Energy is a significant cost of production. As energy costs rise and fall, the increases are difficult to pass on to customers in the price of products and services. But regardless of current energy costs and current trends, a more energy-efficient process is more competitive.

Safe drying of solvents requires excess ventilation air. Extra air keeps the vaporized solvents well below the concentration where they might burn or explode. A lot of energy goes towards heating ventilation air to the drying temperature. And for processes that use a thermal oxidizer for pollution control, much more energy is used to reach 1500°F in order to destroy the volatile organic solvents.

Without an analyzer to monitor the solvent concentration, ventilation is four times (4X) what is needed to keep the maximum solvent load[1] of the dryer below the LFL[2]. Since the dryer rarely operates at its maximum rated load, the ventilation might often be 10X what is needed for the actual load[3].

At least half this ventilation air, and the cost of heating it, can be saved. With an analyzer to continuously monitor the solvent concentration, the required ventilation is only two times (2X) what is needed to keep the actual solvent load of the dryer below the LFL[4]. Ventilation can be adjusted to what is needed for the typical solvent load, or even continuously adjusted to match the actual solvent load at any given time, so there is no need to heat a large excess quantity of ventilation air.

Here are summaries of the most common ventilation methods found in NFPA-86:

- Without an analyzer, the dampers must be fixed in position to provide enough ventilation to keep the solvent concentration below 25% LFL at the maximum solvent load.

  Without an analyzer, there is no chance for detecting and responding to an increase in solvent concentration. There is no energy savings.

- With a continuous solvent vapor analyzer, dampers can be adjusted, but only by some means other than using the analyzer's reading to modulate them, as long as the analyzer performs a safety shutdown before the actual solvent concentration can exceed 50% LFL.

  This approach saves energy. If the process conditions rarely change, the savings can be significant.

- With a continuous solvent vapor analyzer, dampers can be adjusted using the analyzer's reading to modulate ventilation so that the solvent concentration can reach 50% LFL, as long as ventilation always remains above what is required for 50% LFL at the maximum solvent load. The analyzer must perform a safety shutdown before the solvent concentration can exceed 50% LFL.

  With an analyzer used for process control, the safety must come from providing a significant amount of ventilation air at all times, which limits the amount that the dampers can be adjusted. Additional energy savings is possible in some cases, not all.

- With one continuous solvent vapor analyzer to perform the safety shutdown function before the solvent concentration can exceed 50% LFL, a second analyzer can be used to modulate the dampers so that the solvent concentration can reach 50% LFL.

  This produces the maximum energy savings, especially when process conditions vary. The analyzer used for process control is backed up by an analyzer used exclusively for safety. This provides an extra failsafe condition.

Certainly, for any cost savings to be obtained safely, the analyzer must be used properly. After all, the ventilation air provides a margin of safety to lower the chance of fire or explosion. Without an analyzer, a higher margin of safety – more ventilation – is required. With an analyzer, it is acceptable to reduce ventilation by at least half. But failure in the analyzer must not be allowed to increase risk. The safety shutdown analyzer must be independent of the basic process control system[5].

Whether the measurement is made to control ventilation or to perform safety shutdown, an accurate measurement requires a fast and consistent analyzer.

Why fast? For every second that the analyzer lags behind, the actual solvent concentration can be climbing much higher than the reading made by the analyzer. This "dynamic error" in measurement is the most significant reason for failure to give an alarm following a sudden upset. Solvent rises 10% LFL, or 20% LFL, or more each second following a sudden upset. If the measurement lags five seconds, the process can be already above 100% LFL without an alarm.

Consistency means that the analyzer should measure all the solvents equally. A wide disparity in the response to one solvent compared to another will cause the analyzer to exaggerate the actual concentration and cause excess ventilation. It is not uncommon for some analyzer types to read one solvent twice as high as another. Clearly, such an analyzer will not be able to signal for a 50% reduction in ventilation – it could instead signal for a 50% increase in ventilation.

[1] *Solvent load – for example, "pounds per hour" of solvent*

[2] *NFPA-86 Ovens and Furnaces, requires ventilation so that the solvent concentration cannot exceed 25% LFL (Lower Flammable Limit) "worst case" - at the maximum solvent load.*

[3] *It is not uncommon for the actual concentration to be a fraction of the maximum load, so that %LFL concentrations might be 5% to 10% LFL during actual operation compared to 25% LFL for the maximum load.*

[4] *NFPA-86 allows operation up to 50% LFL if a continuous solvent vapor analyzer is used, compared to 25% LFL without an analyzer.*

[5] *See ISA SP84 or IEC 61511 Safety Instrumented Systems The safety shutdown system and the process control system must be separate and independent. One analyzer can perform either a process control function or a safety function, not both. Otherwise a single failure in one analyzer could take the dryer out of a safe operating condition and at the same time fail to perform a safety shutdown.*