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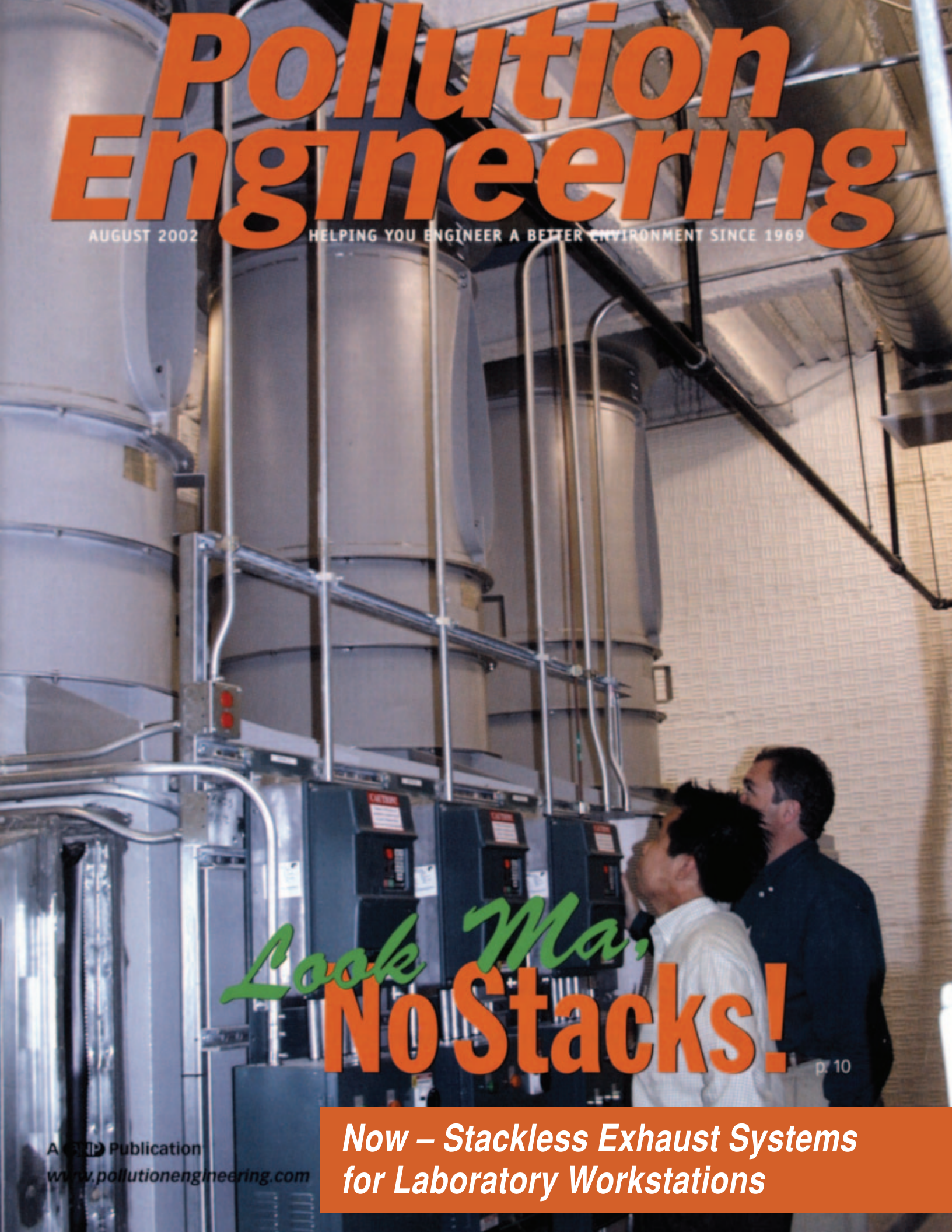

Look Ma, No Stacks!

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Now – Stackless Exhaust Systems for Laboratory Workstations

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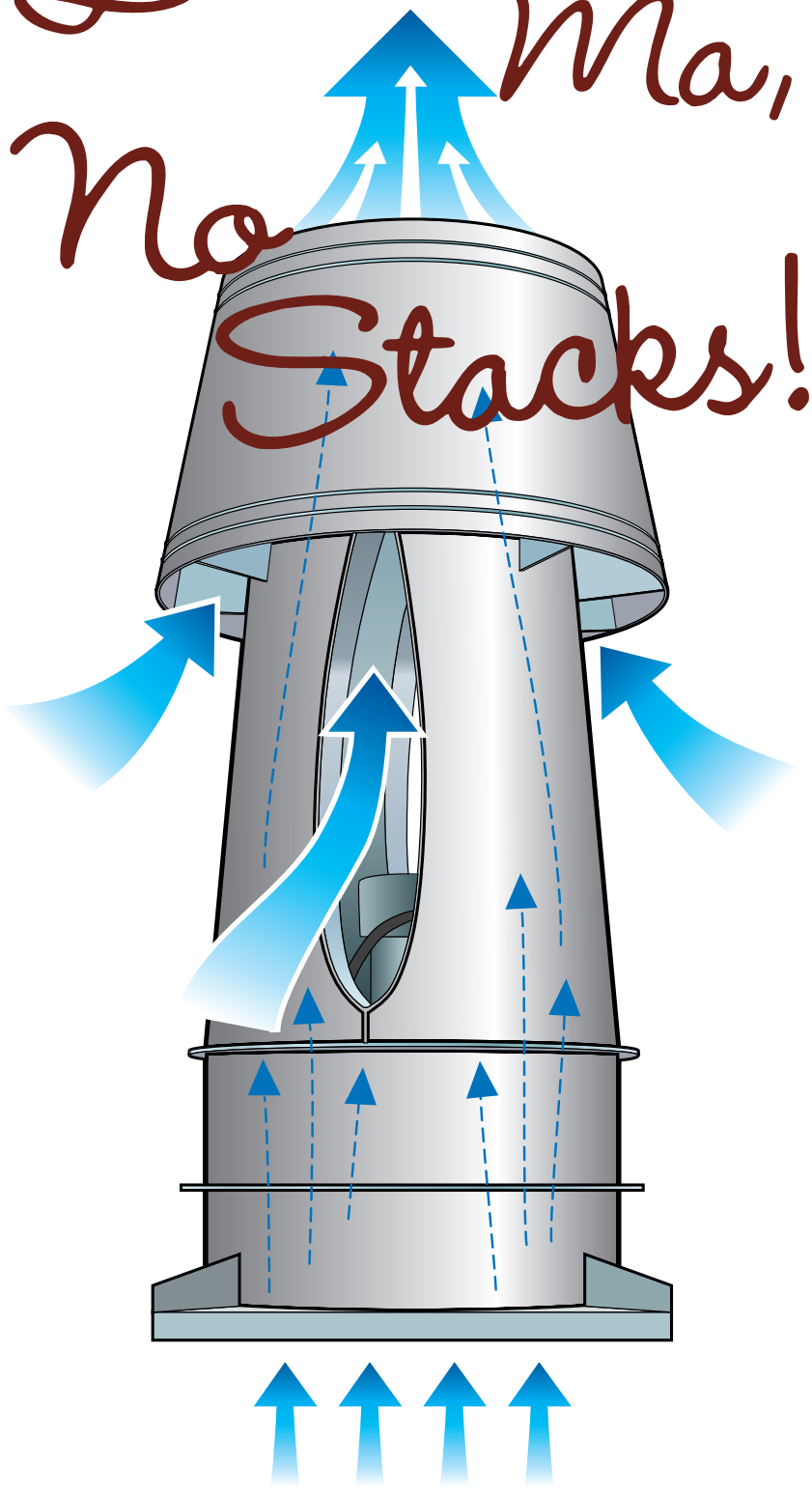
Look, Ma, No Stacks!



Exhausting laboratory workstations at pharmaceutical research facilities utilize a "no stack" solution.

By Paul A. Tetley

Pollution abatement professionals at high-technology research facilities—especially pharmaceutical and biomedical organizations—must deal with a unique set of exhaust management problems.

Typically, pharmaceutical/biomedical facilities require conditioned make-up air in all occupied work spaces. Most of the workspace inside these facilities is consumed by laboratories (and associated workstations). There can be hundreds of workstations in a single building, for example, with each one having a dedicated exhaust fume hood that must be vented into the atmosphere. Under no circumstances can 1) laboratory workstation fume hood exhaust create air pollution problems; 2), re-enter the building (or adjacent buildings); or 3.), generate objectionable odors in the neighborhood. Add these requirements to other considerations, and it's easy to see that exhausting hundreds of laboratory workstations at hi-tech facilities can present unique challenges.

Tall exhaust stacks connote air pollution

Obviously, tall exhaust stacks on a building's roof are perceived as "pollution generators," even if they're only emitting steam. Traditionally, they are expensive, complex and heavy because of associated mounting hardware, roof curbs, guy wires and so forth.

But how can they be eliminated? How can one send exhaust into the atmosphere without any visible exhaust stacks?

Those involved with issues of pollution abatement, odor management and indoor air quality (IAQ) at a hi-tech facility, usually would not consider using an exhaust system without any roof exhaust stacks. Until now, this has hardly been possible. Yet that is essentially what has been done at Pfizer Pharmaceutical's Global Research and Development facilities (LaJolla Laboratories) in the Torrey Pines area of San Diego. In the design and construction of its advanced pharmaceutical research facilities, Pfizer faced a number of tough exhaust management problems for their laboratory workstation fume hoods.

Two of these problems included limited and costly indoor space, and stifling building height restrictions. Use of conventional centrifugal fans for workstation exhaust was prohibited by interior space limitations and the need for tall, dedicated exhaust stacks on the roof. However, tall roof exhaust stacks were not an option: The 30-foot total building height

Eric Doan, mechanical engineer, and Don Crotty, principle, for TKG Consulting Engineers Inc.

restriction in San Diego prevented that solution. The solution did require unique thinking; however, instead of thinking "outside of the box" to develop a practical solution, the engineers and designers for this project thought "inside the box." In other words, they installed laboratory workstation fume hood exhaust systems inside of the buildings. That presented some interesting engineering challenges.

At Pfizer's new facilities (actually two buildings containing more than 220,000 square feet completed within three months of each other), there are about 175 laboratory workstations in use. Each workstation incorporates a dedicated fume hood for direct exhaust to the atmosphere—without any possibility of pollution generation (based on appropriate codes and standards) or re-entrainment. Both buildings are only three stories high (to comply with the height restriction), thus making it impossible to mount tall exhaust stacks on the roof. Both buildings also require 100-percent conditioned makeup air in occupied work spaces. With these restrictive parameters how does one exhaust nearly 200 laboratory workstations, without consuming valuable floor space, that conform to the limiting 30-foot building height.

Stacks? What stacks?

With these rules at hand, Don Crotty and Amy Hsu, principle in charge of providing laboratory HVAC systems and project engineer, respectively, at TKG Consulting Engineers Inc., of San Diego, created an interesting solution for Pfizer. Instead of suggesting dedicated centrifugal exhaust fans for each laboratory workstation fume hood (the traditional approach), they recommended that mixed flow impeller systems be used with the exhaust fans located inside the building, in specially designed "fan rooms" that require less than half the space of centrifugal fans. What's more, the exhaust stacks are not even visible from the property line since they only extend about 10 inches above the roofline—and a decorative parapet around the roof perimeter obscures them from view.

"We've used them before at the University of California San Diego project at Ritter Hall Laboratory, as well as Scripps Institute," says Crotty, the use of mixed flow impeller laboratory workstation fume exhaust systems supplied by Strobic Air Corp., of Harleysville, Pa. "However, this is the first project where we've put the fans inside the buildings (with slight modifications)."

Let it flow

Mixed flow impeller-type roof exhaust systems operate on a unique principle of diluting outside air with plenum exhaust air at high-discharge velocities, sending a powerful vertical exhaust plume up to 350 feet high.

Because they introduce up to 170 percent of free outside air into the exhaust stream, a substantially greater airflow is possible for a given amount of exhaust without additional horsepower, providing excellent dilution capabilities and greater effective stack heights over conventional centrifugal fans.

These systems also reduce noise, use less energy and provide enhanced performance with faster payback over conventional centrifugal laboratory fume hood exhaust systems, with typical energy reduction of $.44 per cfm at $.10/kilowatt-hour, thus providing an approximate two-year R.O.I.. Energy consumption is about 25% lower than conventional centrifugal fans with substantially reduced noise levels, particularly in the lower octave bands. They conform to all applicable laboratory ventilation standards of ANSI/AIHI Z9.5 as well as ASHRAE 110 and NFPA 45, and are listed with Underwriters Laboratory under UL 705.

The systems are designed to operate continuously without maintenance for years under normal conditions; direct drive motors have lifetimes of 200,000-hours. Non-stall characteristics of the systems mixed flow wheels permit variable frequency drives to be used for added variable air volume savings, built-in redundancy and design flexibility.

Virtually maintenance-free operation (there are no belts, elbows, flex connectors or spring vibration isolators to maintain) eliminate the need for expensive penthouses to protect maintenance personnel under adverse conditions. Consequently, additional savings of several hundreds of thousands of dollars are realized in a typical installation.

Mixed flow impeller systems are available with a variety of accessories that add value, reduce noise, or lower energy costs substantially. For example, accessory heat exchanger glycol/water filled coils for use in 100-percent conditioned makeup air facilities add exhaust heat to intake ventilation air to save thousands (or hundreds of thousands) of dollars in energy costs.

Eric and Don check out the system.

Crotty added that the decision was mainly based on a space issue . . . and being able to "locate the mixed flow fans in a confined area within each building maximized utilization of valuable research and administrative space while permitting compliance to building code height restrictions."

Within both new facilities—used for biological and chemical research—all the laboratory workstations incorporate 6-foot- and 8-foot-wide fume hoods. There are 36 individual mixed flow impeller fans in the building, each configured for variable volume operation (VAV) for enhanced efficiency and energy savings for the workstation fume hood exhaust. Twelve mixed flow impeller fans use 20 HP motors (providing 17000 cfm at 3.0" SP), and 24 use 15 HP motors (providing 12500 cfm at 3.0" SP). All the fume hoods are connected to the mixed flow impeller fans via ductwork and common plenums. Also, the fans are virtually maintenance free with the exception of greasable bearings (there are no belts, pulleys, or pillow block bearings to maintain).

Throughout this project, Crotty and Hsu also worked with Mike Fiorito at Custom Mechanical Sales, of San Diego, a manufacturer representative marketing custom HVAC equipment for laboratory, universities, hospitals and many hi-tech industries.

With regard to the Pfizer project, Fiorito said that, "In addition to the building height restriction, there is also a 50 dB sound ordinance (at the property line) that TKG had to address."

This was solved with two different approaches: Each mixed flow impeller fan incorporates a unique accoustical nozzle silencer which lowers attenuation substantially (in the region of 15 net dBA.)

In addition, the "fan rooms" were "beefed up with insulation and foam on the entire wall," according to Hsu. "The walls are about 18 inches thick with double and triple chip board and batt insulation, foam on the finished inside part of the wall, and sound insulation on all ductwork connecting the exhaust fume hoods to the fan plenums.

"It really took a lot of careful looks at the sound levels to achieve our goal," Hsu adds.

TKG's engineering staff at Pfizer (clockwise from left): Pat Foreman, Eric Walker, Steve Dalo, Eric Doan and Amy Hsu

"The interesting thing with VAV systems such as this, is that the fans don't even come close to 100-percent utilization," Crotty says. "We haven't even seen what they're capable of doing. So while there is no noticeable noise at the property line as a result of this installation, we were more concerned with people working in the building."

Saving space

In recommending mixed flow impeller systems to Pfizer building management, Crotty says that TKG also looked at use of traditional centrifugal fans. However, in addition to more efficient operation—without the tall stacks and expensive mounting hardware, as well as maintenance issues associated with centrifugal fans (see sidebar), Crotty adds that the critical issue for Pfizer was space restrictions.

"By using the mixed flow impeller systems valuable floor space was conserved for more productive applications that would have otherwise been needed to accommodate centrifugal fans."

At this point, Pfizer facilities management people are pleased with their new mixed flow impeller laboratory workstation exhaust systems. They are meeting or exceeding all performance requirements with regard to eliminating pollution and IAQ problems while meeting all appropriate standards as a "good neighbor" in the community. As far as the lack of visible exhaust stacks on the roofs of these buildings, you could say that in this instance the idea of, "out of sight, out of mind" is a fair statement. **PE**

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