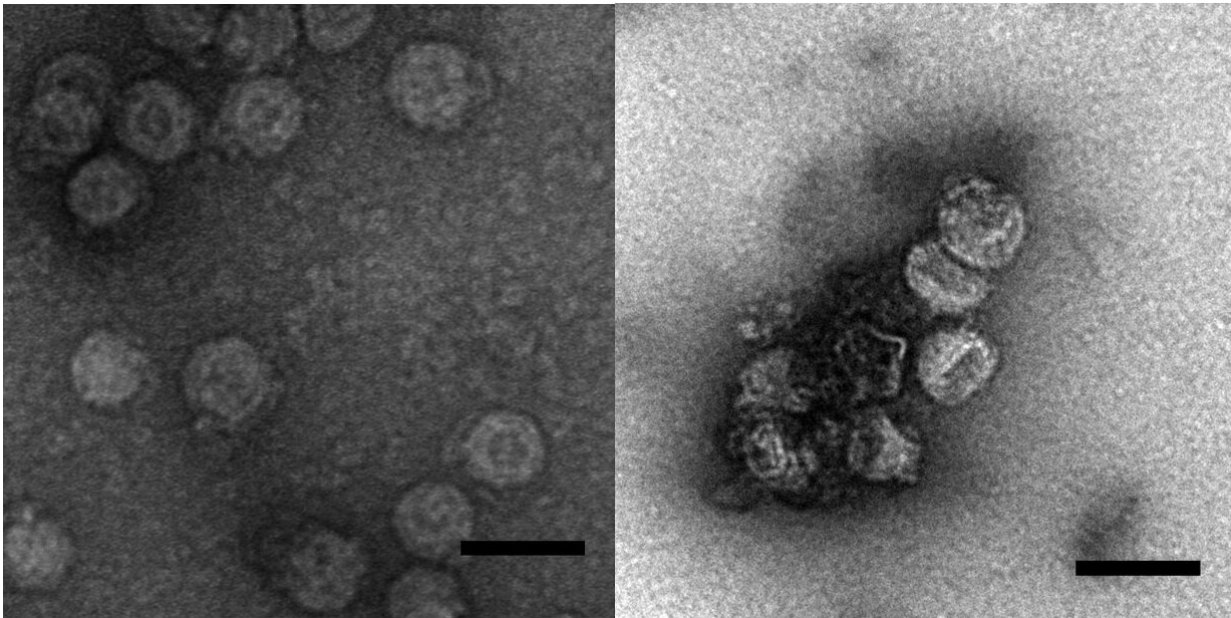


Standard water treatment technique removes and inactivates an enveloped virus

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An enveloped virus, $\Phi 6$ (left), clumps together and becomes damaged by conventional iron coagulation (right). Scale bar, 100 nm. Credit: Adapted from *Environmental Science & Technology* 2021, DOI: 10.1021/acs.est.0c07697

Enveloped viruses have been detected in raw sewage and sludge, but scientists still don't fully understand the fate and infectivity of these viruses during water purification at treatment plants. Now, researchers reporting in ACS' *Environmental Science & Technology* have discovered that a standard water treatment technique, called iron (III) coagulation,

and its electrically driven counterpart, iron (0) electrocoagulation, can efficiently remove and inactivate a model enveloped virus.

Enveloped viruses have an outer coating of lipids and proteins that helps protect their genetic material. Typically, disrupting this coat inactivates the virus. Until now, most studies have investigated only disinfection by chlorine or [ultraviolet light](#) as a means to control enveloped viruses in wastewater. However, particles suspended in the water can sometimes shield viruses from disinfectants. Shankar Chellam and colleagues wondered whether a different method called coagulation with iron (III), which is already widely applied during water treatment, can remove and inactivate enveloped viruses. They also wanted to study a related technique, iron (0) electrocoagulation, that shows promise for small-scale [water treatment](#). As a model enveloped virus, the researchers chose an RNA virus, called $\Phi 6$, that infects bacteria.

The researchers treated a solution containing $\Phi 6$ with either iron (III) or with iron (0) electrocoagulation, both of which formed iron precipitates. The hydrophobic viral envelopes stuck to the precipitates, allowing $\Phi 6$ to be easily removed as the solids settled. The conventional coagulation reduced the amount of active virus in the water by more than 100,000 times in 2.6 minutes, whereas electrocoagulation was slower but about 10 times more effective. The researchers observed that the structures of most of the viral particles in the iron precipitates were damaged, which rendered them unable to infect their host bacteria. Electrocoagulation also oxidized lipids in the viral envelope, further inactivating $\Phi 6$.

These results suggest that water [treatment plants](#) are already well equipped to remove enveloped viruses from drinking water by iron (III) coagulation, and viral levels are likely even further reduced by the additional treatment steps of filtration and disinfection, the researchers say.

More information: "Removal and Inactivation of an Enveloped Virus Surrogate by Iron Conventional Coagulation and Electrocoagulation" *Environmental Science & Technology* (2021).

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