PE0908 Air/Water Instrumentation

The Next Wave in Air Purification

Some rare microorganisms collected all over the world may be the key to control technology for hazardous air pollutants and volatile organic compounds catching up to the lofty expectations of government and environmentalists.

By Edward D. Seagle, P.E.

Before the 1990 Clean Air Act amendments, the EPA regulated air toxics one chemical at a time. However, from 1970 to 1990, the agency established regulations for only seven pollutants. The 1990 Clean Air Act amendments instead required the agency to identify 187 industrial sources of pollution by categories. The amendments also directed the agency to require sources to install controls or change production processes.

The EPA has published regulations covering a range of industrial categories, including chemical plants, incinerators, dry cleaners and manufacturers of wood furniture. The law requires the agency to first set regulations using a technology-based or performance-based approach to reduce toxic emissions, such as hazardous air pollutants (HAPs) and volatile organic compounds (VOCs) from industrial sources.

The idea behind regulating by categories is that multiple pollutants often come from the same source. Modern HAPs/VOC removal filters are designed to receive airflow from an existing or proposed air-exhaust stack. Filters can be sized to a removal efficiency of more than 99 percent for many industries, including coatings, epoxy resins manufacturing, fabric coating and dying, fiberglass manufacturing, formaldehyde resins production, furniture manufacturing, paint manufacturing, pharmaceuticals production, printing industry, resins production, and tire manufacturing, among others.

Such efficiencies have been achieved thanks to a specific grade of granular activated carbon, an approach velocity through the carbon of less than 75 feet per minute, an 18-inch depth of carbon bed, and a relative humidity in the air stream of less than 50 percent.

Modern filtration

Since these regulations went into effect, technology has caught up to the high expectations of the federal government. Advances in filtration have allowed almost the entirety of HAP and VOC emissions to be removed from industrial sources. But taking a look at one such modern filtration device can demonstrate how hard it actually was to get there.

One modern filter for such applications is comprised of a stainless steel outer housing with a rotating drum mounted inside the housing. The rotating drum contains an 18-inch layer of granular activated carbon sandwiched between layers of perforated steel, and steel screens through which the exhaust air must pass in order to exit the filter.

HAPs and VOCs are adsorbed onto the carbon. The rotating drum cycles through a water bath in the bottom of the outer housing with approximately 30 percent of the carbon in the drum being submerged at all times, and the pollutants are leached from the carbon into the water by use of a microbial product placed in the water.

The drum rotates at three revolutions per hour. The water is aerated by the blower unit and contains a proprietary assemblage of microbes. The microbes degrade the pollutants into carbon, CO_2 and water, and the filter has a clean bed of carbon as it emerges from the water bath. The microbes must be added every four weeks to maintain a viable colony for consistent degradation. The microbes will reduce the contaminants in the water to near EPA drinking water standards for the contaminant. This is accomplished without a sludge buildup of any kind.

The filter is equipped with its own aeration system and rotating drive assembly. The total electrical requirement is 1½ horsepower for the standard systems. The filter housing and screen arrangement is constructed of 304 stainless steel. The aeration piping is schedule 40 PVC or 304 stainless steel. The blower is capable of delivering 70 CFM @ 40 inches of water column.

Meet the microbes

The microbial population is a particular assemblage of natural microorganisms initially selected to bio-remediate hydrocarbons. The microbes are effective on a range of compounds such as those found in furniture or fiberglass production. A major difference between these microbes and their indigenous cousins is their density, over 90 billion per gram. The organisms also can double in population every 15 minutes in a favorable environment. They are non-toxic and non-pathogenic. It is due to the special characteristics of this collection of microbes that modern filters can clean the carbon in place.

Removing odor

If the carbon used inside the rotating drum is replaced with catalytic carbon, the filter becomes an odor removal system for use on wastewater pumping stations or wastewater treatment plants. The difference with this system is the method of cleaning the carbon in place with no downtime. There is no high-acid water to dispose as long as the water bath section is discharged every month before the system is recharged with the microbial product. The water discharge can be treated as normal wastewater. ***PE***

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