Control Instruments® Corporation

Application Note

The Importance of Response Time When Measuring Flammable Vapors in Process Ovens and Dryers

"It can not be emphasized too strongly that the solvent vapor concentration measurement system is to have a very fast response time so that corrective action can be taken in response to upsets such as excessive introduction of solvent into the oven.

A response time of as little as 5 seconds might be required in some cases"

(NFPA 86)

Continuous Monitoring

NFPA 86[1] requires the use of continuous analyzers to measure the potential flammability of vapor concentrations in any oven or dryer zone exceeding 25% LFL[2]. Sequential sampling systems that multiplex sample streams from several locations into a single analyzer are not allowed—nor are combined or blended streams from multiple locations.

Analyzer Response Time

Analyzer specifications state the time required for the device to reach 63% or 90% of its final measurement in response to a sudden increase in the sample concentration. These times are solely based on the response of the detector and do not take into account sample transport time, alarm reaction, and the time required by the user's corrective devices.

Sample Transport Time

The speed at which a sample is drawn from the process and reaches the analyzer's detector is critical. Long sample lines, lines with small radius bends or in-line sample conditioning filters, can induce dangerous delays.

Sample Condensation and Drop-Out

Both the analyzer and the sample lines must be warmer than the flashpoint of the vapors traveling through the sample stream. Condensation of any substance in the sample stream, even those which are not of interest, can cause sample flow restrictions or clogging.

Corrective Action

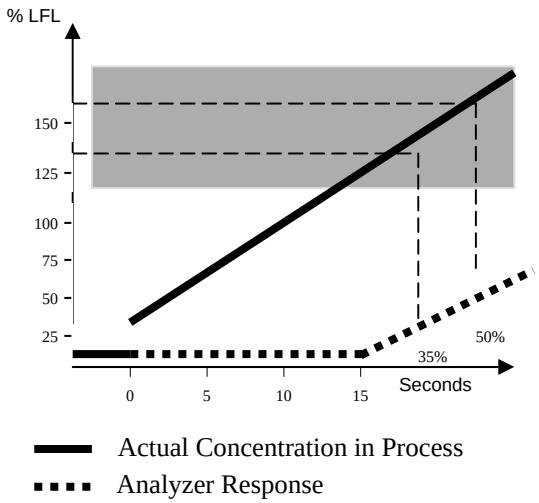
The analyzer should contain it's own alarm relays, connected to the controls of the user's corrective device. For example, the danger alarm relay should directly activate the process emergency stop, fan speed, damper release, or whatever action is appropriate.

Total System Response Time

The speed of a flammable vapor monitoring system is the sum of its parts; sample transport, detector response, alarm activation, and corrective action. It is easily determined by injecting a test gas directly into the tip of the sample probe inside the process, measuring the time it takes for the alarm to sound and corrective action to take place. The concentration of test gas should be at least 10% LFL above the Danger (High) alarm point.

Consider a system with a fifteen second delay, monitoring a process that loses control at 7% LFL per second. By the time an upset in the process reaches the analyzer and activates the 35% LFL Warning alarm, the concentration within the process is already at 140% LFL. The 50% LFL Danger alarm does not activate automatic corrective action until the atmosphere in the process is above 150% LFL.

Illustration: The LFL percentage versus the system delay in seconds.



1. National Fire Protection Association standard for the safe operation of ovens and furnaces.

2. Lower Flammable Limit; the minimum concentration of solvent vapors in air which can propagate a flame.

Control Instruments® Corporation

25 Law Drive
Fairfield, NJ 07004-3295
973-575-9114
Fax 973-575-0013
sales@controlinstruments.com

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