by Ann Hasbach, Contributing Editor

Advanced Oxidation Provides Hands-Off TCE Destruction

For more than five years, one of the nation's largest advanced technology and manufacturing companies has relied on advanced oxidation technology (AOT) to remove trichloroethane (TCE) from groundwater at a former tool and die manufacturing site in Massachusetts. In addition to TCE, the organic contaminants include 1,2-dichloroethene, tetrachloroethene and 1,1,1-trichloroethane.

Manny Vazquez, project engineer, recalls the team's decision to install what in 1990 was considered very new technology. "We did a feasibility study comparing conventional air stripping with advanced oxidation," Vazquez says. "We followed that up with pilot tests and a bench scale study.

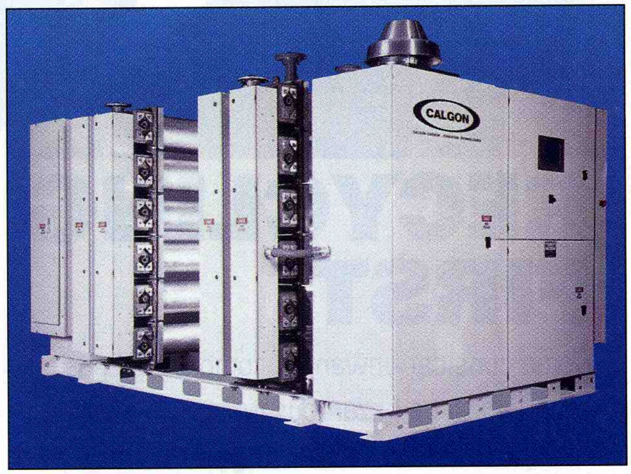
"Advanced oxidation was the only technology we evaluated that could meet our treatment objectives, which were to reduce the TCE and its degraded products from as high as 20 ppm to below 5 ppb."

Based on the evidence of the pilot tests and bench scale study, the company installed a perox-pure system from Calgon Carbon in 1991. Also critical in the decision to choose advanced oxidation was the fact the plant was completely automated, requiring no employees onsite. A remote sensing alarm notifies contractors in the event of failure.

The system uses a high-powered, medium-pressure lamp that emits high-energy ultraviolet (UV) radiation through a quartz sleeve into the contaminated water. An oxidizing agent, in this case hydrogen peroxide, is added to the contaminated water and is activated by the UV light to form hydroxyl radicals. The hydroxyl radical typically reacts with pollutants one million to one billion times faster than chemical oxidants like ozone and hydrogen peroxide.

In the five years the advanced oxidation system has been operating at this site, on-line performance has been better than 99 percent, according to Vazquez. "Less than one percent downtime is due to routine maintenance, inspection and cleaning of the system. Other than that, it continues to run and the destruction efficiencies continue to be achieved without fail."

When considering an oxidation system, Vazquez advises, "The clarity or conditions of the influent may be the deciding factor. If you have a lot of solids, high turbidity or metal content, you will have to consider front-end treatment. Operating costs are another issue. The cost of electricity should be carefully weighed against the lack of disposal expenses and on-site attendance."

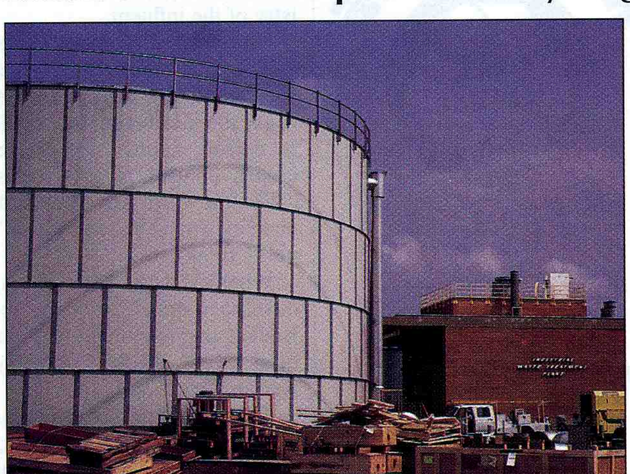


A major manufacturer considered such factors as unattended operation and low maintenance when it chose to install advanced oxidation technology.

In his case, Vazquez points out, "If we had selected air stripping, for example, we would have had to contend with air permitting. Treating those emissions would probably have required activated carbon, which would add secondary disposal issues and cost. With oxidation, the contaminants are not transferred from one medium to another. They're totally destroyed. Disposal costs are not a concern."

Circle No. 225

Extreme Wastewater pH Poses Recycling Challenge



A one-million-gallon, custom-made tank holds water awaiting recycling at Boeing's Wichita plant.

When The Boeing Co.'s Wichita, Kan., airplane plant sought to achieve both cost savings and environmental objectives by scaling up its wastewater recycling program to more than a million gallons per day, the hostile influent stream was a major challenge.

"This is not your ordinary influent, even by industrial standards," says Dr. John W. Clarke, biologist and senior manager, Environmental Operations, at Boeing Wichita. "This is a very aggressive influent. Most of it comes from our Manufacturing Process Facility (MPF), where one batch of wastewater may have a pH of 1 and the next a pH of 13."

The MPF is where metal airplane parts are cut, cleaned, heat-treated, etched, anodized, painted and put through numerous other processes. Often these steps involve dipping in 20,000 to 30,000 gallon tanks that are periodically dumped and refilled. This means that at any given moment the influent might contain solvents such as trichloroethylene, perchloroethylene or acetone; while the next batch may be chromated salts; the next etching acids; then degreasers, cleaners and surfactants. Other batches might contain glycols, coatings or fluorescent dyes. And always, solutions contain heavy metals such as chrome.

One of the first steps in the plant's multimillion dollar upgrade was selecting a one-million-gallon storage tank to hold the variable pH influent after it has passed through initial screenings for trash, oil and grit at the Industrial Waste Treatment Plant (IWTP). The influent has been blended and diluted before being pumped to the storage tank for recycling, but it must be held there for anywhere from several hours to several days before it enters the stream for treatment prior to recycling. This storage tank requires a coating that stands up to the continuously changing chemistry of the influent.

"We wanted to use a bolted steel tank because it involved substantial cost savings and because the interior coating could be factory applied for greater quality control," Clarke notes. "We knew an off-the-shelf coating for that tank wasn't going to work."

What has worked is a coating developed specifically for the Boeing application by Columbian Steel Tank Company, Kansas City, Kan.

"Normally, tank coatings can handle pH variations of 3 to 11," explains Columbian Steel Tank Sales Manager Pat Wilson, "but this application was well outside those parameters."

"We looked at all our coating possibilities and determined we really needed to invent a new one. It had to be a thicker coating, but one that would retain its flexibility, that wouldn't crack when the bolts go through it, and that would hold up to the two-coat, heat-curing process at our plant," Wilson explains.

It took three months and four experimental coatings to perfect the one used for Boeing. And it wasn't just the coating that was new. By the time the process was completed, Columbian Steel Tank had changed the coating application equipment and nozzles, and even some of the procedures on their line. They used different gasketing on the Boeing tank, as well, according to Wilson.

From the holding tank at Boeing, the influent is pumped as needed to a bank of reverse osmosis chambers. These units were already in place to further purify city water, but considerable excess capacity has allowed it to be used for the entire recycling program. After passing through reverse osmosis, air strippers remove any remaining volatile organics.

"The water is held in another one-million-gallon bolted steel tank and drawn off to process through reverse osmosis as needed by the MPF and by four of our larger cooling towers at the plant," says Clarke. "If the system senses a drop in pressure, city water kicks in to make up the difference, but that water has a different chemistry and must be treated before it's used."

The savings to Boeing is already $300,000 a year in city water purchases. Boeing has achieved a 90-percent reduction in wastewater leaving the site, and the program is still in the shake-down phase. In the near future, a new control room for the IWTP will enhance the performance and monitoring of the recycling program, and additional capacity and distribution will take recycled water to all 43 of the plant's cooling towers and buildings.

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