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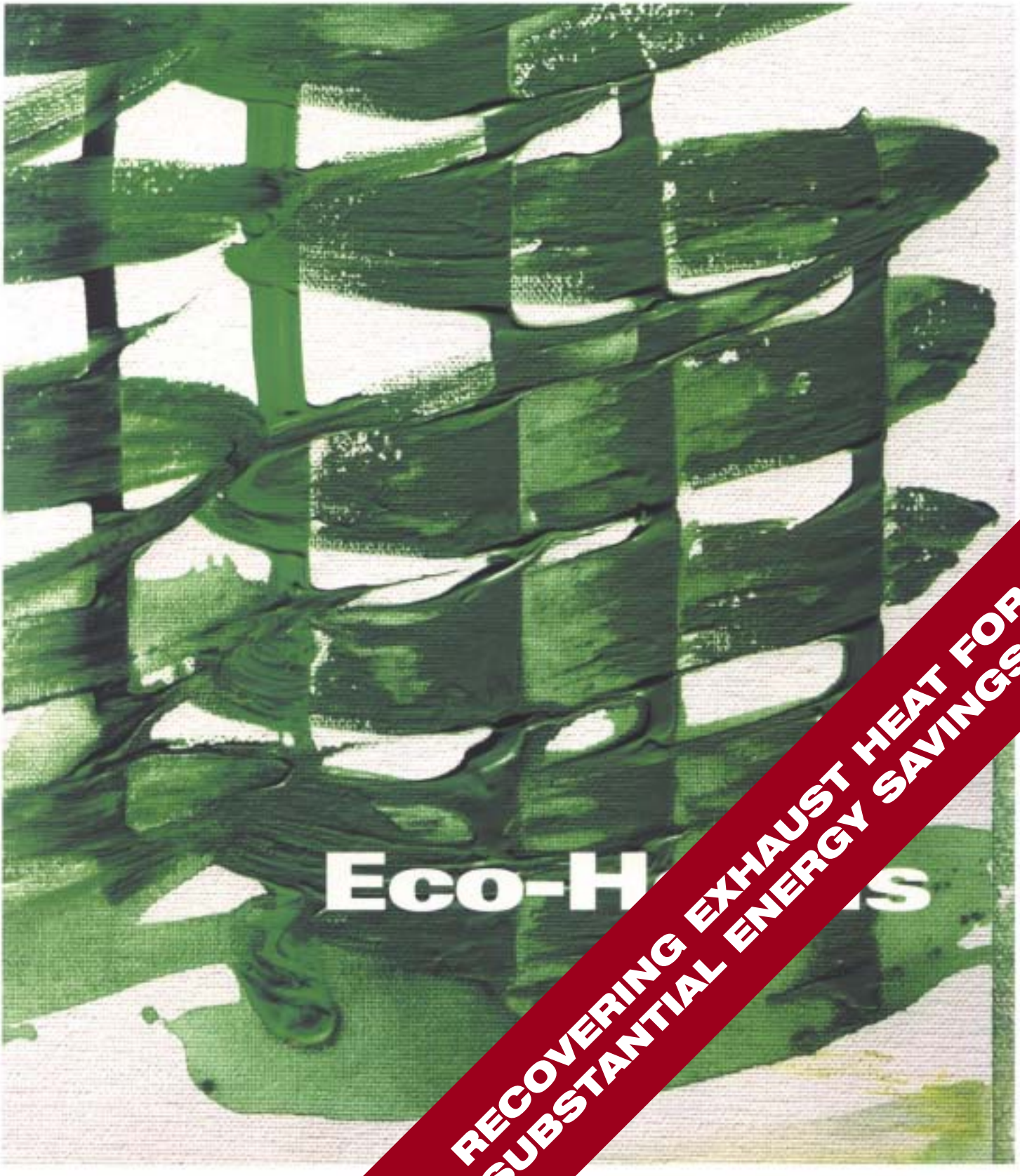


RECOVERING EXHAUST HEAT FOR SUBSTANTIAL ENERGY SAVINGS

Recovering exhaust heat results in substantial energy savings

Heating costs reduced 3 percent for every 1° F added

As Frank Sinatra put it, "It's not easy being green." This is particularly true with buildings when energy costs for heating and cooling are expected to rise as much as 50 percent in many parts of the country as they are this year.

In the pharmaceutical-research industry, energy costs already are high because firms, which have many laboratory work stations and fume hoods to exhaust, are prohibited from re-using air. Instead, they must provide conditioned, 100-percent makeup air for workers. One way to do this is to recover the heat from building or process exhaust and put it back into the intake or "makeup" side of the HVAC system.

That is exactly what Bill Waldron, facility manager for Neurogen Corp., was thinking following the construction of a 20,000-sq-ft chemical-research building in Branford, Conn. Faced with the high costs of heating and cooling makeup air, he wanted a practical and cost-effective solution. As it turned out, most of one already was in place, just above his head.

UP ON THE ROOF

The facility's 18 laboratory-work-station fume hoods were being exhausted on the roof with Tri-Stack mixed-flow impeller exhaust systems from Strobic Air Corp. Each system, connected to an exhaust plenum serving the work stations, provides high-efficiency exhaust to eliminate pollution and the possibility of re-entrainment, a particularly critical issue when conditioned air is introduced into a building on a constant-flow basis, as in this case.

Roof-exhaust re-entrainment not only can affect the health of building occupants, it can have far-reaching legal consequences. For example, building managers and owners, consulting engineers, HVAC contractors, and even architects have been named as defendants in cases associated with employee illness and IAQ.

About the system

The mixed-flow, impeller-type laboratory-work-station fume-hood roof-exhaust systems for Neurogen Corp.'s research facilities dilute outside air with plenum exhaust air at high discharge velocities, sending a powerful exhaust plume up to 350 ft into the air.

Because the systems introduce up to 170 percent of free outside air into the exhaust stream, a substantially greater air flow than is provided by conventional centrifugal fans is possible for a given amount of exhaust without additional horsepower. This results not only in excellent dilution capabilities, but greater effective stack heights.

With these systems, a typical energy reduction is 44 cents per cfm at 10 cents per kilowatt-hour. This translates to a return on investment of approximately two years. Energy consumption is about 25-percent lower than it is with conventional centrifugal fans, with substantially reduced noise levels, particularly in the lower octave bands. The systems conform to ANSI/AIHA Z9.5-1992, *Laboratory Ventilation*; ASHRAE 110-1995, *Method of Testing Performance of Laboratory Fume Hoods*; and ANSI/NFPA 45-1996, *Fire Protection for Laboratories Using Chemicals*, and are listed with Underwriters Laboratory under UL 705.

The systems are designed to operate continuously for years under normal conditions, as their direct-drive motors have lifetimes of 200,000 hr. 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.

With no belts, motor bearings, elbows, flex connectors, or spring vibration isolators to maintain, the systems are virtually maintenance-free. This, coupled with the fact that the expensive penthouses to accommodate maintenance personnel under adverse conditions are not needed, results in additional savings of several hundred thousand dollars.

HEAT RECOVERY

The Tri-Stack systems at Neurogen are designed to accommodate a unique heat-recovery system (essentially, a heat exchanger containing coils filled with a solution of glycol and water) that extracts ambient heat from the laboratory-work-station-fume-hood-exhaust stream before discharging it above the roofline. This warmed air is transferred to the intake or makeup side of the building's ventilation system and reintroduced as part of the conditioned air entering the building. As a result, the amount of natural gas needed to preheat the makeup air is reduced substantially.

During the winter, "There were days when we were putting about 10° F into the makeup air simply by treating the air prior to its exit out of the exhaust system and forcing it back into the makeup side," Waldron said.

Ten° F was the difference in temperature between the intake air (at outside ambient temperature) and the makeup air after it passed through the Tri-Stack system's heat-exchanger coils, Waldron explained.

"For every degree you add, you reduce your energy costs about 3 percent," he said. "A 10° F rise in intake air translates into a 30° percent energy saving.

"In addition to reducing our costs, we also help contribute to a cleaner

Mixed-flow impeller fans on the roof of Neurogen Corp.

environment, since less fossil fuel is consumed."

RETURN ON INVESTMENT

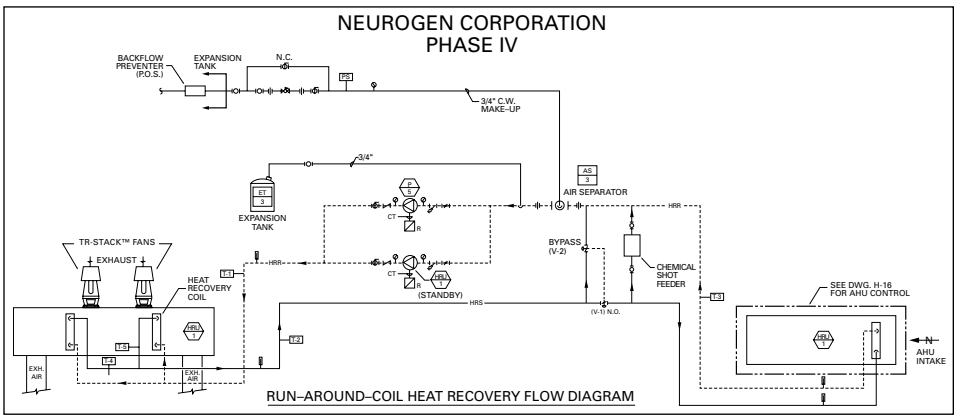
With regard to overall costs—for system hardware as well as energy charges—Waldron believes that a payback cycle of three years or less makes this solution economically sound for Neurogen (some users have experienced actual payback in two years or less, depending on system configuration, climate, and other variables).

Because Neurogen is located in the Northeast, it experiences varying temperatures during the year. Conditioned makeup air is cooled with fume-hood exhaust during the cooling season and warmed during the heating season. The system is usable only when outside air temperatures are below 40° F or above 80° F.

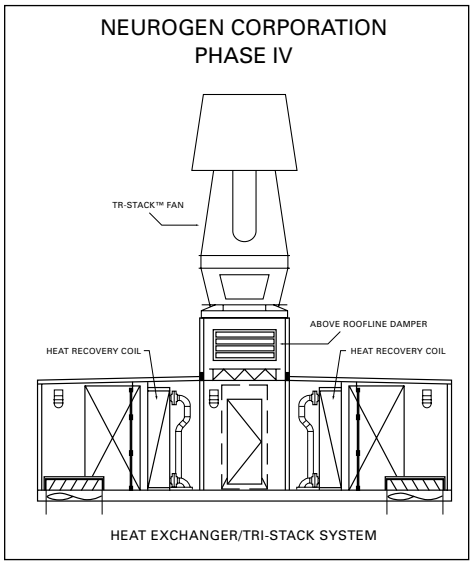
"You need a big enough difference between outside and inside air to make it practical," Waldron said.

With regard to cooling air in warmer temperatures, Waldron said that, typically, if outside air is brought back into the building at 90° F and sent through the heat-recovery system, the air-temperature drop will be 4° to 5° F.

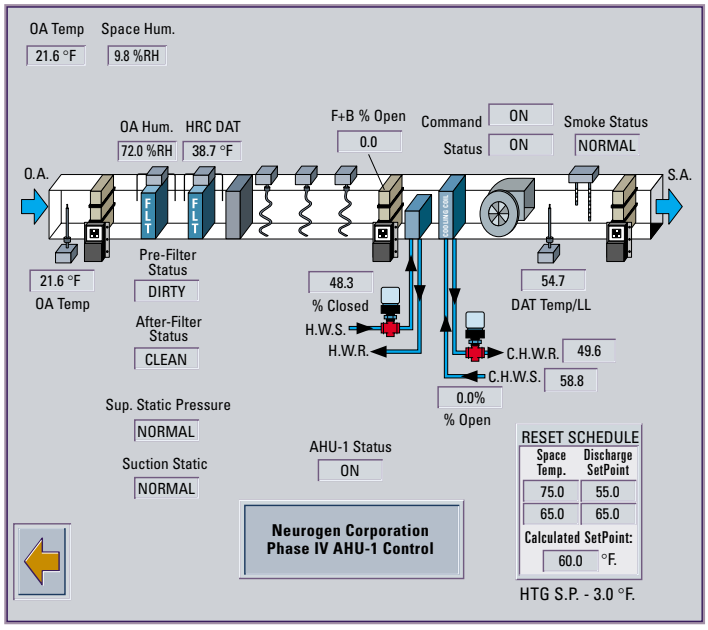
Information and images courtesy of Strobic Air Corp., a subsidiary of Met-Pro Corp.



The Neurogen heat recovery system is energized through the ATC system based upon outside air temperature (OAT). When OAT is below 45° F or above 80° F, the heat recovery supply valve (V1) opens, the bypass valve (V2) remains closed and the pump is turned on. This unique system preheats makeup air for the intake ventilation system at least 10°F, resulting in a 30% reduction in heating costs. Built-in safety features prevent heat loss in case of equipment malfunction.



The exhaust air heat recovery module at Neurogen Corp. is composed of Tri-Stack laboratory workstation fume exhaust systems with accessory glycol/water heat recovery coils inside stainless steel casings. The fan/heat exchanger package preheats or pre-cools building intake air at Neurogen's conditioned 100% makeup air Phase IV facility. Dampers above the roofline help provide constant air volume to maintain discharge velocity.



System status screens such as this provide real time data on system operating and performance parameters. The difference between the indicated outside air temperature and the air temperature after it passes through the heat recovery coil represents energy savings.

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