Direct or Indirect Heating?
A look at Kitchen Ventilation Make-Up Air Systems

Thanks to a recent White Paper by the Foodservice Consultants Society International (FCSI), we now have what should become a universally accepted Best Practice guide for the design and specification of one of the most misunderstood and misapplied, “out of sight, out of mind” appliances employed in every commercial kitchen — the cooking equipment ventilation system. This briefing will summarize the recommendations of the comprehensive study relative to incorporating a heated make-up air system into your kitchen and reviewing the two prescribed methods for doing so — Direct or Indirect Gas-Heated Systems.

It’s no secret that the kitchen ventilation system is one of the largest energy-consuming appliances in the foodservice industry. In a typical foodservice establishment, the HVAC system typically accounts for 20% - 30% of the facility’s total energy consumption, with the kitchen ventilation system representing nearly half of that load.

For many years, the complex interactions between a building’s overall HVAC system, make-up air, and exhaust systems were not well documented. Recent research sponsored by the California Energy Commission, Pacific Gas & Electric, and others has resulted in design recommendations for commercial kitchen ventilation systems that can achieve significant

Best Practices for Optimization …

In some situations, such as Quick Service Restaurant (QSR) concepts, it may be acceptable to have 100% of the make-up air (MUA) provided through rooftop HVAC units. However, in full service and institutional kitchens with larger exhaust requirements, it may not be practical or energy efficient to supply 100% of the replacement air through the building HVAC system. An independent MUA supply is often the answer, but it requires careful design. Not only can make-up air velocities affect the ability of the hood to capture and contain cooking effluent, locally supplied make-up air that is too cold or too hot can create an uncomfortable working environment and significantly increase the energy consumption of the HVAC system.

Before we look at the energy saving attributes of gas-fired make-up air units, let’s review some basic design strategies that will help to optimize MUA and performance improvements, including lower operating costs, increased energy efficiency, reductions in greenhouse gas emissions, improved indoor air quality (IAQ), and overall better comfort for kitchen staff.
improve the performance and energy efficiency of your kitchen ventilation system.

- Minimize the design exhaust rate by prudent selection and application of Underwriters Laboratories (UL) Listed hoods, and take advantage of the exhaust flow recommendations from hood suppliers for the cook line under consideration.
- Do not use short-circuit hoods; field and laboratory investigations have shown that these hoods fail to capture and contain effluent adequately.
- Do not use four-way or slot ceiling diffusers in the kitchen, especially near hoods. Their higher air velocity can have a detrimental effect on hood performance, particularly when the flow through the diffuser approaches its design limit.
- Diversify MUA pathways using a combination of backwall supply, perforated perimeter supply, face supply, displacement diffusers, etc. Minimize MUA velocity near the hood; it should be less than 75 fpm (feet per minute).

- Use direct-fired MUA heating when heating is necessary.

That last suggestion is where we will focus the remainder of this article. We will point out the inherent differences between a direct-fired and indirect-fired MUA system and show how a direct-fired system can save an operator a lot of money in the long run.

How a Make-Up Air System Works…

Make-up air systems replace the air exhausted from the kitchen during the cooking process with fresh outdoor air that has either been heated or cooled (depending on the season). It maintains a constant incoming air temperature regardless of the outdoor air temperature. Many manufacturers offer direct-fired burners with turndown ratios of up to 30:1 that are 100% efficient — all the heat goes directly into the airstream. The high turndown capability allows the flame to adjust to wide, outdoor-air temperature swings throughout the heating season. For example, a unit with a maximum temperature rise of 90°F in the winter can adjust down to as little as a 3°F temperature rise for milder spring and fall weather.

Indirect gas-fired make-up air heating equipment is only 60% to 80% efficient due to heat exchanger inefficiency and heat lost up the flue. It is also possible to experience condensation within heat exchanger sections of indirect-fired units in cold climates, which causes corrosion and premature failure.

This can be accomplished by minimizing the volume (cubic feet per minute) of make-up air through any one pathway and maximizing the area of the grilles or diffusers through which the MUA is supplied, or by using a combination of pathways.

- Consider evaporative MUA cooling in dryer climates. Evaporative cooling can be an effective method of maintaining MUA temperatures within a range that is comfortable for kitchen staff and does not hamper hood performance. However, the maintenance requirements of evaporative coolers must be considered.
- Consider a variable or two-speed exhaust fan control for operations with a high diversity of appliances or with a set schedule of use. Demand ventilation controls allow reductions in exhaust and make-up air while appliances are idle to help minimize operating costs.

A direct-fired make-up air system solves five major ventilating problems:
• maintains comfort for customers in the dining room
• controls infiltration
• replaces stale air with fresh air
• prevents negative air pressure
• reduces cold and hot spots on the cooking line and in the kitchen, resulting in happier employees.

In a direct-fired make-up air unit, the air that is to be heated is passed directly over an open flame. No heat exchanger is involved. This design results in an extremely efficient system that achieves 100% combustion efficiency and a 92% overall thermal efficiency (with 8% of the total heat lost in the latent heat of water formed in combustion). The combustion is so complete that any remaining combustion products are well within code-prescribed safety limits. Because of these benefits, direct-fired units are ideal for commercial kitchen ventilation applications.

Is Safety a Concern?

Some foodservice consultants and mechanical inspectors have expressed concern over these direct-fired systems and, thus, have posed a slight hindrance to marketing efforts. However, direct-fired MUA is the safe and efficient way to introduce fresh, make-up air continuously and save a lot of energy when it comes to comfortable heating and airflow.

Conservation & Comfort are Key…

With the continuing rise and fall of energy prices over the past couple of years, conservation has definitely become a critical topic once again. As a result, the attributes of direct-fired gas make-up air systems for today’s commercial kitchens will go a long way towards reducing energy costs while providing a comfortable environment for kitchen employees.

If you are interested in learning more about maximizing your profits through improved energy conservation or how GFEN can assist you in the evaluation process, log on to www.gfen.info and look for the directory of participating natural gas companies and affiliated kitchen ventilation members.

Direct gas-fired make-up air technology is the most energy efficient choice for heating make-up air because it does not use a flue or heat exchanger. The gas is burned directly in the air stream being heated. That means 100% of the available heat (every BTU of gas burned) is delivered directly and efficiently to the building.