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Venturi Injectors Add Efficiency, Green Performance

JIM LAURIA

Odor in pulp and paper manufacturing is a huge issue—one that is growing increasingly important as the share of paper and paperboard products dedicated to food and beverage packaging increases. Beyond the long-standing problems caused by hydrogen sulfide and mercaptans in neighbor relations and nuisance complaints, there is little tolerance among consumers for the vinegar, Swiss cheese, or vomit odors of volatile fatty acids (VFAs) that can be entrained in paper or paperboard and released as the package is warmed.

Odor concerns increase further as plants go deeper into “green” technology. Recycled feedstocks and closed whitewater reuse systems can quickly build up massive populations of odor-causing bacteria. Gentler bleaches allow more microbes to survive. And large chests with long dwell times and “dead spots” in their flow can dramatically increase the tendency of a mill to go anaerobic, which raises the risk of dangerous buildups of toxic and explosive hydrogen sulfide as well as VFA-producing bacteria.

“As soon as you close that system, you’re retaining more of the organics and bacteria in the water,” says Mike Spillner of Mazzei Injector Company in Bakersfield, CA. “The

temperature is going to go up and oxygen levels will go down. You’re going anaerobic.”

BOOSTING OXYGEN LEVELS

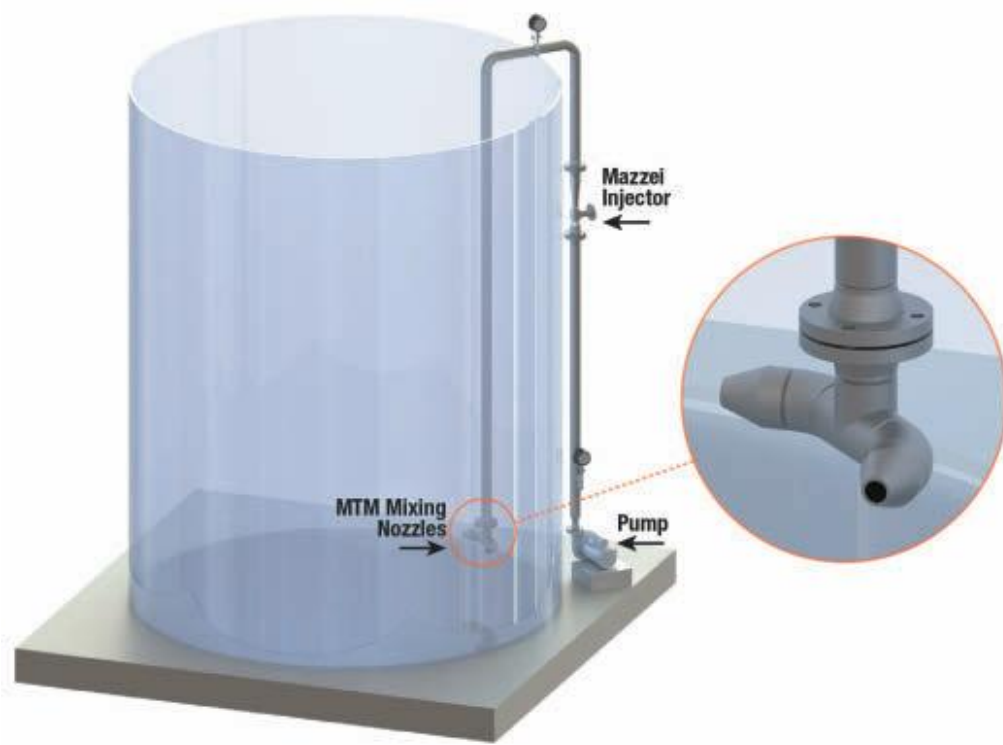
Three VFAs dominate odor management conversations: acetic acid, which gives vinegar its distinctive smell; propionic acid, which smells like Swiss cheese; and butyric acid, which emanates the aroma of rancid butter or vomit. All are produced in anaerobic conditions by bacteria that may either be strict anaerobes or facultative, which means they can function with higher levels of oxygen in the system as well as in anaerobic conditions. Hydrogen sulfide is produced almost exclusively by anaerobes.

Aerating the system shifts conditions to favor aerobic bacteria and control anaerobes,

eliminating hydrogen sulfide production and minimizing the formation of VFAs.

Venturi injectors are becoming an increasingly popular tool for aerating water supplies in a wide range of areas of pulp and paper mills, especially in full-recycle mills where the stakes are highest for odor control. Because they operate on the Venturi effect—in which the flow of water through the specially shaped pipe increases in velocity, creating a vacuum that draws air or oxygen into the stream—the injectors are extremely simple and highly efficient. The only maintenance demand is the upkeep of a single pump outside the tank. In contrast, spargers and their compressed air or oxygen systems require significant amounts of energy and maintenance.

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Whitewater chest aeration/mixing using a Venturi injector, mixing nozzles, and an easy-to-maintain external pump.

DEAD SPOTS

Anaerobic pockets due to dead spots in flow around the chest are also a significant concern with spargers or mechanical mixers. Mechanical mixers on the side or top of whitewater chests are even more costly to operate than spargers and more likely to leave anaerobic pockets. Maintenance, especially in the corrosive environment of a pulp mill, is frequent, unpleasant, and demanding.

Spillner says customers often comment on the benefits of nearly eliminating maintenance with Venturi systems. “One customer summed it up by telling me, ‘it does the job that my previous aeration equipment was doing, but I never have to worry about it when it comes to maintenance,’” Spillner says.

GREATER GAS TRANSFER

The efficiency of the Venturi injector extends beyond cost savings in operation and maintenance. As air is drawn into the system by the flow of water in the injector, it is sheared and mixed thoroughly with the whitewater, maximizing gas transfer efficiency.

A recycle mill was having significant problems with VFAs. By installing a Mazzei injection system and maintaining an existing hydrogen peroxide regimen, the mill reduced butyric acid concentrations to approximately 15 parts per million (ppm) from untreated levels as high as 400 ppm; lowered propionic acid levels to about 30 ppm from untreated rates as high as 600 ppm; and brought acetic acid concentrations to less than 590 ppm from untreated levels of as much as 1,600 ppm.

In that mill, operators were able to dramatically reduce the rates of biocide they applied—a key indicator, and a key benefit, of thorough aeration. Because properly aerated water minimizes populations of anaerobic bacteria and reduces biofilm, Spillner notes that customers often comment on the cost savings and benefits of decreased chemical handling that result from the reduction in biocide demand.

Reducing anaerobic conditions and biofilm buildup is aided by discharge systems in whitewater chests that include specially designed nozzles that shear and mix the aerated whitewater with the tank’s contents. Using computational fluid dynamics (CFD) modeling, Mazzei has built significant expertise in optimizing the size, placement, and orientation of each nozzle to maximize gas transfer and create a mixing

pattern that eliminates dead spots in the flow around the tank.

CONTINUED GROWTH

A recent report from McKinsey, citing RISI data, highlighted growth in the container-board, tissue, and carton board segments of the industry; others have noted the growth of the recycled segment. In both cases, odor control is of paramount importance. A system that provides excellent odor control while boosting

a mill’s green credentials—through reduced consumption of both energy and biocides—is destined to grow, too. 

Jim Lauria is vice president of sales & marketing for Mazzei Injector Company, LLC, a fluid design company that manufactures mixing and contacting systems. Lauria has more than 20 years of global water treatment experience in the agricultural, municipal, industrial, and commercial markets. Contact him at jlauria@mazzei.net.