Mazzei®

CASE STUDY

Improving the Quality of Secondary Wastewater for Indirect Potable Reuse—From Pilot to Full Scale Plant

Pure Water Monterey Ground Water Replenishment Project (Monterey Pure)

Monterey, California, USA

The Problem: In spite of the recent abundance of water, many of California's aquifers continue to balance on the edge of water scarcity. Decades of overpumping have reduced the amount of ground water available to supplement surface water resources diminished by drought. The Pure Water Monterey Ground Water Replenishment Project (Monterey Pure), addressed the need to replenish a local aquifer, by piloting Advanced Water Treatment (AWT) processes, to determine the best method to convert secondary wastewater into a pure water resource.

The pilot AWT channeled screened, secondary wastewater through microfiltration (MF) and reverse osmosis (RO) membrane filters, with ozone placed at the head of the treatment train. A primary goal of the AWT pilot plant was to determine the optimum ozone dosage required to improve and extend the services runs and flux of the MF filter.

The 8.9 MGD full scale design developed from the pilot data, required a peak applied ozone dosage of 30 mg/l, at an ozone transfer efficiency > 90%, to ensure optimum operation of the AWT process. The specified contact system required five Mazzei sidestream injectors (SSI) and a Mazzei Pipeline Flash Reactor (PFR), followed by a wafer-type motionless static mixer. Once the project was awarded, Mazzei conducted an in-depth analysis to determine if the specified SSI-PFR-Mixer contacting system could provide a > 90% transfer at all operating conditions or, at a minimum, achieve the ozone transfer provided by the high pressure pipeline contactor used in the pilot.

Mazzei engineering compared the ozone contacting conditions of the pilot plant, which mixed ozone gas into a 30 psig pipeline, with the specified full scale design which would mix ozone into a 8.5 psig pipeline. It was clear to Mazzei that the lower pressure of the full scale contactor would make it difficult to achieve the ozone transfer efficiency provided by the pilot plant, and extremely challenging for the full scale system to reach an ozone transfer efficiency > 90%.

The Solution: To improve ozone transfer in Monterey Pure's full scale plant, from a process design view an easy solution would have been to increase the working pressure of the pipeline contactor. However, the energy cost of pumping against a 30 psig pressure made this an unattractive option. Therefore, Mazzei's design approach focused on two other process parameters that affect ozone dissolution—the applied ozone dosage and the kinetics of gas mixing and dispersion.

With the use of multi-phase computational fluid dynamics (CFD) modeling, Mazzei conducted multiple analyses to optimize the design. CFD modeling showed that injection of all of the ozone into a single PFR would create excessive gas saturation and localized high dissolved ozone residuals that would slow the transfer of ozone to

World Leader in Mixing and Contacting Technologies

Contact us today.

Mazzei Injector Company, LLC

500 Rooster Drive

Bakersfield, California 93307-9555

TEL 661-363-6500

FAX 661-363-7500

www.mazzei.net

solution. Since gas dissolution contact time in pipeline contactors is measured in seconds, not minutes, the reduced ozone transfer rate would reduce ozone transfer efficiency. Consequently, Mazzei proposed an alternative design that replaced the specified, single PFR with two shorter-length PFRs, to create two lower dosage dissolution zones and reduce localized gas saturation and dissolved ozone residuals (FIGURES 1 & 2 BELOW ARE EXAMPLES).

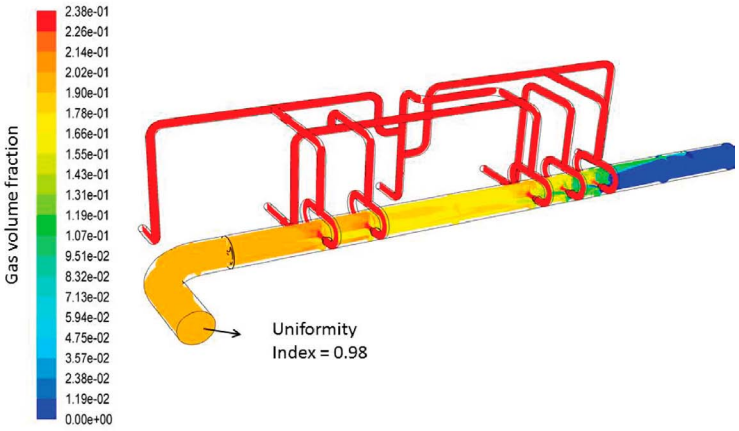

Figure 1. Contours of gas dispersion across representative cross-sectional planes, Case 1

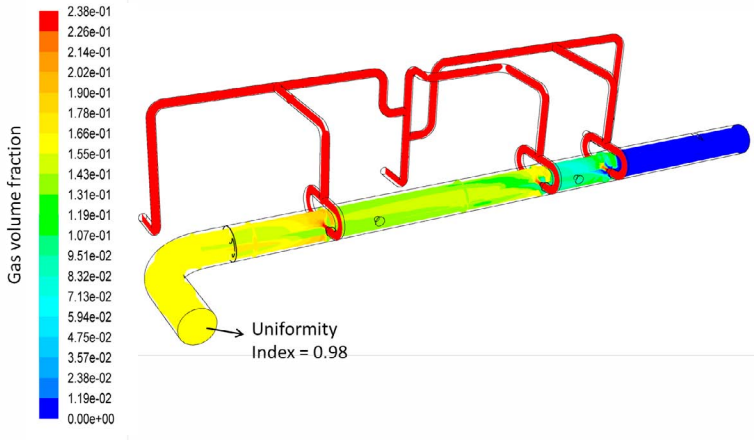

Figure 2. Contours of gas dispersion across representative cross-sectional planes, Case 2

The use of multiple sidestream injectors at separate PFRs would give plant operators a wide range of flexibility in the operation of their ozone dissolution system. Plant operators could choose to adjust the ozone transfer efficiency and the energy cost of gas injection by choosing the number of duty sidestream injectors used. Depending on the wastewater quality, periodic operation at a lower ozone transfer efficiency—using fewer sidestream injectors—may be more cost effective than maximizing the number of duty injectors in operation.

Conclusion: Ozone pilot plants designed to determine the required ozone dosage for full scale plants, frequently use gas contacting conditions which cannot be economically scaled up for full plant operation. This is especially true for water reuse projects, which often require a high transferred ozone dosage to optimize the operation of their advanced wastewater treatment process.

Recognition of the discrepancy between the pilot plant and the full scale gas contacting parameters of Monterey Pure's ozone system, prompted Mazzei to modify the full scale ozone dissolution system... changing from a single PFR to dual PFRs to decrease the localized applied ozone dosage and increase the time interval between the multi-stage ozone additions.

Multi-phase CFD modeling was used to design the project's PFRs and to determine the optimum placement of the PFRs in the pipeline contactor. This final design—which is currently in fabrication for installation in late 2017—was selected based on its uniformity index , an index that measures the homogeneity of the gas-liquid mixture produce by the gas contacting system.

To get a better understanding about how a Pipeline Flash Reactor works, check out this animation.

Mazzei®

For additional information on how Mazzei can assist with your water treatment goals, contact us at:

Mazzei Injector Company, LLC
500 Rooster Drive
Bakersfield, California 93307-9555

TEL 661-363-6500
FAX 661-363-7500
www.mazzei.net