Bioprocessing and Bioconversion of Gases and Vapors

Gas/vapor-phase bioreactors and biofilters are useful in a wide variety of applications to treat off-gases. For example, they can be used in environmental remediation systems such as soil vapor extraction and industrial process off-gas streams containing hydrocarbon and halocarbon vapors, odor control, and conversion of "greenhouse" and combustion gases (SO_X and NO_X). Contaminants are converted to innocuous by-products, such as CO_2, biomass, water and salts.

In thin-film gas-phase bioreactors and biofilters, microorganisms are cultured as a biofilm on support media in a gas-phase atmosphere. Depending on the application, the support can be inert materials, such as polypropylene rings used in biotrickling filters. Compost is used in biofilters. Targeted gas and vapor mixtures are passed into the bioreactor where they are degraded by microbes in the biofilm. It is believed that gas/vapor mass transfer limitations inherent in liquid-phase bioreactors are significantly decreased in the gas/vapor-phase bioreactors, thereby increasing conversion rates.

Progress

One INL biofilter, the Biocube, received an R&D 100 Award in 1993. It has since been developed and commercialized. A full-scale biofilter has been installed and is operating as a control technology for hydrogen sulfide and volatile organic compound emissions produced during the mixing of asphalt. This biofilter removes hydrogen sulfide components of the off-gas stream. Optimization of the system for complete treatment of all components of the off-gas stream continues. This work has demonstrated that biofilters scale linearly from laboratory units.

INL has also studied an anaerobic biofiltration system for removing SO_X and NO_X from combustion gases. Laboratory research showed high combustion gas removal efficiencies in biofilters operated at empty bed residence times of less than 13 seconds.

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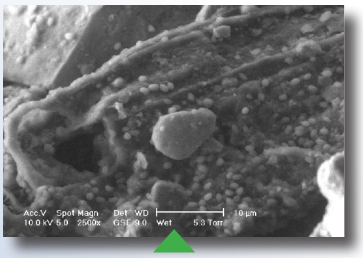

Micrograph of bacteria on biofilter media.

Asphalt vapors biofilter.

Experimental-scale NO_x biofilters.

The Energy of Innovation

Idaho National Laboratory

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Selected Publications/Presentations/Patents

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