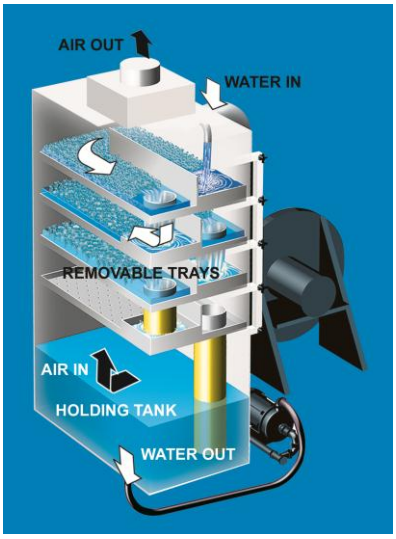
Effective Drinking Water Cleanup Using Air Stripping Technology

By Liz Jones for QED Environmental Systems, Inc.

Some of the most common volatile organic compounds (VOCs) found in public water supplies are easily removed using air stripping technology. Air stripping is a process that removes or "strips" VOCs from water by contacting clean air with contaminated water across a high surface area, causing the VOCs to move from the water into the air. It is a very simple and robust process – as long as air is mixing with water, contaminant removal continues. There are different types of air stripping technology, but the most common are packed towers where contaminated water flows over packing media, and stacked tray or sliding tray systems, which use a turbulent mixing to create high air to water surface contact.



The counter current flow of a tray air stripper.

The air stripping process is governed by Henry's Law. The Henry's Law constant (H) of any dissolved contaminant can be used to predict how effectively that contaminant will be driven from the water into the air. Some contaminants are easier to strip than others, for instance, vinyl chloride strips easily, benzene less so, and MTBE is relatively difficult to strip. A pilot test may be required to determine the expected level of stripping if the mixture entering the air stripper contains free-phase organics, or non-volatile, polar organic chemicals since these contaminants impact H values for the full range of VOCs present in wastewater. Temperature also affects the stripping process – higher water temperature increases stripping.

Air Strippers: A Comparison

Removal efficiency

All air stripping technologies are capable of meeting stringent removal efficiency requirements of greater than 99% for many of the target VOCs found in drinking water. However, fouling conditions and changing influent rates are a challenge for tower strippers, since the packing media can become clogged and inefficient. The upper liquid distribution piping in tower stripper is optimized for a given flow, so higher or lower liquid flow rates can lead to flooding or channeled flow that further reduces efficiency. In contrast, the froth transfer zone in tray strippers is relatively immune to fouling. The design of tray strippers provides for a wide flow turn-down, since water depth is established with weirs in the flow channels, allowing stripping to continue even if the liquid flow is zero. When there is a high total water flow, air stripper units can be used in parallel to handle significant influent into the system.

Cost

Capital costs for packed towers and tray systems are similar at low flow rates. At higher flows and removal rates, packed towers can become more cost-effective than the tray stripper technologies. But, the annual O&M costs of tray systems are lower because trays are much more resistant to fouling than

the costly packing media used in a tower, and the smaller systems are much easier to inspect, clean and maintain. A sliding tray air stripper can have a labor cost savings as great as 80% over a packed tower because cleaning the unit is essentially a one-person job. In general, O&M costs increase with the number of units required for a given flow rate, regardless of technology, since more units require more power and maintenance.

Size

Packed towers can be very tall and usually require cranes and heavy equipment during installation. The tower itself may require insulation as its efficiency can be reduced in cold climates. Generally, tray strippers can be installed indoors, but stacking tray strippers have to be accessed from all sides for installation and maintenance. Sliding tray air strippers can have a total footprint up to 60% smaller than stacking tray strippers because they only need to be accessed from the front.

Maintenance

The condition of packed tower media is difficult to observe, and it is prone to fouling. If the media gets fouled with scales or other solids it will have to be flushed with an acid solution or replaced. Packed towers have to be shut down for maintenance, and many can only be accessed by ladders on the outside of the tower. Most tray air strippers are easy to monitor and inspect even while in operation. But, stacking tray strippers may require overhead cranes or hoists to lift the trays, and the piping connections need to be broken to service the units. For most sliding tray strippers, the trays can be removed, pressure washed, and replaced by one person with no need to break piping connections.

Cheyenne, Wyoming's groundwater treatment plant, outside view.

Four E-Z Tray Air Strippers inside Cheyenne, Wyoming's groundwater treatment plant (pictured above).

Air Strippers: Drinking Water Treatment Case Studies

The U.S. Army Corps of Engineers (USACE) – Omaha District has funded the design and construction of a new groundwater treatment plant in Cheyenne, Wyoming, to treat groundwater from the city's Borie well field. This important groundwater supply was apparently contaminated with tricholorethene (TCE) in the late 1960s at the Former F.E. Warren Atlas Missile Site 4. The new facility was designed, constructed and placed into long-term automatic operations by Boise, Idaho-based firm McMillen, LLC. Matt Moughamian, McMillen's project manager says, "For the given application, the most logical and cost effective groundwater treatment choice was low-profile air strippers. Furthermore, the air stripping technology was able to be

implemented into the city's existing well field hydraulic profile at a location where repumping of the water was not required. This provided a big advantage and further incentive to use a reliable, low-profile air stripping technology, such as that offered by QED E-Z Tray® Air Strippers."

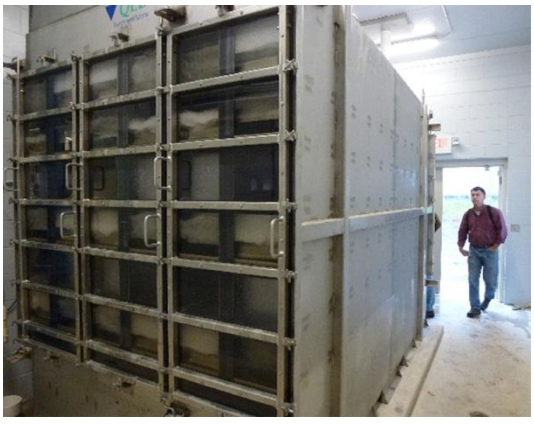
A total of four, 6-level tray E-Z Trays, each with a treatment capacity of 1,000 gpm, were used in McMillen's design to insure that the TCE treatment goal of less than 2 ppb could be reached without pretreatment. Moughamian says the E-Z Tray units chosen for the Cheyenne treatment facility have more than enough capacity to handle the city water's contamination load, "and there have been no issues so far."

In October 2011, the Cedarburg, Wisconsin Light and Water Utility installed a QED E-Z Tray Air Stripper in a discreet addition to their existing production pump building. The E-Z Tray 72.6 handles a flow rate of 600 gpm and treats groundwater containing vinyl chloride that has been traced back to a nearby landfill. The current influent into the Air Stripper is drinking water with less than 1 ppb of vinyl chloride, and the goal is complete removal.

The exposed ladder on the packed tower treating TCE in Cedarburg, Wisconsin.

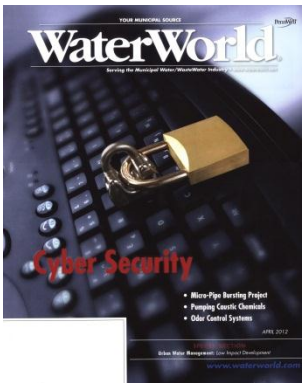
Cedarburg has been using a packed tower air stripper for 18 years to treat TCE at a different supply well location, but when vinyl chloride contamination needed to be addressed, Cedarburg Water Utility Supervisor Tim Martin started looking into alternative treatment options because of numerous design issues with the packed tower. The treatment facility sits adjacent to a residential neighborhood, so the Utility also wanted to avoid the conspicuous nature of a tower. "The packed tower system necessary to treat the vinyl chloride would have to be constructed outside and would have been about 40 feet tall. Competitive price was a factor in choosing an E-Z Tray, but I liked the fact that the whole process could be constructed indoors." Martin says.

Because the EPA requires 99% removal of all VOCs, the Utility needed an efficient and reliable system. Martin realized the Utility could over-design their E-Z Tray system to not only treat the current level of vinyl chloride at the 99% removal rate, but be ready to treat any increases in vinyl chloride or other contaminants that may occur in the future. "We are only utilizing four of the six trays in our system right now," Martin says. "Hopefully there won't be any major changes in the groundwater, but we are ready for the future."



The E-Z Tray Air Stripper inside Cedarburg, Wisconsin's pump building.

About the Author: QED Environmental Systems in Dexter, Michigan, is a leader in environmental monitoring and remediation equipment. For more information on air strippers for drinking water applications visit www.qedenv.com/airstripper, contact sgauss@qedenv.com or call 800-624-2026.



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