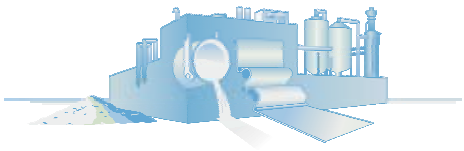
Reducing Emissions of Volatile Organic Compounds

Biological Treatment System Proposed To Control Emissions of Volatile Organics and Odors

A number of pollutants that originate from pulp mill operations fall under the Environmental Protection Agency's guidelines for controlling emissions of hazardous air pollutants (HAPs). Gas streams with high concentrations of HAPs are likely to be handled by incineration or steam stripping. These thermal treatment methods are highly energy-intensive, however, and result in high treatment costs. For more dilute gas streams (known as high-volume low-concentration (HVLC) gas streams), biological treatment technologies offer an economical alternative to thermal treatment methods.

HVLC streams are produced from a variety of plant processes. For example, chlorinated organic compounds are present in HVLC streams produced during bleaching operations. Other organic compound emissions of concern include methanol, acetone, aldehydes, terpenes, and benzene. The specific sources of these dilute gas streams might include foam breaker, filtrate, and black liquor tanks; knotter systems; brownstock storage tanks; pulp washers; oxygen delignification blow gas and washer areas; and others. Although odorous emissions from mills are not covered by EPA's rules, they are part of the 2020 Environmental Agenda, and their control is also desirable since they may contain such compounds as hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide.

Because the majority of the organic compounds emitted in pulp mill as streams are biodegradable, it is believed that biological treatment is an economically sound, technically-feasible method for their handling.



Benefits for Our Industry and Our Nation

- A simple, reliable, and economic method for treating contaminated gas streams from pulp mills and other industrial sites
- Beneficial also to municipal wastewater treatment plants, where odor control is a problem

Applications in Our Nation's Industry

A pilot plant was constructed and operated at Simpson pulp and paper mill in Tacoma, WA. This demonstration could lead to commercialization of the new process.

Project Description

Goal: To develop a shallow suspended growth sparged gas reactor (SSGR) system for the cost-effective treatment of HVLC gas streams.

Rather than employing conventional biological gas-treatment systems such as biofilters or biotrickling filters, both of which contain a media to trap odors and emissions, the investigators proposed further work on a non-media system. In the SSGR, the organic or the odor-causing inorganic pollutants were introduced as gas bubbles into a liquid phase containing a "suspended growth biomass," and the pollutants were transferred from the gas to the liquid phase as the bubbles move through the liquid. Even in a shallow reactor, where energy use and capital and operating costs are minimal, gas-liquid mass transfer rates can be efficient enough to remove more than 98 percent of the contaminants. The investigators determined the operating conditions that are most efficient for treating HVLCs, while minimizing the liquid depth of the reactor.

Results

- Performed tests with a bench-scale SSGR for treating a gas stream containing organic contaminants at 50°C, followed by tests of the treatment of a gas stream with reduced sulfur compounds, formaldehyde, and methanol. The latter laboratory SSGR was operated at temperatures ranging from 30°C-50°C.
- Designed, fabricated, and installed a 2.4-m diameter by 1.5- m high pilot plant at the Simpson Mill in Tacoma,WA. The pilot plant was fed exhaust gas from a pulp washer, and was operated for a short period at 30°C in September 2000, before a mechanical failure in the gas cooling system prevented further operation.

Project Partners

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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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