flowback to the future

By Shea Casey

Turbine aerator demonstrates efficiency in flowback & produced water tests

In the early fall of 2012, a small municipal wastewater treatment plant in Texas experienced motor failure on one of its four floating aerators. When asked, the local motor repair company advised against the replacement of the motor. Instead, it recommended that the entire floating aerator be replaced with a new turbine aerator that had recently entered the market. The motor company felt that a 2-hp turbine aerator could outperform the failed 5-hp prop aerator. The plant manager agreed to the replacement.

The new aerator performed beyond everyone's expectations. It was not long before the manager had replaced all four of the prop aerators with new turbine aerators. During the change-out it became apparent that two of the new 2-hp turbine aerators could generate almost as much dissolved oxygen as all four of the larger 5-hp aerators. Stated differently, that is the equivalent of 4 to 20 hp. The savings in power costs were significant.

In early 2012, Richard Owens, engineering consultant to VaraCorp LLC, which introduced the turbine aerator, searched for the most contaminated water he could find to test its performance. He settled on hydrofracturing flowback water, known to be highly contaminated with fracking chemicals, hazardous biocides and anaerobic bacteria.

Aerator Testing

Working in conjunction with two chemical companies, Owens and VaraCorp tested the new turbine aerator in both flowback and produced water. The tests were conducted in 20,000-gal frac tanks. Within minutes after the turbine aerators were turned on, the foul chemical odor emanating from the manhole covers on the tanks had disappeared. Within seven hours, all 20,000 gal of the jet-black water in each tank had turned almost clear.

Water samples were collected approximately every hour and were tested by one of the chemical companies for various contaminants. With each passing hour, almost all of the contaminant levels began to plunge.

These results attested to the power of dissolved oxygen to redress contaminant issues. More importantly, the tests showed the versatility and efficacy of the new aerator.

The process behind the aerator entails a combination of the scientific principles of centrifugal force and precession as applied to rotating fluids. As the turbine spins beneath the water, it creates a low-pressure zone within its internal chamber. A hollow air shaft connects the turbine to the air above the water surface. Atmospheric pressure at the surface forces air down the air shaft into the turbine, which then slings this air into the surrounding water in the form of dissolved oxygen.

The result is an underwater cloud of superfine bubbles. The turbine can push this cloud outward in excess of a 70-ft diameter. Further, it can push the cloud downward up to 10 ft.

Today, there is a societal effort to protect and/or reuse precious water resources. Even if wastewater must be disposed, the goal is to convert it into the most eco-friendly state as reasonably possible. Wastewater engineers have long known about the power of oxygen to address the issues presented by water contaminants. The challenge has been to find an aerator that can hold up to the vagaries of wastewater treatment sites. Bubble diffusers, for example, can become clogged. Prop aerators can become tangled with plastic bags or other debris.

The frac tank tests revealed another result: The turbine aerator was able to reduce biocide costs. Frac operators and municipal wastewater engineers often use biocides to kill pathogens. Many biocides, however, react with water contaminants and end up being consumed as oxidizing agents and not as disinfectants. In other words, the contaminants interact with the biocide to create new (oxidized) compounds, thus reducing the availability of the biocide to act as a disinfectant. As a result, larger quantities of biocides must be used to actually kill pathogens.

The dissolved oxygen injected by the turbine aerator served to oxidize the contaminants in the frac tanks, thus reducing the amount of biocide used by the second chemical company. Specifically, the amount of biocide needed in the frac tanks for the final microbial "kill" was less than half of what would have been expected.

Forward Thinking

By reducing chemical and chlorine-specie biocides, turbine aeration offers a low-cost contaminant level reduction. The turbine aerator, therefore, is being viewed as a means of pretreatment for black water remediation. Exciting new technologies are being developed to treat water for recycling, notably in frac operations. Many of these technologies will perform better and at a lower cost if the water is pretreated with dissolved oxygen.

Conserving freshwater resources via recycling has long been possible. The issue often has been the attendant cost. The turbine aerator represents a step forward in low-cost pre- or post-treatment of contaminated water, making it more suitable for recycling. WWD

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Above: The turbine aerator can be considered a means of pretreatment for black water remediation. Below: This split image shows the frac cure tank before and after turbine aeration.