Field Application Article

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Potential exposure to solvents eliminated

Dry-disconnect coupling assembly reduces piping requirements, cross-contamination

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By repiping a solvent distribution system in one of its fermentation production buildings, The Upjohn Co.'s Kalamazoo, MI, facility reduced potential solvent emissions, cross-contamination concerns and potential employee exposure.

Previously, trapped solvent in a second floor transfer line, which led to 13 tanks on the third floor, had to be cleared by blowing the pipeline with nitrogen. Not only would this nitrogen blast increase the load on a new vapor recovery unit (VRU), but the non-condensable nature of the nitrogen would have reduced this regional solvent recovery system's efficiency.

The installation of a self-draining solvent distribution system above the tanks reduced by a factor of 10 the need to blow the lines with nitrogen. The addition of dry-disconnect couplings at the hose connections eliminated drips—potential exposure sources.

Isolation processes use solvents

Upjohn's isolation processes to separate and purify bulk steroids and antibiotics after fermentation use various solvents, some of which have recommended exposure levels as low as 50 ppm. Proposed regulations would reduce those levels even further.

One isolation unit at the Kalamazoo plant feeds four solvents via a solvent distribution station. Previously, operators connected hoses, located on the second floor, for methylene chloride, acetone, butyl acetate or heptane to a common header that branched to the top of 13 isolation vessels, located on the third floor (Fig. 1). When the transfer was complete, the line had to be blown clear with nitrogen and the filters changed. Pockets within the line posed product contamination, worker exposure and cleanup concerns, which were made worse with conventional hose connections.

Vapor recovery unit

Upjohn is installing a large environmental project that involves a VRU for volatile organic compound (VOC) vapors from several buildings. Most of the solvent vents will be attached to this cryogenic condensation-type system.

Says Production Engineer James Janicki, "Since it's a cryogenic condensation system, non-condensable gases reduce its efficiency. We had to find ways to reduce the amount of nitrogen that would vent into this regional collection system. Our goal is to minimize nitrogen flow into the system."

If the regional system had too much nitrogen in it, it would not condense a sufficient amount of VOCs. Upjohn might then risk an excursion based on the Michigan Department of Natural Resources air permits.

Janicki found that a large amount of nitrogen in the collection system could come from clearing the solvent lines by blowing nitrogen through them, so he sought ways to reduce or stop blowing in one of the solvent distribution systems in the fermentation building.

Solvent distribution system

"We had an old solvent distribution system supplying the various tanks in one of our fermentation units. This single solvent supply line, containing a positive-displacement meter and filter, permitted the transfer of only one solvent at a time," says Production Engineer Brian S. VanderWilp.

The operator had to clean the line by blowing nitrogen into the tank. The tank vents are connected to the regional VRU.

"The higher elevation was a challenge, because no matter how hard the nitrogen blew, there was still some solvent left in the vertical pipe. That was a housekeeping problem with safe materials and became a greater problem with toxic materials. The operator had to dispose of that waste properly and change the filter each time," VanderWilp says.

Residuals remaining in the lines caused several potential problems: contamination by getting traces of one solvent into another product; employee exposure; and fugitive emissions.

"Once you open the hose connections, residual solvent can drip from the hose," said Neil Weaver, safety specialist with the company's Chemical Div. "The entire industry is faced with this issue. Our major motivation was to eliminate workplace exposure from disconnecting these assemblies."

Hard-pipe option

Installing dedicated supply lines for each of the four solvents to the 13 isolation tanks would require 52 separate lines. Although this approach would eliminate the need for hose connections and line cleaning, it was expensive and there was not enough space for the required piping.

Top: Drip-free hose-disconnect assemblies completely seal off both tank connection and hose end to eliminate potential solvent exposure. Fermentation Operator Richard Culp connects a solvent hose to a tank.

Right: Four hoses supply solvents to 13 process tanks at this solvent distribution station.

Below: Batch controllers measure the four solvents: acetone, heptane, methylene chloride and butyl acetate.

Overhead sloping lines

As an alternative solution to hard piping, VanderWilp installed one solvent line per isolation tank, sloping toward the tank. The lines contained no pockets, allowing them to drain, not trap the fluid. Also, Upjohn installed a filter, a flowmeter and a batch control system in each of the four solvent lines (Fig. 2). To improve the safety of the hose connections, VanderWilp used a dry-disconnect coupling assembly.

To keep the solvent lines sloping towards the tanks and free of pockets, the new solvent supply station needed to be located above the tanks, with the hose connections at about shoulder height. With the connections at this level, disconnections are a potential exposure problem due to residual solvent in the line.

"The dry-disconnect fittings gave us the extra margin of safety required to adopt this approach. We could locate the new arrangement at shoulder level because of the drip-proof system, and not worry about the operators being exposed to solvent fumes," VanderWilp says.

A different type of hose coupling assembly provides the necessary drip-free disconnection. This dry-disconnect device uses a quarter-turn disc to control the flow. When the hose coupler and mating adapter on the isolation vessel are separated, the disc splits into two identical halves. Each half acts as an automatic cap that seals the end of the hose before it is disconnected, preventing drips and leaks.

A mechanical interlock prevents the connection from opening unless the two halves of the disc are closed. Other dry disconnects can be accidentally separated when the line is still open. This new design also has the lowest pressure drop of any dry disconnect that VanderWilp

considered. Its smooth-bore configuration allows improved flow, unlike couplings that have many internal components.

Equipped with a coupler-end swivel to help alignment, the assemblies are lighter and easier to handle than conventional dry disconnects. Seals are easily accessible for inspection, cleaning and replacement. The couplings are rated for 150 psi.

Seal performance improvements

"Because the assemblies are exposed to methylene chloride and acetone, we originally specified Teflon® seals. Teflon was the only standard material offered by the manufacturer that could stand up to both," Janicki says.

The dry-disconnect manufacturer worked closely with Upjohn to improve the performance of the Teflon seals. This cooperation has resulted in an improved seal design, increasing seal life. "The result is a consistent, drip-free operation. Since we installed the new seals, we haven't had a failure," VanderWilp says.

Although Upjohn had to completely repipe the facility, the assemblies eliminated the need for exhaust hoods and a special HVAC system to handle any fugitive emissions.

"Whenever the line is apart, the couplings being closed addresses the potential fugitive emissions because the line may still be wet with solvent. We know the line is closed whenever it is disconnected because we can't disconnect unless it is closed," VanderWilp says.

Reduced nitrogen use

"We've seen no solvent in some lines and only a small amount in some of the longer lines. The lines are easier to clean," VanderWilp says.

He adds that now only a small nitrogen burst lasting a few seconds is required to clear the lines. Before this, 30 sec to 60 sec of nitrogen was used.

Janicki adds, "We were so pleased with the dry disconnects that we purchased more for another project in a basement location.

"These dry disconnects allowed us to make our connections without solvent vapors collecting in a low spot. We have solvent vapor monitoring devices there, so we would know if we had any problems with it. This area is monitored closely."

■ Dry Link® Hose-coupling Assemblies–Victaulic®-Environmental Products Div., Victaulic Co. of America, Easton, PA. Internet address: www.drylink.com.

■ Model DC1-7-120-S6 Valve Actuator with Two-stage Shutoff (Dribble-Control) Package—El-O-Matic International, Hackensack, NJ.

■ Model W4/1502 Turbine Flowmeter and Model 665 Batch Controller with NEMA 7 Explosion-proof Enclosure— INVALCO Inc., a subsidiary of Smith Meter Inc., Hutchinson, KS.

■ Model 7PC1 Filter with Cuno 1 High Cartridge Pack Assembly—Cuno Inc., Meriden, CT.

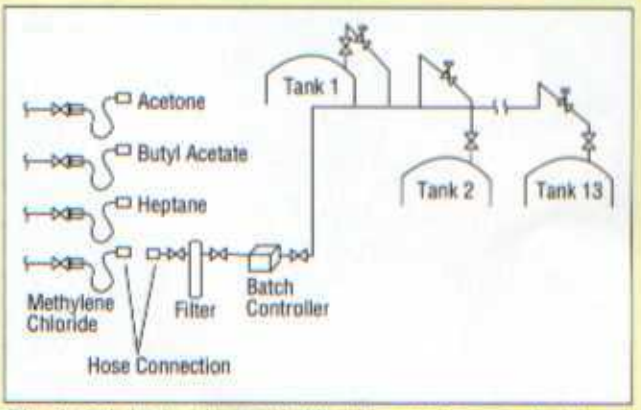

Fig. 1. Original solvent distribution station required nitrogen to blow lines clean but a small, remaining amount had to be disposed.

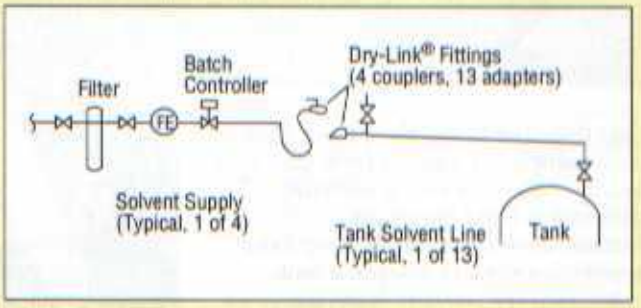

Fig 2. Revised solvent distribution station is self-draining. Drip-free hose-disconnect assemblies cut potential exposure to solvents.

Plant profile

Headquartered in Kalamazoo, MI, The Upjohn Co. is in its 109th year of operation. The company operates more than 200 research, manufacturing, sales and distribution facilities globally for its human and animal health, pharmaceutical and specialty chemical, and agronomic and vegetable seed businesses.

The Kalamazoo manufacturing facility is Upjohn's largest worldwide. The chemical and fermentation production area produces fermentation and chemical products such as corticosteroids, prostaglandins and antibiotics for medicinals.