Variable Speed Comes to the (Kitchen) 'Hood

The Problem

Most commercial kitchen hoods operate at 100 percent capacity even during idle periods when ventilation systems can safely be turned down. Because hoods and associated exhaust and makeup-air fans are among the largest consumers of electricity in a commercial kitchen, the annual cost of wasted energy can amount to thousands of dollars per hood.

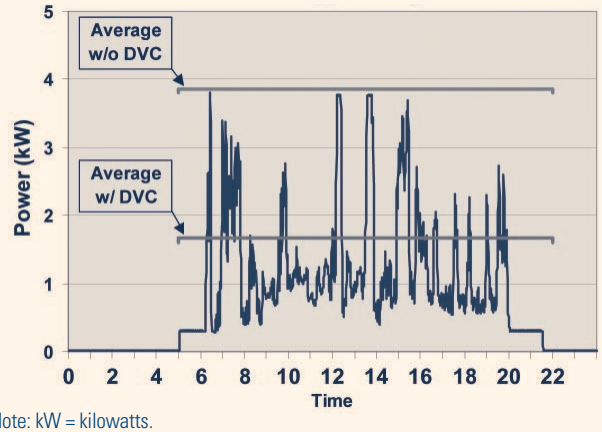
The Solution

A new technology that reduces ventilation rates during slow periods makes it possible for restaurants and institutions to significantly reduce the amount of wasted energy. Lower fan speeds also means less noise. The concept calls for control of kitchen ventilation-fan speed based on the amount of heat, smoke, and steam released by cooking. Using this approach, Melink Corporation of Milford, Ohio, has developed a variable-speed kitchen exhaust-control system called the Intelli-Hood that cuts energy consumption by between 40 and 70 percent compared to traditional hoods (**Figure 1**).

The Intelli-Hood demand ventilation control (DVC) system incorporates sensors and a microprocessor into kitchen hoods. The system monitors cooking activity and adjusts fan speeds accordingly. With annual fan-energy savings of $1,500 to $10,000 per hood, plus additional savings of 15 to 40 percent from reduced building heating and cooling losses, the Intelli-Hood can pay for itself in as little as one year. Annual energy savings can top 60,000 kilowatt-hours, which translates to reductions of up to roughly 45 *tons* of carbon dioxide (CO_2) per hood.

Figure 1: Energy savings of DVC systems

In this plot of the power drawn by hood fans in a demand ventilation control (DVC) field test, the upper horizontal line shows the near-constant power consumption of a traditional system, the jagged line shows the consumption with a DVC system, and the lower horizontal is the average consumption of the system. Substantial savings are achieved because fan speeds are adjusted to match demand.



Note: kW = kilowatts.

Figure 2: Intelli-Hood technology is unobtrusive

The Intelli-Hood ventilation control system is largely built into the inside of a restaurant hood. In this photograph, the system isn't even visible, though it saved the University of California kitchen into which it is installed more than $6,500 per year.

Features and Benefits

The Food Service Technology Center, an independent research organization in San Ramon, California, that tests the efficiencies of a number of commercial cooking technologies, tested the Intelli-Hood in 2006. The Center found that the system provided significant energy and monetary savings at all of the test sites. Savings were also found in field demonstrations at a number of California colleges, including the University of California (UC) at Santa Barbara, UC Berkeley, Butte College, and Sacramento City College. DVC-equipped hoods are also compact and easy to install, and they improve the work environment.

Lower energy costs. By optimizing fan speed, the Intelli-Hood reduces energy consumption of fans by as much as 70 percent during idle periods. And because a lot of air from the heating and air-conditioning systems is sucked up through kitchen hoods, HVAC system energy consumption also drops by 20 to 30 percent. This translates to savings of thousands of dollars per year per hood and a rapid payback (**Table 1**). Also, if the makeup air comes from the dining room, these systems can further reduce HVAC costs by increasing building circulation for free cooling or heating when outdoor conditions are appropriate.

No sacrifice of indoor air quality. The Intelli-Hood can also help to ensure optimum indoor air quality by monitoring the CO_2 levels in the make-up air stream. The exhaust-fan speed can be increased to 100 percent if the indoor CO_2 levels exceed a predetermined threshold. For example, in facilities where makeup air comes from the dining room, the Intelli-Hood can detect and moderate CO_2 levels in the dining area.

Compact design. The Intelli-Hood system takes up very little space and can be unobtrusively incorporated into virtually any standard commercial kitchen ventilation hood (**Figure 2**).

Easy installation. The system can be set up in a few hours by a trained technician and requires little maintenance.

Less noise. Exhaust hood fans in commercial kitchens can be quite noisy, which can lead to miscommunication, a higher risk of accidents, and lower employee productivity. By reducing fan speed, the Intelli-Hood reduces fan noise by up to 90 percent during idle times—creating a safer and more productive working environment.

Decreased fire risk. The sensors in the Intelli-Hood system monitor the temperature of kitchen exhaust air and sound an alarm or shut off cooking appliances if the temperature gets too high.

Applications

DVC systems are effective in most commercial or institutional kitchens, including restaurants, dormitories, hospitals, hotels, cafeterias, and banquet facilities. The system can be incorporated into existing kitchens or included in new construction. Energy savings depend on the fan-motor loads at full speed, the variability of the kitchen operation, and the number of operating hours per year. Cost-effectiveness increases proportionally to the size of the ventilation system, number of operating hours, and airflow rates. The payback period is usually between one and four years in new construction and two and six years for retrofits. Some utilities offer incentives for restaurants that adopt this technology, further reducing the payback period. Pacific Gas and Electric, for example, offers a $300 rebate per exhaust-fan horsepower in new hoods and $350 in retrofits.

California Codes and Standards

Title 24 of California's Code of Regulations does not address kitchen ventilation systems.

Collaborators

Melink Corporation originally developed this technology. More recently, Captive Aire and Halton have introduced DVC systems as well.

For More Information

For more information on this project, please contact the California Energy Commission researcher listed below.

More PIER Technical Briefs can be found at www.energy.ca.gov/research/techbriefs.html.

Contacts

California Energy Commission, Michael Seaman, mseaman@energy.state.ca.us, or visit www.energy.ca.gov/research/buildings.

Melink Corporation, Ted Owen, towen@melinkcorp.com, 513-965-7500, or visit www.melinkcorp.com.

California Institute for Energy and the Environment, Karl Johnson, karl.johnson@ucop.edu, 650-255-6867 or 510-587-6221.

Table 1: Sample annual savings are gained by replacing hoods with variable-speed ventilation in an existing facility

A study conducted by the Food Service Technology Center found that variable-speed hoods significantly reduced energy consumption in commercial kitchens. On average, test case kitchens saved $775 per month in energy and yielded a payback period of 1.9 years, with an initial cost of $18,000.

	Savings	
	Energy	Dollars
Direct energy	31,375 kWh	3,770
Peak demand	6.2 kW	550
Additional building heating	3,800 therms	3,800
Additional building cooling	9,900 kWh	1,190
	Total savings = 9,310	

Notes: kW = kilowatt; kWh = kilowatt-hour. Assumptions: $0.12/kWh, $8.00/kW monthly demand, $1.00 per therm.

About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) Program. PIER supports public interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

Arnold Schwarzenegger, *Governor*

California Energy Commission

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