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Less Out, Less In

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Exploring variable ventilation in the kitchen

When kitchen exhaust fans are running all day and you are not actively cooking, it's like throwing money up the exhaust stack. This is not a good idea for quick-serve and fast casual restaurants, especially in today's economy where margins are tight and getting tighter. In a typical foodservice facility, anywhere from 35 to 40 percent of energy costs go toward heating and air conditioning. It's this part of the energy pie that a variable ventilation system can help control and manage.

Variable ventilation, also known as demand control ventilation (DVC) or variable exhaust, is not a new concept. In the building automation world, it exists in many forms, but in the commercial kitchen environment it is not widely used. A demand controlled kitchen ventilation (DCKV) system reduces energy consumption for exhaust fan motors and HVAC.

To understand the importance of managing kitchen exhaust, it helps to know how a ventilation system works and the impact of airflow in a foodservice environment.

Ventilation control systems found in most foodservice facilities are still in the dark ages. A manual on-off switch operates the fans in one of two ways: either on at full speed or totally off. There is no inbetween. Since kitchen exhaust is normally sized for peak cooking, the exhaust airflow rates are set for maximum, full-load cooking to remove all the effluent, heat, smoke, steam and combustion gases.

However, today's building standards allow for reduced exhaust when less effluent is present. That's important because exhaust air is not free. You have already paid to heat or cool your foodservice facility so why waste that air and spend more money to re-heat or re-cool the replacement air?

In order to properly manage building air balance, the variable exhaust management system must also control the make-up air system. With less exhaust air going out, you must manage the amount of make-up air coming in. Done correctly, "less out, less in" means less work for the HVAC system to recondition make-up air, which equates to money saved.

Options for Managing Exhaust Fans

There are different ways to manage exhaust fans. Temperature sensors can be used to indicate when equipment is turned on. If additional equipment is activated, heat increases in the duct, and the sensor will tell the system to speed up the exhaust fans.

Another option is to use optical sensors, which shoot a beam from one end of the hood to the other. The presence of steam or effluent will break the beam to indicate that cooking is occurring. Exhaust fan speed can then be increased or decreased depending on whether the beam is detecting activity. The use of infrared beams is another technique, with the beams shooting down onto the cooking surface to indicate either temperature or the presence of food. In addition, some restaurants use utility data to keep track of cooking events to see if burners are on and cooking.

The ideal technique would consist of some form of smart kitchen equipment tied into the exhaust management system to communicate that the equipment has started or stopped a cooking cycle. The system will also adjust fan speeds continually in real time based on cooking activity to maximize energy savings.

A variable exhaust management system should also be tied to the restaurant's fire suppression system. For example, if you're running the fan at low speed, and there's a fire under the hood, the exhaust management system would switch the fans to high speed to draw the fire-extinguishing chemical up the ductwork.

In addition, the system needs to maintain all safety interlocks that are part of the store's normal infrastructure. Often the exhaust fan is interlocked with the kitchen equipment to prohibit cooking if the exhaust fan is turned off. Likewise, if the cooking equipment is turned off, the fan may be interlocked so that the exhaust air is automatically turned off when the kitchen equipment is not in use. The ideal system would find a way to maintain and support those interlocks.

Capture and Contain is Critical

When fans are slowed down, a foodservice facility still must maintain "capture and containment," meaning that all smoke, steam, effluent and heat from that equipment must be evacuated out of the space. Therefore, care must be taken not to slow the fans down to the point where they no longer handle capture and containment. A visual inspection of the hood is required to make sure that the effluent is captured and evacuated.

Beyond visual inspections, there are other considerations that may not be seen by the naked eye. For example, you may have some heat escape from the hood that is not visible; there are ways to evaluate this with commercial kitchen equipment testing, including a Schlieren machine, which uses shadow graph technology.

Technologies used to slow the fans can include multi-speed motors (with two or three speeds) or variable frequency drives where you take a single speed motor and increase and decrease fan speed. In addition, some motors have built in speed controls.

There are many different ways to approach variable ventilation. But the optimum solution involves having an integrated system that receives information directly from the kitchen equipment, and then having that system tied into an energy management system.

Saving Money

These systems save money in several ways: When exhaust fans are slowed, less electricity is consumed, which can save a few hundred dollars a year in motors watts. The real savings comes from the air conditioning systems; if you have less air going out, then you have less air coming in so your AC has less work to do. This can save thousands of dollars a year on heating and air conditioning.

A recent study examined the use of fryers, grills and exhaust fans in quickserve restaurants. It covered multiple sites, hours and pieces of equipment and showed that restaurants were cooking at full capacity only 10 percent of the time. They were cooking at intermediate capacity 17 percent of the time, and cooking in either one vat, cooking in one zone on the grills or not cooking at all 73 percent of the time. The bottom line is this: A foodservice facility must always be ready to cook but is not actively cooking all the time.

Flexibility

Fan speed must be correctly set. Ideally the exhaust management system would be field adjustable to accommodate site-specific conditions and future operational changes. For example, fans may run at 60 percent for low speed but if you add new menu items that generate more effluent, the exhaust airflow rate may need to be increased to maintain proper capture and containment. Perhaps the fans need to run at 65 or 70 percent. The system should be flexible enough to allow for adjustments in the field to accommodate either menu changes or site-specific issues.

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