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SOLVENT COATING

Explosion Protection for Perforated Coating Pans
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The use of solvents to coat tablets has been decreasing for years. Aqueous coating became the popular answer to safety issues imposed by the FDA and EPA. Formulations, as well as equipment, began to recognize water as the alternative coating method.

However, solvent coating maintains a niche in the pharmaceutical industry. Recent delivery technologies, by their nature, cannot entirely rely on aqueous coating. Manufacturers must address the issues of explosive mixtures, such as acetone.

The National Fire Prevention Association (NFPA) publishes two standards regarding deflagrations (an explosion in which the combustion zone propagates at less than the speed of sound) within a contained enclosure. NFPA Bulletin 68, "Guide for Venting of Deflagrations, 1994 Edition," discusses explosion venting. Explosion vents protect against deflagrations by releasing pressure from the protected vessel in a known manner before the vessel ruptures. In the event that a vessel cannot be safely vented, NFPA Bulletin 69, "Explosion Prevention Systems, 1992 Edition," sets out guidelines for five alternatives.

Because a coating pan's design makes it difficult to vent in accordance with NFPA 68, solvent coating pans must be protected using one of the methods described in NFPA 69. These methods are:

Control of oxidant concentration
This method cannot be practically applied to a coating pan. This method would require that the process air, usually several thousand CFM, be replaced with an inert gas like nitrogen.

Spark Extinguishing Systems
This method cannot be used because it only applies to ductwork containing combustible dusts or solids (NFPA 69:6-1.1). It does not apply to large enclosures, like a coating pan, containing volatile organic solvents.

Pressure Containment
This method can be used to protect a coating pan if the standards in NFPA 69 are adhered to. In a containment system, the enclosure being protected must be strong enough to withstand the maximum pressures produced by a deflagration. The flame front and pressure wave produced by the explosion must be contained within the enclosure.

Any solvent coating pan, which is not rated to **three bar**, may rupture during an internal deflagration. Any solvent coating pan, which is rated between three and six bar, may deform during a deflagration but will not rupture. A solvent coating pan must be rated at six bar or higher to prevent deformation from occurring. A pan built to two bar construction does not meet NFPA 69.

In addition, NFPA 69:5-2.3 limits pressure containment to isolated enclosures. A solvent coating pan is connected to other processing equipment via large diameter inlet and exhaust ducts. NFPA 69:5-2.3 states the pressure containment cannot be used in such systems "unless appropriate test data are available." Without this test data, a pressure containment system does not satisfy NFPA 69.

Control of Combustible Concentration (% LEL Monitoring)

Any mixture of air and a combustible gas will only be flammable if the concentration of the combustible gas is within a certain range. If the combustible concentration is below the solvent's lower explosive limit (LEL), or above the solvent's upper explosive limit (UEL), then the mixture will not ignite. One way to prevent an explosion from occurring is to keep the concentration of solvent vapor below the LEL. NFPA 69:3-3.1 states that if automatic instrumentation with safety interlocks are used, then the solvent vapor concentration must be below 60% of the LEL. Without safety interlocks, the vapor concentration must be kept below 25% of the LEL. If the concentration of solvent vapor in the coating pan can be kept below these limits during the coating process, then this method of explosion protection can be used.

Deflagration Suppression

The pressure increase associated with a deflagration does not build up instantaneously. The rate of pressure increase is quite low for roughly the first 100 milliseconds after ignition. After this point, the pressure increases rapidly. Explosion suppression systems detect the pressure increase from a deflagration before the rapid rise begins. The detector then triggers the system to quickly disperse a pressurized chemical suppressant, such as sodium bicarbonate, into the coating pan. The suppressant inhibits the deflagration limiting the maximum resulting pressure to 1-5 psi (0.07-0.34 bar). The coating pan only needs to withstand this reduced pressure.

The Thomas Engineering Approach

NFPA standard 69 requires that only one of the above methods needs to be used to protect against deflagrations. TEI has chosen to implement two independent systems in the Accela-Cota: combustion concentration control and explosion suppression for an added measure of safety.

Combustion Concentrations

This method is controlled by monitoring the %LEL of the solvent vapors at up to four separate locations: in the exhaust duct just above the coating pan, underneath the sink where any solvent leaks could accumulate, outside the coating pan where the operator is working (optional), and in the solution prep room where large amounts of liquid solvent are present (optional). Sensors at these locations continuously monitor the %LEL. To provide an additional safety factor the sensors are set to trigger an alarm at 25% of the LEL, well below the 60% required by NFPA 69. The sensor alarms are interlocked with the process controller. In the event of an alarm, the spray pump is shut off directly by the %LEL sensor monitor, and the airflow is maximized to dilute any solvent vapors in the coating pan. A display lets the operator know which sensor triggered the alarm. With this system, the solvent vapors will never reach an explosive concentration.

An explosion suppression system is provided as an extra layer of safety in addition to the %LEL monitoring system. A suppression system is provided to protect against an explosion inside the coating pan. The system can be expanded to include the dust collector. Normally, the dust collector will be protected by explosion venting. NFPA 68 requires that the vented material be discharged, through a maximum 10 feet of duct, to a safe location outdoors. If this requirement cannot be met, then the dust collector must be protected by an explosion suppression system.

The efficiency of the Thomas Engineering Accela-Cota XR models, and the sound engineering approach to conform to NFPA Standard 69, answers the needs for complete solvent coating systems.

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