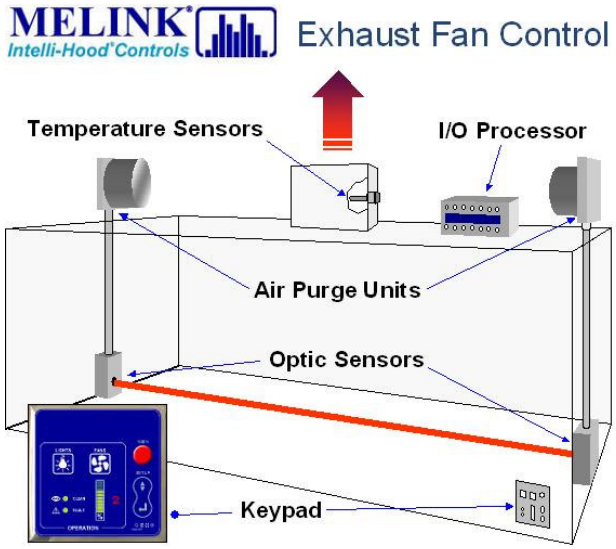
Demand Ventilation Control in Commercial Kitchens

University of California, Santa Barbara—Carrillo Dining Commons

Big Exhaust Hood Energy Savings, Reduces Make-up Air Heating Requirements

Most commercial kitchen hoods operate at 100% capacity all day long, even during idle (non-cooking) periods when ventilation rates can be safely reduced. The cost of wasted energy every year can be thousands of dollars per hood. *An effective way to reduce energy consumption and cost is to control the speed of kitchen ventilation fans based on the demand for ventilation created by cooking.* A properly implemented demand ventilation control strategy will minimize the energy burden while maximizing the ability of the hood to capture and contain cooking effluent.

The Melink *Intelli-Hood® Controls* package is a demand-ventilation-based energy management system for commercial kitchen exhaust hoods. Its processor controls the speed of the exhaust and make-up air fans through variable frequency drives (VFDs) based on two types of input signals: from temperature probes placed in the exhaust duct collars, and infrared (IR) beams that cross the bottom of the exhaust hoods. *(Continued on Page 4)*



Product Overview

Energy Savings

- Reduces fan speeds in response to lower cooking loads.
- Typical fan energy reductions range from 40 - 75%.
- Typical make-up air heating and cooling load reductions range from 15 - 40%.

Operation/Maintenance

- Comprehensive programming capabilities with simple operator keypad. Periodic maintenance consists of basic cleaning of optic and temperature sensors.

Manufacturer: Melink Corporation.

Market: Commercial and Institutional Kitchens

Availability: Melink Corp. (http://www.melinkcorp.com)

Field Demonstration

UC Santa Barbara - Carrillo Dining Commons

A single demand ventilation fan speed controller was installed at the kitchen of the Carrillo Dining Commons This one controller operates four fans in two separate hood systems: The Hot Cuisine line pictured below uses a pair of hoods with a total exhaust airflow of 7,000 CFM; the corresponding make-up air unit has gas heating.

The “Hot Cuisine” serving area

Main Preparation Area Hoods

The main preparation cooking area has two back-to-back 17-ft. hoods tied in to a single 9,200 CFM exhaust fan, again with a gas-fired make-up air unit.

This small box is the operator keypad.

CPUC Partnership

The University of California/California State University (UC/CSU) and Investor-Owned Utility (IOU) Partnership Program has identified an incentive for this technology based on the energy saved per year. This is typically enough to pay for a significant portion of the installation cost. For more information please visit: www.uccsuiouee.org.

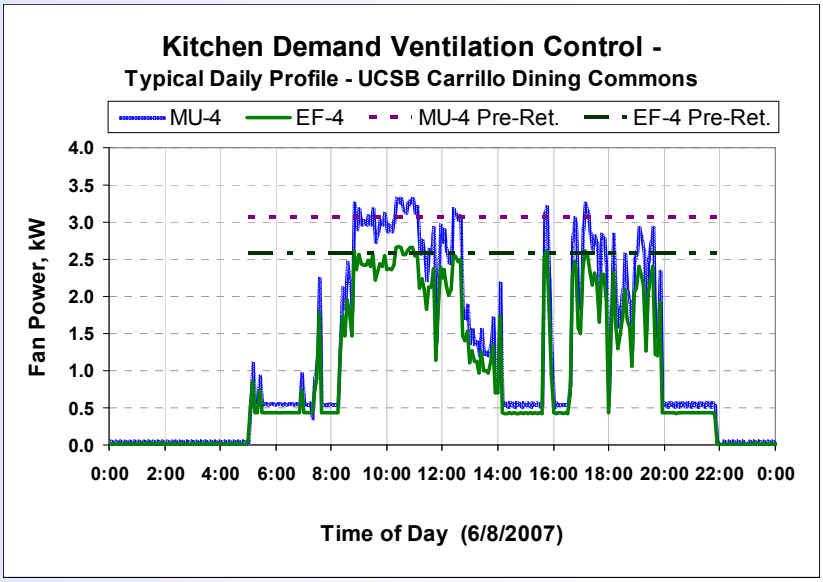
Installation Cost and Payback

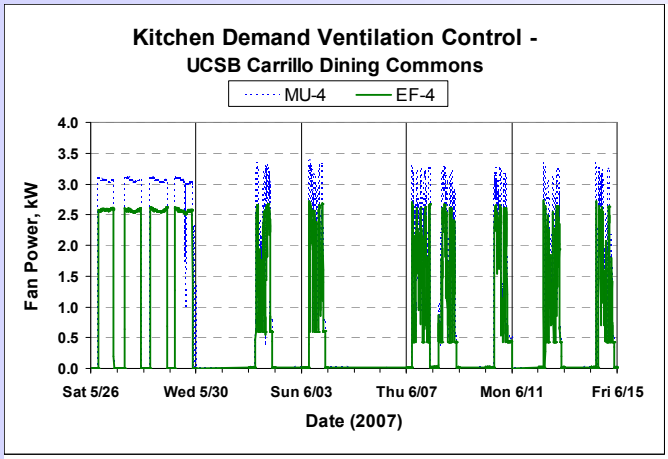
The installed cost of a Melink *Intelli-Hood® Controls* package at any particular kitchen facility depends on how many systems a particular kitchen needs -- there is a step up in cost every four hoods. Typical costs range from $7,000 to $32,000 per kitchen, depending on the number of hoods and fans, whether the work is new or retrofit, and the complexity of the system. Energy savings depend on the fan motor loads (kW) at full speed, the variability of the kitchen operation during the day, and the number of operating hours in the year. With the UC/CSU/IOP Partnership incentives, the investment will usually be returned in just two to four years!

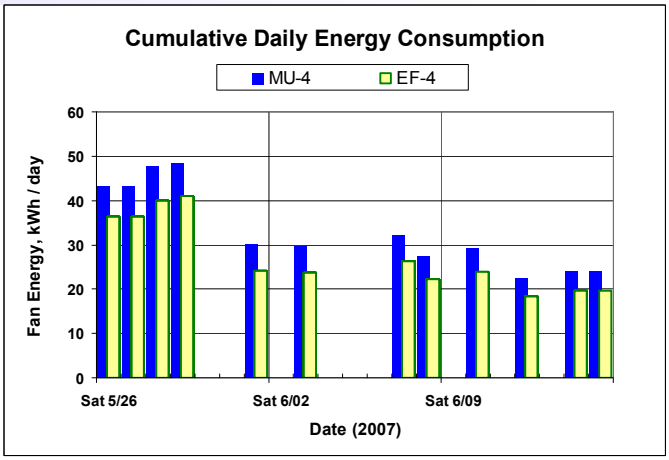
Study Results

Energy performance data for all four controlled fans was collected for 20 days in May and June, 2007. The estimated combined fan energy savings were about 54%, which equates to annual savings of 31,950 kWh and $3,670. Calculated make-up air average CFM reductions yielded an additional savings of about $1,480 per year from heating load reduction (no cooling savings in this case since make-up air is not cooled.) These savings are based on energy rates of $1.00/therm and $0.115/kWh.

The typical-day power profile at right illustrates the fan power modulation with the DVC system in operation.







The above charts measure fan performance before and after the DVC retrofit. Only days when the system was active are shown after 5/30.

Fan	Full Speed Power w/o DVC		Average Power w/ DVC	Daily Energy Consumption		Yearly Energy Consumption		Savings			
				kWh/day		kWh/yr		Electric	kWh %	Gas	$
	CFM	kW	kW	w/o DVC	w/ DVC	w/o DVC *	w/ DVC **	kWh/year		therms	Saved/yr
EF-2	7,000	3.8	1.6	53.8	16.7	18,840	5,840	13,000	69%		$2,389
MU-2	7,000	2.0	0.8	29.4	9.5	10,300	3,320	6,980	68%	893	$803
EF-4	9,200	2.7	1.8	38.1	22.6	13,340	7,910	5,430	41%		$1,205
MU-4	9,200	3.5	2.4	46.5	27.8	16,270	9,730	6,540	40%	581	$752
Total	**32,400**	**12.0**	**6.6**	**168**	**77**	**58,750**	**26,800**	**31,950**	**54%**	**1,474**	**$5,150**

* Based on full-speed power, operating 17 hr/day, 350 days/year, w/ manual control.
** Calculated using 17 hr/day, 350 days/year, with averaged energy throughout monitoring period w/ DVC .

For UC/CSU Partnership participants, this project would be eligible for incentives totaling: **$9,143**

Actual Initial Cost = $ 32,630 **Without Incentives, Payback Period, yr = 6.3**

Net Initial Cost = $ 23,487 **With Incentives, Payback Period, yr = 4.6**

(Continued from Page 1) As a temperature probe senses a rise in temperature, the controller signals the fans to ramp up proportionally from a predetermined minimum speed to a setpoint speed that is based on the temperature range programmed into the system. If an IR beam is broken by either smoke or steam produced by the cooking process, the exhaust fan and make-up air (MUA) unit will go to 100 percent speed (or a preset maximum speed) until the smoke or steam is cleared.

Considerations

Since the fans will operate at full speed only when required, the system allows for a higher exhaust rate safety factor in the design without sacrificing the reduced energy consumption of a lower average exhaust rate. Optimized performance and savings can be achieved by effective controller programming tailored for each equipment line and accompanying hood during system commissioning.

Each Intelli-Hood processor can receive inputs from up to four separate hoods and then control the VFDs for each hood's accompanying exhaust and supply fans. Cost-effectiveness increases proportionally to the ventilation system size and airflow rates. Aside from the incremental cost difference for larger VFDs, the installed DVC system cost per hood is relatively independent of exhaust capacity. Furthermore, an estimated $2000 per system can be saved if installed during new construction or remodel as opposed to a retrofit. One caution, take care at the design stage to integrate Melink with the main building HVAC system.

Conclusion

Demand-Ventilation Controls are a cost-effective solution to reducing the energy load and cost associated with operating exhaust ventilation systems in college foodservice operations. DVC can also reduce electricity demand during peak utility periods because average reductions in fan power are realized throughout the day (see illustrated load profile). Although the DVC retrofit cost can be significant with respect to an operating budget, the investment will usually be returned within two to four years. And the bonus for kitchen staff will be an improved working environment with dramatically reduced noise levels from the exhaust ventilation system.

Availability

The Melink *Intelli-Hood® Controls* package is available directly from Melink Corp. or *Intelli-Hood® Controls* dealers. Several major hood manufacturers are now supplying DVC as a factory-installed hood option. Two hood manufacturers (Captive-Aire Systems, Inc. and Spring Air Systems, Inc.) have introduced lower cost DVC systems that utilize temperature-only based sensors to modulate fan speed. It is anticipated that the energy saving potential of the lower-cost strategies will be reduced to some degree. However, both of these two manufacturers also offer Melink controls as an option.

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.

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