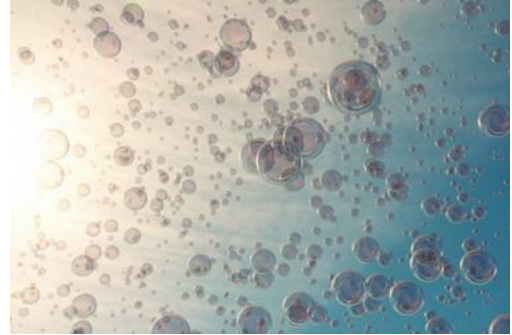


## A Perilous Choice: COVID Patients Or Safe Drinking Water?

 Source: [Mazzei Injector Company, LLC](#)

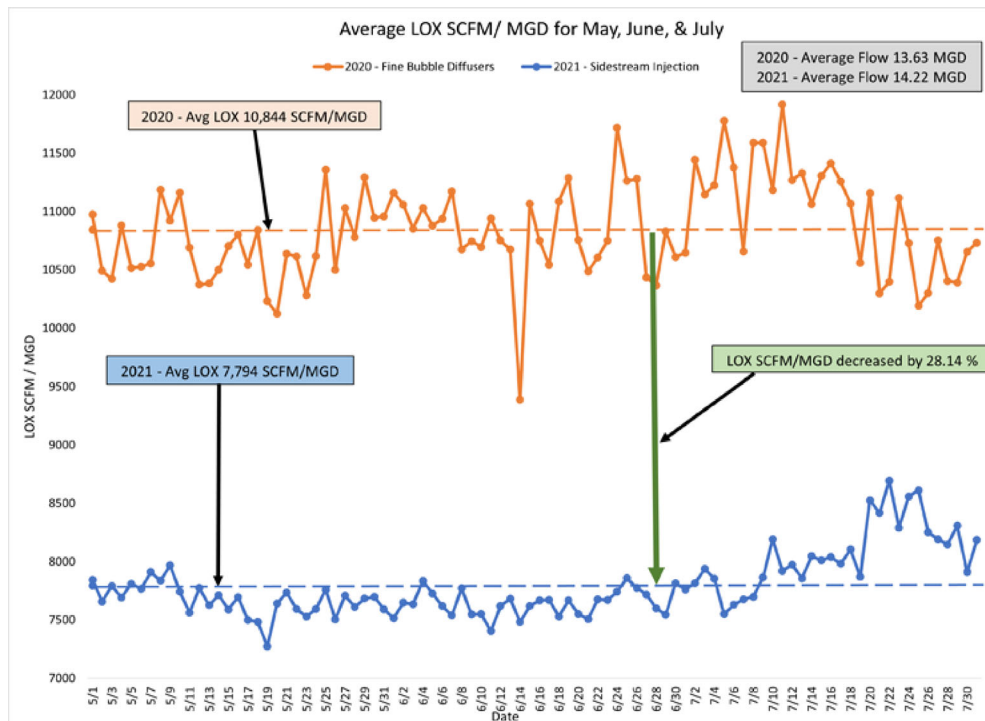
 By [Jim Lauria](#)

In August 2021, as Florida's hospitals were filling up with COVID-19 patients, the mayor of Orlando pleaded with local residents to reduce water use to free up liquid oxygen (LOX) — used both in water purification and medical ventilators — to provide life support for victims of the pandemic. The Orlando Utilities Commission (OUC) was operating the ozonation systems at its eight water treatment plants with just half its normal oxygen supply, prompting the mayor to call for a 40 million gallon per day decrease in water demand.



Fortunately — thanks to OUC's commitment to becoming a resilient utility — the mounting disaster in Orlando was lessened by upgrades that had been installed prior to the pandemic. The commission proved that resilience is about more than energy and carbon emissions. OUC had replaced fine bubble diffuser (FBD) ozone systems with sidestream injection (SSI)/pipeline contacting systems in three of its water treatment plants. The significant increases in mass transfer efficiency from the liquid-oxygen-fed ozone generators and active mixing action of the venturi injectors and Pipeline Flash Reactors (PFRs) of the sidestream injection systems was already helping Orlando's constricted oxygen supply go further.

In fact, the year OUC switched from fine bubble diffusers to sidestream injection ozone delivery systems in its Conway water treatment plant, LOX use per MGD dropped more than 28%.



*Switching from fine bubble diffusers (orange line) in 2020 to sidestream injection (blue line) resulted in a 28% reduction in LOX consumption for ozone dosing in OUC's Conway water treatment plant.*

### Mass Transfer: 98.7%

Fine bubble diffusers are a passive mixing technology, limited to an optimal ozone gas flow of just 0.12 scfm/ft<sup>2</sup> — any additional gas tends to have adverse effects on contactor hydraulics. The low ozone gas flow volume was adequate in the days when it reflected about as much ozone as air-fed generators could produce. As oxygen-fed ozone generators came online, capabilities rose to produce ozone concentrations as high as 10% by volume, and fine bubble diffuser technology could not keep up.

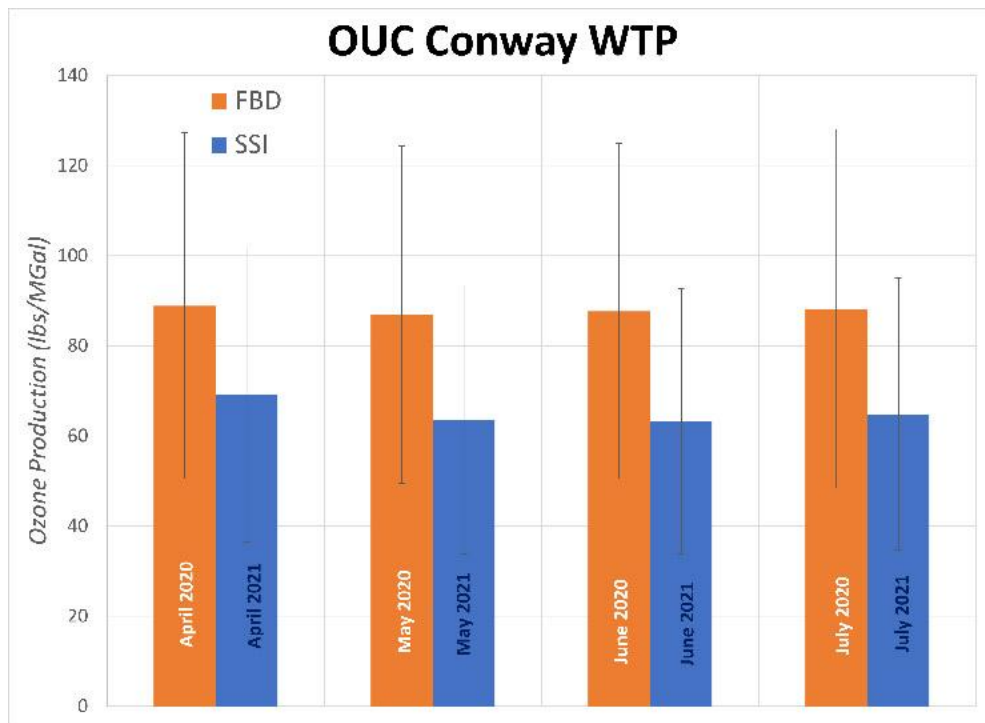
Sidestream injection provided an ideal alternative. SSI systems divert 3 to 10% of a plant's total flow into venturi injectors, which use the energy of the water to create a vacuum that draws in and mixes the ozone into solution. The ozonated sidestream is then mixed back into the main flow through a Pipeline Flash Reactor, a manifold of precisely oriented nozzles that provide thorough mixing almost instantly. In the OUC plants, just 12 feet (3.7 meters) of pipeline — 7 feet of PFR and 5 feet of static mixer — replaced several concrete contacting basins while improving mass transfer.



*This Pipeline Flash Reactor (PFR) in the OUC Conway water treatment plant helps achieve 95% uniformity of ozone in solution with just a few feet of pipeline.*

In fact, due to the shearing and mixing effect of the venturis in its sidestream injection system, OUC's Southwest Water Treatment Plant's mass transfer efficiency has been measured at 98.7%, allowing plant staff to maintain ozone doses of 9.4 to 9.9 mg/L.

Installing a sidestream injection system allowed the Southwest facility to increase its capacity from 30 to 40 MGD in 2014. On the other hand, SSI systems also exhibit excellent performance in high turndown, maintaining their accurate and uniform ozone delivery even when flows are substantially reduced.

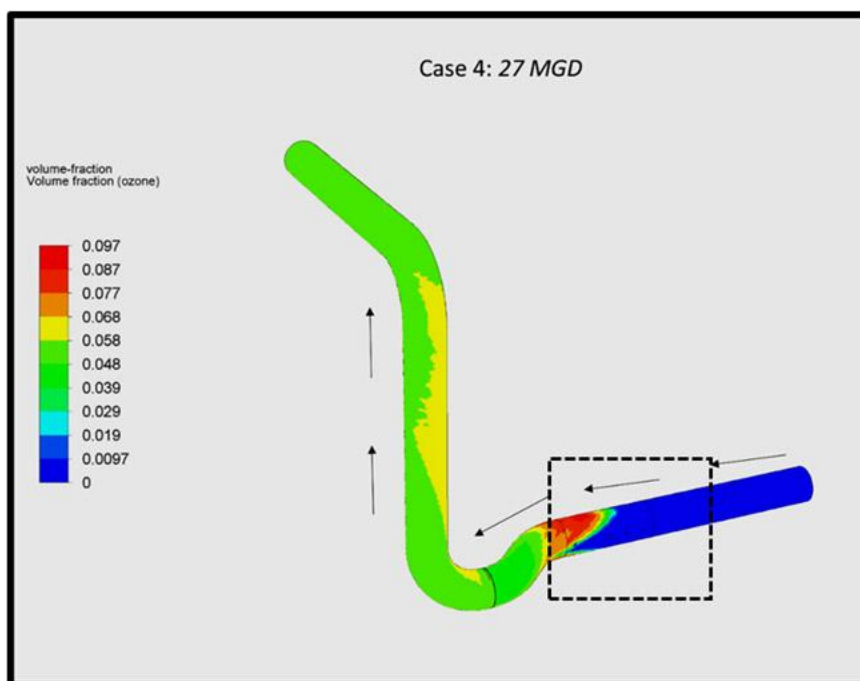


Higher mass transfer efficiency resulting from a switch from FBD to SSI allowed OUC's Conway water treatment plant to significantly reduce its ozone production — just in time to divert vital liquid oxygen to area hospitals to help COVID-19 patients.

### Uniformity Permits Automation

Due to the thorough mixing by the sidestream injection/PFR ozone system, the coefficient of variation (COV) of dissolved ozone residual in water has been reduced to less than 5%, a massive improvement compared to COVs of 25 to 45% from fine bubble diffusers. With reliable uniformity of mixing (over 95%) in the sidestream injection systems, OUC was able to utilize oxidative reduction potential (ORP) sensors in the treated water stream. Based on ORP readings passed to a SCADA-PLC system, the plants have been able to automatically control ozone dosing. Automated dosing has further increased the plants' efficiency in ozone use, saving even more oxygen.

By contrast, ozone levels in FBD systems must be measured so far downstream that the readings reflect doses delivered 20 to 30 minutes earlier. This effect is compounded at low flows, creating more challenges to automation and dose-response.



Using computational fluid dynamics (CFD) modeling, Mazzei engineers fine-tuned a Pipeline Flow Reactor that could inject ozonated water (red) into Orlando's main flow (blue) almost immediately and mix it uniformly (green and yellow).

### Reduced Inputs

Through targeted dosing and high mass transfer, Orlando's SSI system eliminates hydrogen sulfide from its treated water.

SSI provides energy savings, too. LOX-fed ozone generators require less than half of the electricity per unit of ozone produced than air-fed generators do — 6 to 10 kWk/kg for the oxygen-fed systems vs. 12 to 20 kWh/kg for air-fed. In addition, venturi injectors and Pipeline Flash Reactors imparting additional hydraulic mixing energy to the flow.

Finally, operations and maintenance in the SSI-equipped plants costs are significantly lower than in FBD-outfitted ones. Especially during the pandemic, when social distancing and staff shortages were in effect, reducing the need for workers to climb into drained contact basins or track down problems was — literally — a breath of fresh air.

Orlando, like the rest of the world, ultimately got through the summer '21 wave of the pandemic, and the supply of LOX returned to normal. But the lessons learned about the efficiency of sidestream injection will last well into the future.

---