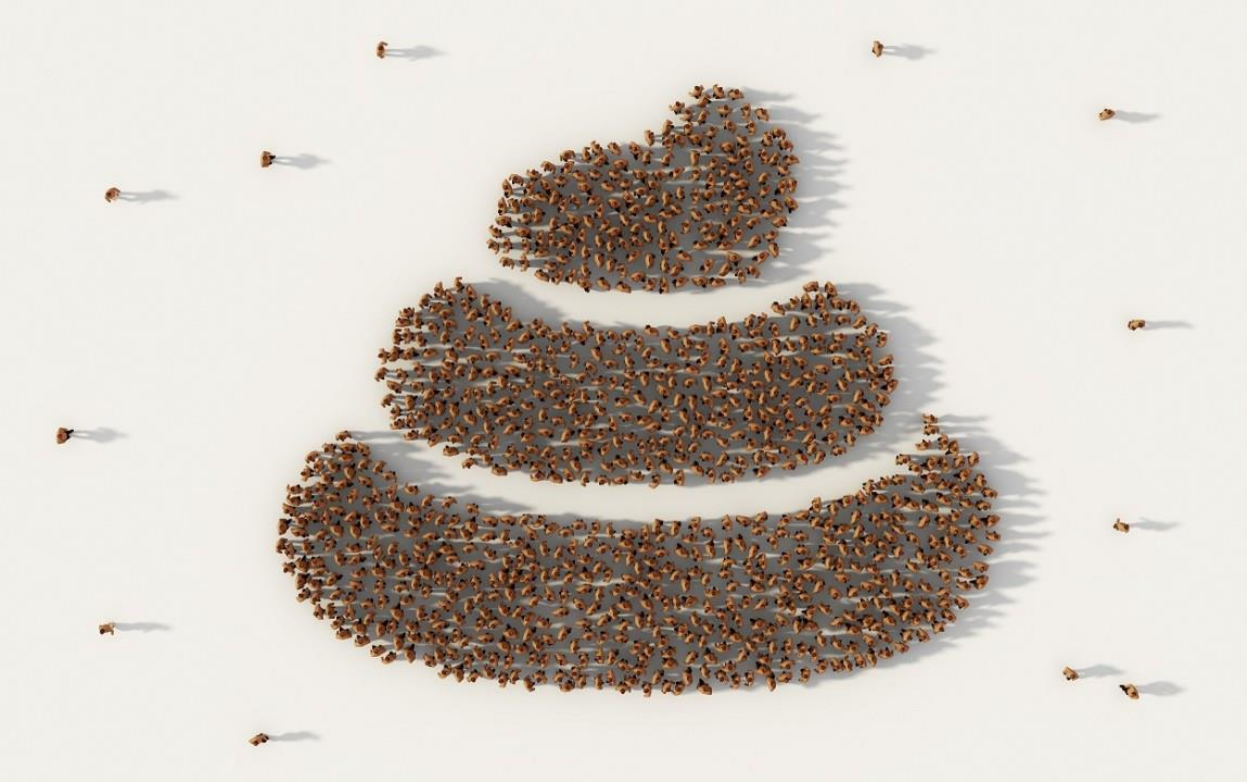

You Shouldn't Splash That S**t Around

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The novel coronavirus pandemic has brought a wide range of health issues into sharp focus, including the spread of pathogens through aerosols, tiny droplets of liquid that can hang in the air for minutes or even hours.

When Chinese scientists announced in February that RNA from the novel coronavirus was present in feces — findings later corroborated by research conducted in the U.S. — and could be transmitted through a fecal-oral route, scientists recognized a new and terrifying mode of

contagion. Similarly, the novel coronavirus has been detected in wastewater in The Netherlands, and American scientists are observing the virus' RNA in tests of raw sewage across the country.

That's certainly little surprise. In 2003, the World Health Organization published a report on the spread of SARS — a close cousin of the new coronavirus and a model for our current acute respiratory virus outbreak — through the faulty wastewater handling system in a Hong Kong high-rise.

These findings highlight the vital role wastewater treatment professionals play on the front lines of protecting us all from not only COVID-19, but from the many pathogens carried in municipal waste.

They also underscore how important it is that we protect those wastewater treatment professionals from the pathogens they face at work.

Protection On The Front Lines

At the University of California, Riverside, Haizhou Liu and his collaborator Vincenzo Naddeo at the University of Salerno published an editorial perspective in *Environmental Science: Water Research and Technology* last month stating that the new coronavirus can be transported in aerosols. They also said that, left untreated, the virus can remain infectious for days or longer in wastewater.

Fortunately, chlorine is highly effective at controlling other coronaviruses like SARS and Ebola, and experts believe we will find that existing treatment technologies will allow our water professionals to maintain safe wastewater and drinking water supplies. The Occupational Safety and Health Administration (OSHA) recently published guidance indicating that oxidation with hypochlorite or peracetic acid, or exposure to UV radiation are expected to provide sufficient protection to protect wastewater workers and the public. We also know that oxidation with ozone has a devastating effect on a wide range of viruses, so the likelihood is high that ozonation is extremely efficient at deactivating the novel coronavirus.

But upstream of treatment plants' disinfection processes, the potent combination of threats — aerosols and feces — may be an ongoing work hazard in many of our nation's wastewater treatment systems, where aerators swirling or splashing on the surface of aeration tanks or basins kick up clouds of tiny, pathogen-laden droplets. In short, these surface aeration systems can be a highly efficient mechanism for lifting pathogens into the air in infection-ready packages and exposing workers to them. Whether the pathogen is COVID-19, *E. coli*, *Cryptosporidium* or another germ, aerosolizing it represents a serious risk.

The Water Environment Federation (WEF) has published extensive guidance on protecting wastewater employees with engineering controls such as enclosures, physical barriers and enhanced ventilation to minimize exposure to pathogens. WEF also lists safe work practices like hand washing, removing work clothes before eating or leaving the work site, and avoiding touching the face or wounds while handling sewage. Last, personal protective equipment (PPE), provides barriers that are truly the first and last lines of defense.

Better Options

Those measures are all extremely important and have kept countless people safe in a situation full of daily hazards. But the danger can be reduced, at least in new construction or major retrofits, by eliminating the surface aeration systems that create much of the aerosol load in the first place.

That's especially compelling because surface aeration is marginally effective, at best, in deep basins. Under the best of circumstances, surface aerators can only mix air into wastewater in the top few feet — and they expend all their energy trying to push air down into the water, while it naturally wants to float back to the surface.

Of course, maintaining surface aerators can also be dangerous. Workers breathing in aerosols, breaking down and rebuilding splashers or jets, fixing motors, balancing off catwalks to access aerators — it's all a recipe for disaster.

As our country navigates its way back to normalcy after the pandemic first wave of Coronavirus-19, our hope is that the recovery plan will focus a major effort on helping outfit municipal and industrial wastewater treatment facilities, as well as livestock manure lagoons, with venturi aeration systems.

Venturi aeration systems for wastewater basins consist of three elements: a highly efficient venturi injector, specially designed mixing nozzles and a properly sized pump.

In those systems, a stream of wastewater is piped around the tank or basin, directed through a manifold system to outlets at the bottom of the basin. As it passes through venturi injectors at the top of each lateral in the manifold — reaching velocities as high as 40 feet per second with just a few horsepower of pump pressure — the stream creates a vacuum that draws in air and mixes it with the wastewater.

At the bottom of each lateral in a Mazzei venturi aeration system, Mass Transfer Multiplier (MTM) nozzles shear the aerated wastewater and any undissolved air into the water at the deepest area of the basin. The turbulence and repeated shearing of the bubbles continually exposes new surfaces to the gas/liquid interface, minimizing the impact of grease and grime in the wastewater that could otherwise inhibit solubilization.

By releasing the aerated stream at maximum depth, the venturi aeration system uses the weight of the basin's water itself to take advantage of the fact that oxygen transfer occurs more efficiency at higher pressure. As the bubbles begin to rise, chances are much higher that they will go into solution in the higher-pressure depths. By contrast, surface aerators operate at depths least likely to permit air to be dissolved.

Not All Created Equal

Just fitting venturis to a sidestream system is not enough to ensure good aeration. The pump must be scaled to the system to power the proper amount of suction and mixing in the venturi

injector, and the nozzles must be designed to create the shear, turbulence and tiny bubble sizes that maximize the gas transfer into solution. At Mazzei, we use state-of-the-art computational fluid design (CFD) models to design and scale our systems, optimizing every aspect from the dimensions of each component to the precise placement of every nozzle in a basin to ensure thorough gas transfer and eliminate the formation of dead spots in the circulation of the air/liquid mixture around the basin itself.

The result is systems that are significantly less prone to fouling and much easier to maintain than bubble diffusers, and significantly more efficient — and safer — than aerosol-generating surface aerators. Our goal is to see America's recovery plan include significant funding for the improvement of our water and wastewater infrastructure. As we strengthen and upgrade the wastewater systems that help keep us safe and healthy, we should work to help keep plant operators on the front lines of our nation's fight against waterborne disease safe and healthy, too.