How to Control Dampers for Energy Savings

By automating damper controls on ovens, as much as a 50% reduction in fuel costs can be realized. As the cost of fuel increases, so do the concerns about energy optimization and safety.

This application note shows you how to safely use flammability monitoring to effectively automate damper controls and reduce the costs of owning and operating ovens and dryers.

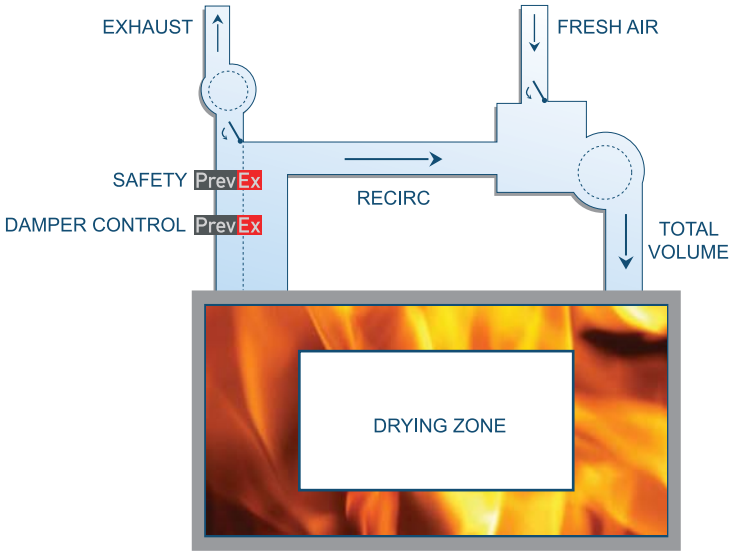
Safety

Automating damper controls to modulate the flow of fresh air and/or exhaust through an oven can reduce the amount of fresh ventilated air moving through the system. This reduction in turn, greatly reduces the consumption of natural gas used for heating any unnecessary added air.

By doing this, care must be taken. If the primary controller was to malfunction, and the dampers were not to open, an added risk of fire or explosion presents itself.

The National Fire Protection Association's Standard for the Safe Operation of Ovens and Furnaces (NFPA-86) states that if a continuous vapor concentration controller is used to control the oven exhaust, then a secondary protection system must be used to prevent an analyzer failure from causing a hazardous condition[1].

This secondary protection system shall have a separate continuous vapor concentration high limit controller for each zone.



Otherwise, a fixed damper must be set so that solvent vapor concentration input cannot exceed 50% LFL (for the highest design solvent).

Cost Savings

The use of redundant analyzers, for secondary safety, is preferred over setting damper stops to a "worst case" setting of 50% LFL for cost savings, due to the increased design flexibility of the total system.

If fixed damper stops are used as secondary safety, the damper will not close enough when the oven/dryer is lightly loaded and the optimization that comes from damper control is then greatly reduced.

When dampers can be sufficiently closed beyond the "worst case" position, especially when the ovens/dryers are lightly loaded, no additional air is heated and customers can achieve a substantial cost savings.

The solvent load in many ovens and dryers contain a mixture of VOC's in differing proportions and concentrations. In various applications, different product is running through the ovens and dryers, so even formulations are changing from product to product.

Since it depends on the actual process conditions, in particular, the variation in loading from zone to zone from time to time, the flexibility of using a secondary solvent vapor monitoring analyzer will precisely measure and safely allow proper modulation of fresh air or exhaust from an oven or zone.

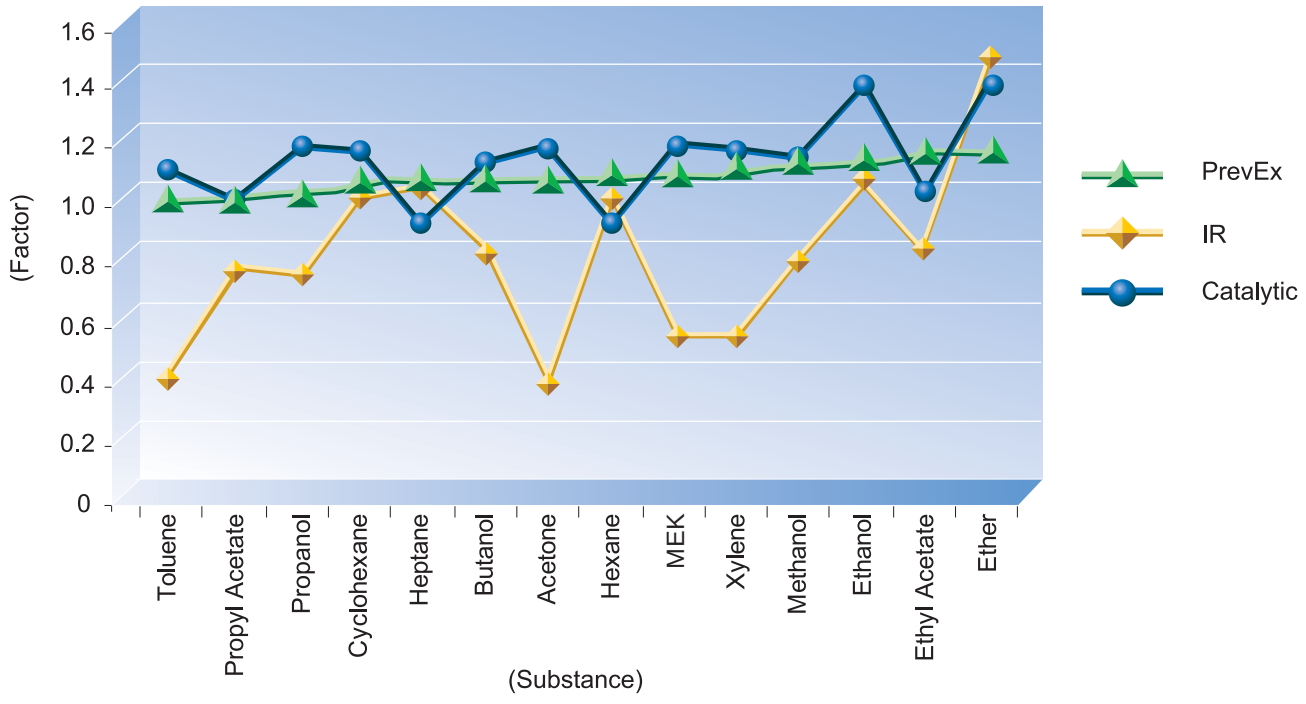
Technical Considerations

Most dryers are used for more than one solvent. Accuracy depends completely on how the sensor responds to each solvent. This means that precise measurement of solvent vapor concentrations should be made with the highest level of accuracy to optimize the control of damper position and achieve maximum energy savings.

The measuring principle of the sensor is important to achieve these goals.

The amount of error that results from attempting to measure two different vapors that have different response factors can be understood by taking the ratio of the two factors. Thus, an attempt to measure two vapors, one with a response factor of 0.5 and another with a response factor of 1.5, could yield a reading of one third (0.5/1.5) or three times (1.5/0.5) the actual concentration!

The flame temperature type sensor (PrevEx®) is said to have a "universal calibration" for many common solvent vapors, because the response factors are in the range of 0.9 to 1.1. By contrast, factors for catalytic sensors can range from 0.8 to 1.3 (a 1.5 to one ratio) and infrared sensors can easily reach 0.25 to 2.0 (an eight-to-one ratio).



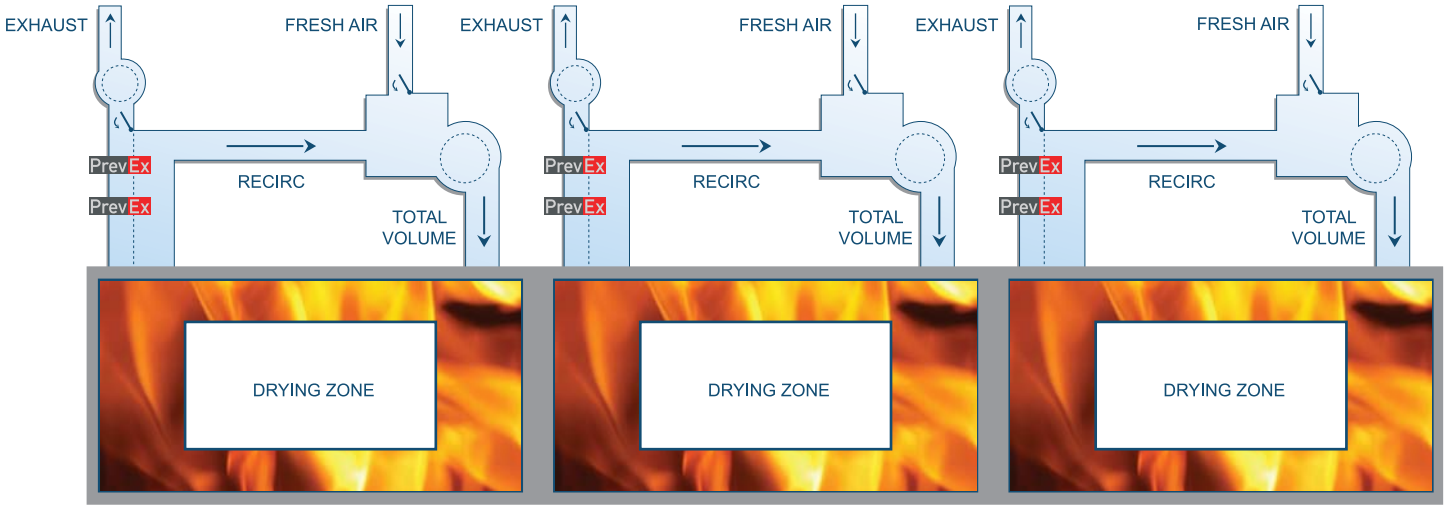
The more solvents that are contained in the process, the greater the error and the wider the damper will stay open, unless precise measurement is continuously taken.

Flame temperature analyzers will react accurately to most flammable substances and will usually measure both single solvents and mixtures with the same high degree of accuracy. Unlike some sensors, flame temperature analyzers were developed for one specific purpose – to directly measure flammability.

Summary

Therefore, direct flammability measurement can be used to precisely measure and modulate damper control to ensure no unnecessary air is heated.

This optimization can result in as much as 50% reduction in fuel costs, so it's not something that should be ignored. The cost of adding solvent vapor analyzers would be quickly recouped.



When selecting a flammability analyzer, do not assume that one size fits all. The appropriate analyzer for a previous application is not necessarily the right choice for another. It's beneficial to select an analyzer that can handle future changes in sample stream composition. However, the specific details of each application need to be examined closely in order to prevent disaster.

The instrument of choice may vary from one application to the next, but the correct process flammability analyzer will always be fast, accurate and fail-safe.

[1] *NFPA-86-2007 Sec 10.1.8.4: Where a continuous vapor concentration controller is used to modulate the flow of fresh air or exhaust from an oven or zone, a secondary protection shall be required to prevent an analyzer failure from causing a hazardous condition.*