WATER ONLINE

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How To Cannibalize Your Own Technology

Source: Mazzei Injector Company, LLC

By Jim Lauria

Business people love to talk about "disruption." They pride themselves on eating their competitors' lunch. Where their markets used to be about raving fans, now it's about inspiring craving fans, fueled by "hunger marketing" and the fear of missing out. There's a lot of dog-eat-dog philosophy...which is why it's important for companies to be willing to cannibalize their own technologies.

"Wait. Cannibalize my own technology? Aren't I supposed to defend my technology from the other cannibals out there?"

That's my point. You've got to eat your own technology or someone else will.

The landscape is littered with the bones of companies that defended their great technologies and ended up watching the world march right past them. Whether it's Kodak or Blackberry or Studebaker's groundbreaking compact cars, being good isn't enough. You've got to take what you do well, break it open and figure out how to do it even better.

Groundbreaking Technology

Since 2002, pipeline flash reactors (PFRs) from Mazzei Injector Company have been cutting-edge mixing technology, concentrating a full mixing zone applications into a few feet of pipe. A sidestream flow of 5 percent or greater of the total volume in a pipeline is diverted and passed through venturi injectors, which use the pressurized flow of the sidestream to draw in ozone (or oxygen or air) and water and thoroughly mix it into the moving liquid. That sidestream slurry is then directed through special mass transfer multiplier (MTM) nozzles into a compact length of pipeline. PFRs efficiently inject, shear and mix the sidestream slurry into the main flow.

Inventor Angelo Mazzei poses with a Pipeline Flash Reactor™ (PFR). Mazzei's system replaced large mixing zones with compact assemblies that fit into pipelines. Recently, the company upgraded the approach, adding new mixing technologies.

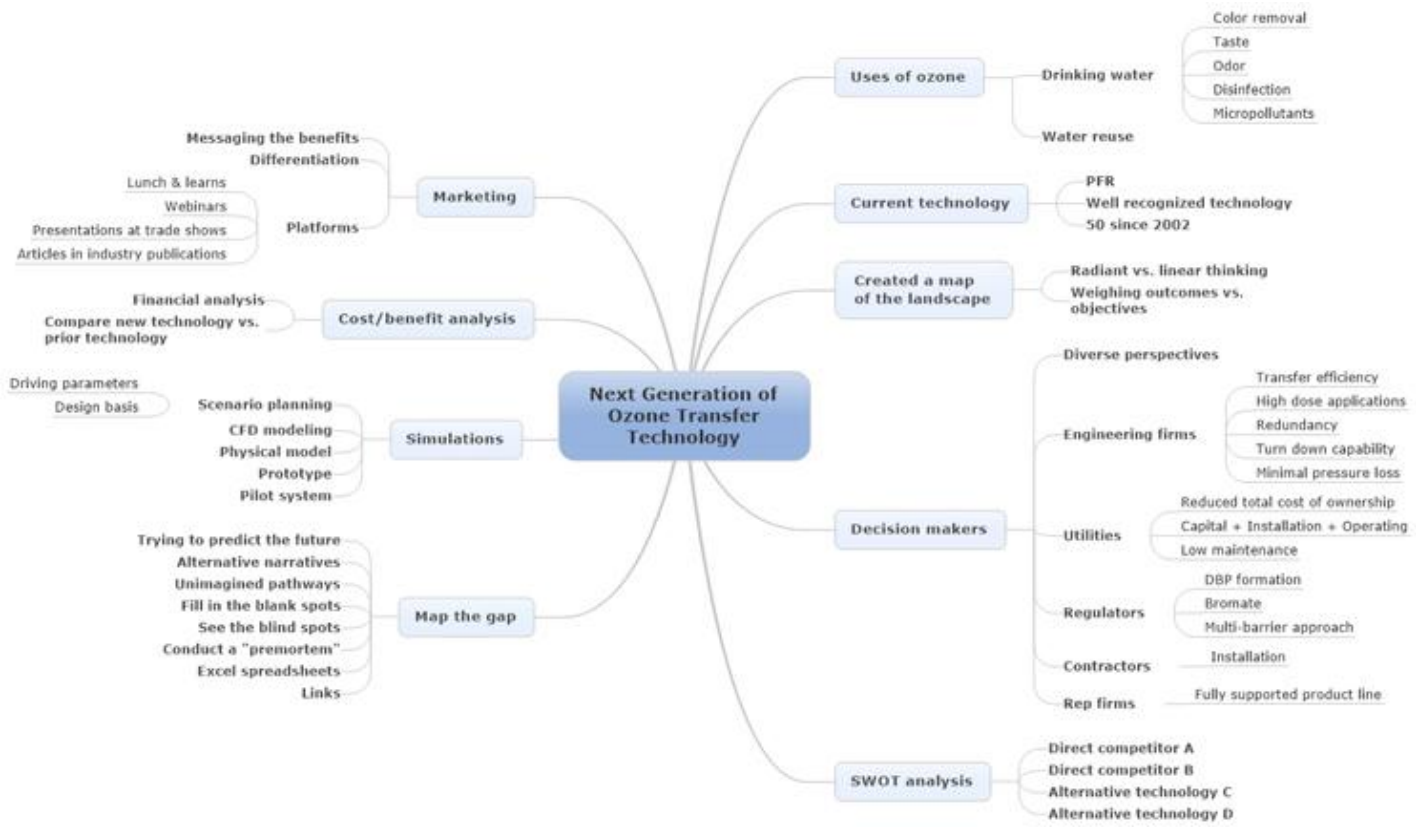
PFRs operate with minimal head loss. They are fully scalable and customizable. And with no moving parts, maintenance is almost a non-issue.

Mazzei has installed PFRs around the world in municipal water treatment plants, finding particular success in ozonation systems for water reuse. Water reuse systems often require high doses of ozone — often over 10 mg/L — which can be a challenge to mix effectively with water, even with large mixing basins.

Our PFR was getting high ratings from customers. But despite our success, we realized that we needed to keep thinking, keep improving and keep asking questions. We needed to take this successful technology and make it even better before somebody else figured out how.

Map, Then Ask Directions

We started with a map of the landscape. We engaged in radiant thinking, reaching out in many directions from a central concept and following radiating thought patterns that, in turn, branched in new directions. Radiant thinking is the opposite of linear thinking—you're free to follow ideas wherever they take you, or head off in new directions, and link ideas together.



Creating a mind map taps into radiant thinking, allowing ideas to track in many directions. The practice is ideal for assessing inputs from diverse sources and planning a variety of deliverables.

Following the branches on our map, we identified the key decision makers in the PFR universe. It's a diverse crowd, from engineering firms to contractors to municipal utility managers to regulators. Engaging all those perspectives was sure to deliver ideas we hadn't thought about.

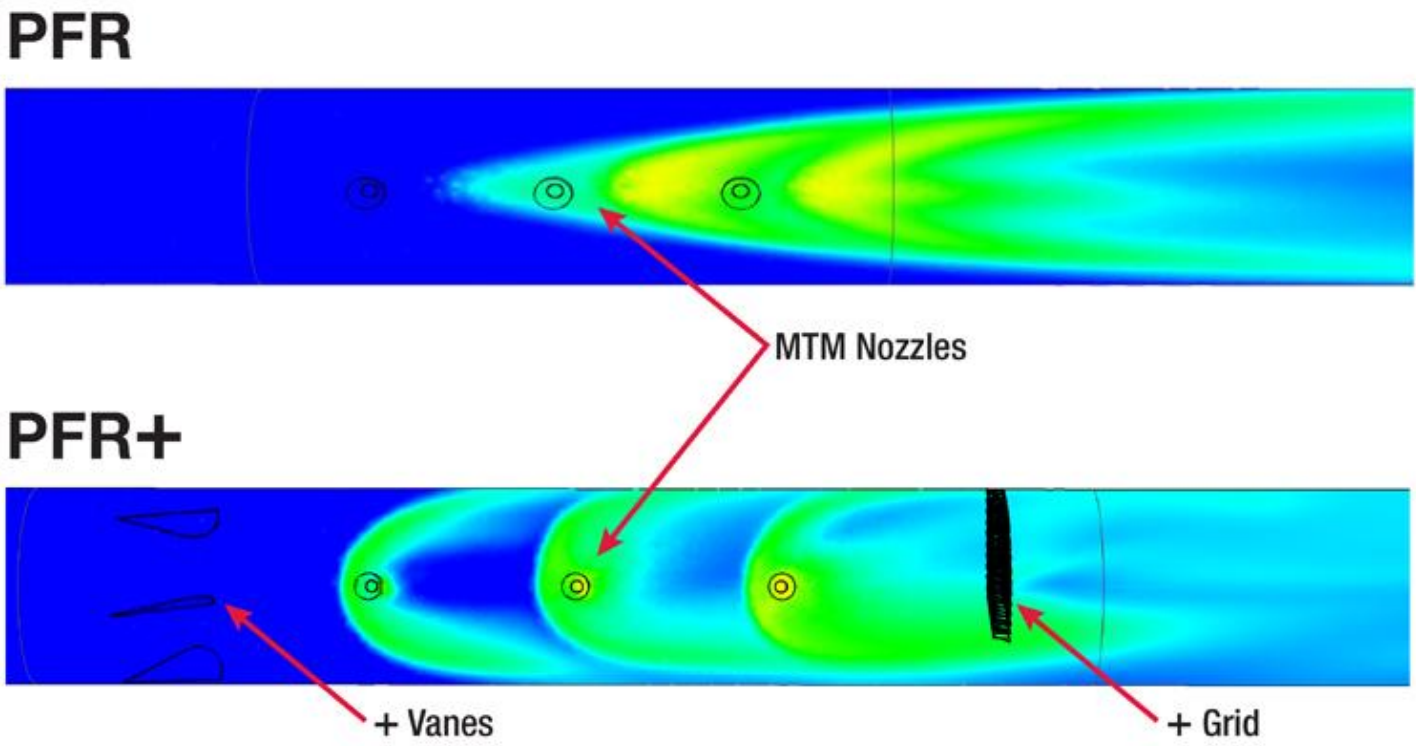
Then we went out and asked them about mixing: how they mix ozone and water; what they need; and where they see the challenges. And, as expected, we learned things we hadn't considered.

New Insights

Engineers, not surprisingly, focused on efficiency — mass transfer efficiency, maintaining pressure in the system, dealing with high-dose applications, and maintaining performance across all plant flow rates - even when flow rates were much lower than normal, which they call "accounting for turndown." Contractors wanted to talk about the efficiencies and nuts and bolts of system installation.

Utility managers focused on cost, from capital investment and installation to operations and maintenance. Their concerns often brought us into discussions of the total cost of ownership of a system.

Regulators thinking about ozone quickly aired concerns about bromate and other disinfection byproducts (DBPs), and are always looking for a multi-barrier approach. And manufacturers' reps wanted assurance that whatever system we presented was part of a fully supported product line.



This computational fluid dynamics (CFD) model illustrates the difference in mixing between the Mazzei Pipeline Flash Reactor (PFR), top, and the company's new PFR+ (bottom). Vanes, nozzles and a mixing grid in the PFR+ combine to maximize shear and improve performance at high turndown ratios.

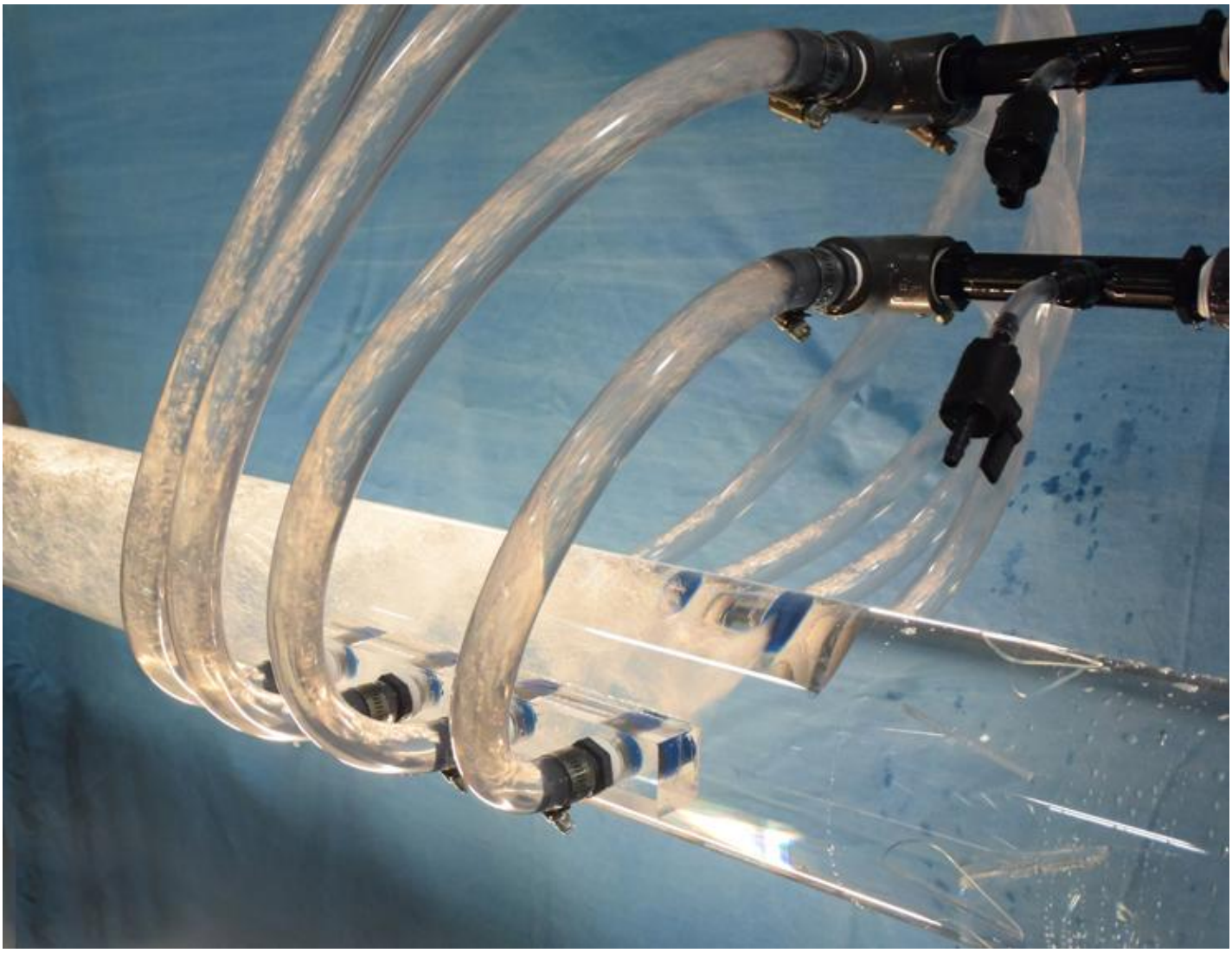
Talk about a 360-degree look at a technology.

With that insight, we engaged ourselves in a visioning exercise — we "mapped the gap." That included trying to predict the future, from the technologies coming down the line for water reuse to the regulations utilities would have to abide by. We tried to imagine unimagined pathways our technologies could take, develop alternative narratives that described the industry of tomorrow, see the blind spots and fill in the blanks.

With the map of the gap and the perspective of our customers (and their customers), we created a much more detailed outline of what we needed to accomplish. It wasn't enough to outperform a mixing basin in a matter of a few feet of pipeline. It wasn't enough to do it with minimal energy

expenditure and almost no pressure loss. And even coming up with a better modular system that needed only to be bolted in place along the pipeline wasn't enough.

We clearly needed a PFR that could not only be efficient from the design, construction and cost perspectives, but one that could handle turndown with ease and mix ozone so quickly and thoroughly that it would eliminate concerns about bromates and DBPs.



The R&D team at Mazzei built this transparent bench prototype to study the mixing action inside the PFR+. Mazzei Mass Transfer Multiplier™ (MTM) nozzles blast ozonated or aerated side stream water into a main flow that has been churned by mixing vanes (visible in the right side of the photo).

PFR+

Drawing on our design engineering staff and computational fluid dynamics (CFD) capabilities, Mazzei developed the PFR+. The PFR+ incorporates flow conditioning vanes inside the pipeline, just upstream of the MTM mixing nozzles. Those vanes divert the pipe flow, impart angular velocity and

set the stage for a thoroughly turbulent mixing zone. They also improve performance during turndown — even at dramatically low flows in systems with large turndown ratios. By the time the flow reaches the nozzles, it is already churning and mixing dramatically.

After the MTM nozzles inject, shear and entrain ozonated water into the main flow, the ozonated water passes through an aggressive angular mixing grid, which adds another opportunity to dissolve ozone into the water with virtually no head loss. In all, the water goes through four separate mixing steps — the injector, the vanes, the MTM nozzles and the angular mixing grid — all within just a few feet. Using precise measurements, our director of research and development modeled dozens of scenarios to zero in on the ideal specs and placement of every element in the PFR+. He also helped the sales team illustrate to clients how the system — customized to each client's individual needs — performs.

This animation illustrates the mixing action of the PFR+ as vanes churn the main flow, Mass Transfer Nozzles inject the gas/liquid slurry from the side stream, and the angular mixing grid enhances contact and mass transfer.

With system drawings and analyses of our conversations with the decision makers in hand, Mazzei penciled out SWOT and cost benefit analyses. We simulated a wide range of scenarios and parameters, built a physical model, and designed systems, ensuring that we are answering the questions posed by our customers. And now we're beginning to tell the story about how our technology got cannibalized — by us.