NEWS RELEASE

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Quick checks for too much outside air help energy efficiency

by Will White

In this day of federal mandates for increased efficiencies and limited funding, facility engineers are looking for ways to save a buck and still maintain comfortable working conditions.

The 1970s oil embargo also created a push for conservation. The government issued temperature setpoint guidelines designed to reduce energy use. Spaces were heated to 68 degrees and cooled to 78 degrees. Where enforced, these setpoints created such unhappy occupants that work force productivity fell. Buildings that heated and cooled unevenly provided stories of people wearing gloves at their desks while trying to type and folks covertly placing space heaters at their feet. Thankfully, those days are over.

Now, the focus is on maintaining reasonable temperatures and adequate fresh air for the health of the buildings and the tenants. New federal standards dictate equipment efficiencies, improved building automation systems with direct digital controls, higher insulation values, low-flow water appliances and increased investments in renewable energy sources.

Even with all the standards in place, installations still need to look at each facility for energy conservation opportunities. Two areas cause perennial problems.

Excess outside air flow into environmentally controlled spaces – Site investigations reveal that this issue results in substantial and costly waste of heating and cooling. The rule of thumb formula for heat transfer in air is:

Q = cubic feet per minute x 1.19 x delta T

In this formula, Q is British thermal units per hour, and the semi-constant of 1.19, as it depends on temperature, is derived from the heat capacity of air, the mass of a pound of air, the number of Btu in a pound of air and a conversion of minutes to hours.

For example, let's use a 20-degree day with your dampers set either to bring in an excess 600 CFM or they're leaking 600 CFM. This is not uncommon. Design engineers often err on the side of excess outside air to prevent the dreaded sick building syndrome, and old dampers seals are notoriously big leakers. Your air handler is delivering 70-degree air to the space so the delta T is 50. Plug that data into the formula:

600 CFM x 1.19 x 50 = 35,700 Btu per hour

Over the course of 24 hours, that's 856,800 Btu. If you are heating with natural gas containing 1,030 Btu per cubic foot at about $10 per 1,000 cubic feet, you are spending for the excess outside air conditioned to space temperature each day for each air handler:

$$\frac{856{,}800 \text{ Btu} \times 1 \text{ MCF}}{1{,}030{,}000 \text{ Btu}} \times \$10/\text{MCF} = \$8.32$$

--- OR ---

$$\frac{856{,}800 \text{ Btu} \times 1 \text{ MCF}}{1{,}030{,}000 \text{ Btu}} \times \frac{\$10}{\text{MCF}} = \$8.32$$

In many systems, although the outside air setpoint is 10 percent, recommissioning teams have found that the system is actually delivering outside air closer to 20 percent or higher. It is very difficult to calibrate dampers.

This $8.32 a day may not sound like much until you consider the vast number of systems an installation has and that many are pulling in much more than 600 CFM of excess outside air. Notwithstanding the American Society of Heating, Refrigerating and Air-conditioning Engineers' requirements for minimum outside air, you can keep your building healthy and reduce excess outside air by using carbon dioxide sensors integrated into your building automation system. Some have alarm limits that, when triggered, open the outside air dampers to 100 percent. Perhaps a less severe response would be to incrementally open the outside air dampers with respect to a rise in the parts per million reading on the sensor as it approaches some adjustable value.

A quick check to see if your dampers are misbehaving is to look at the temperature readings of return air, mixed air and outside air, assuming that you have instrumentation and controls on the air hander and the readings are reliable. If the mixed air temperature reading is halfway between the outside air and return air readings, you can deduce that you have about 50 percent outside air mixing with the return. This is bad news if your setpoint is 10 percent. You can extrapolate other ratios from this approach.

Ask your utility monitoring and control system or energy monitoring and control system manager, operator or controls engineer to check or validate the sequence of operation in the programming for the suspect air handler. Again, recommissioning teams are finding that the proper sequence of operation for the equipment either was never loaded and activated or subsequently changed. This situation can affect the economizer cycle for free cooling as well as the correct setpoint for the dampers. In certain ambient conditions and when correctly engineered and programmed, the dampers alone, through the blending of the return and outside air streams, can provide supply air at the desired temperature without additional heating or cooling.

Exhaust fans in kitchens and dining facilities that run amuck – Where the building automation system does not include either a monitoring or control device on large exhaust fans, they can be a problem. Frequently, the kitchen

workers turn on these fans manually when cooking activities begin, and the fans stay on all day and maybe all night, too.

Usually the makeup air required for the exhaust is provided from a companion system, and the two are interlocked. If there is no makeup air system for these fans and the air is drawn from the space, there is a great loss of conditioned air. When the kitchen is closed, ensure all the fans are off.

Most new grill and stove hood exhaust systems have an integral makeup air channel. When balanced and properly commissioned, this state of affairs is fine. If the exhaust fan draws more air than the makeup channel can provide, the balance is captured from the space and spit out in the world.

As compared with the rest of the inventory, dining facilities are already at the high end of energy use intensity. This conditioned air loss can exacerbate the already high energy use condition.

If you can, compare the energy use as measured or metered of your dining facility with another of similar size and use patterns. Both may be hogs or great models of efficiency, and you'll learn little, but if one stands out as noticeably different, you can investigate why.

These are only two of many areas that need attention in the search for energy efficiency. Excess outside air leaking in, either through the dampers or sneaking in through the building envelope, account for a major portion of loss. A properly balanced, calibrated and instrumented air handler system will go a long ways toward helping you meet your energy goals.

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Acronyms:

Btu	British thermal unit
CFM	cubic feet per minute
MCF	1,000 cubic feet
Q	Heat in Btu per hour
T	Temperature

Photo info:

Occurrences like this in which a broom is used to physically override the control system can cause significant energy loss. Photo by Carl Lundstrom, EMC Engineers Inc.