PROCESS WORLDWIDE

Disconnects: Technology Compared

The Next Generation of Couplings and Disconnects

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The next generation of dry couplings: Easy to handle and safe to operate. (Source: © Lev/Fotolia.com, OPW [M] Frank)

Double ball-valve dry disconnects set new standard in chemical handling — Operators that handle hazardous liquids or toxic chemicals have high demands for loading systems, hoses, pipes and couplings. But how to design such a system? Are traditional bayonet-and-plunger styles still the go-to-solution for chemicals or has the time of new coupling technology finally come?

According to the National Response Center's "Spills and Accidents" database, there were 26,987 incidents involving chemicals in the US in 2015. When looking at the circumstances of said accidents, 42 % of the events involved vehicles, 30 % took place at a fixed site and 11 % occurred at storage tanks, platforms or pipelines.

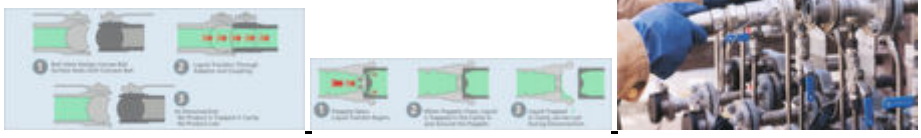
Looking at the causes of these spills, 24 % were due to equipment failure, while operator error and transport accidents both accounted for 7 %. These numbers are likely to mean a great deal of sleepless nights for those involved in manufacturing, transport and handling of chemicals products due to the ever-present threat of a catastrophic spill. Because of the many transfer points in the supply chain, chemical industry operators must ensure that their liquid-transfer equipment like loading arms, hoses and disconnects, provide highest quality and reliability.

Know Your Systems

In general, designing and constructing a chemicals loading system is a complex process. These are just some of the considerations that must be taken into

account:

GALLERY



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- Is it a top-, bottom- or side-loading application?
- What are the ambient weather conditions? Do the products produce extreme temperatures?
- What products will be handled?
- Will any type of cleaning or purging procedure be employed?
- What construction materials are most compatible?
- How long are the loading arms?
- Will railcars or trucks need to be spotted from various distances?
- What flow rates will be required?
- Will any specialized welding be needed for the job (e.g. for a hygienic or sanitary application)?
- What is the design of the support structure?
- Are there any specialized material-handling requirements?
- Is the loading system ergonomically designed?

Even after acknowledging and addressing these questions, deciding on the proper loading system requires a lot of specific steps to be completed succinctly and reliably. Many of the raw materials used in chemical manufacturing are volatile, hazardous or corrosive — from acids and solvents to more specific formulations such as butadiene, xylene and toluene — so they must be treated with the utmost respect and properly contained.

Additionally, preventing spills or leaks is vital because any that occur, besides being dangerous on various levels, have the potential to interrupt the production schedule, and cause the loss of high-value ingredients as well as prohibitive cleanup costs.

Plunging Ahead

When considering the dry disconnects for the safe transfer of hazardous chemicals and their feedstocks, a certain technology has risen to the fore over the years: So called “bayonet-and-plunger” or “poppet” style dry disconnect coupler. The disconnects have gained acceptance because their design and operation possesses a number of benefits like a relatively little fluid loss when

the coupler is disconnected, as little as 0.5 ml of fluid, or the equivalent of 1/10th of a teaspoon (approximately 0.017 of an ounce).
They are also equipped with safety locks that prevent the coupler from opening accidentally. Most brands of bayonet-and-plunger couplers are lightweight and easy to maneuver, which eliminates operational stress and strain on hoses and loading arms. Their low cost also makes them attractive to manufacturers who are looking to streamline capital expenditures and protect the operation's bottom line.

No Jack-of-all-Trades

With all that being said, bayonet-and-plunger couplers do have a number of characteristics that prohibit them from being the absolute best technology choice in chemical-manufacturing applications. First, while an extremely small amount of fluid may be lost during disconnection, there are other coupler technologies that have been proven to lose lesser amounts of fluid. From an operational standpoint, the biggest shortfall of bayonet-and-plunger couplers is their design, which puts a number of internal parts in direct contact with the fluid as any type of flow-restriction negatively affects the production process.
For example, if a bayonet-and-plunger coupler with a 2" I.D. is installed in a 2" line and, the flow rate will actually be less than what is to be expected from a free-flow 2" line as the liquid has to work its way around the coupler parts. This may also necessitate the need for a larger-than-necessary 2.5" or 3" coupler, which can be more expensive.

Disadvantages of Bayonet Couplings

Additionally, a bayonet- and-plunger coupler's internal components, such as springs, guides and poppets, can also create areas where the liquid can collect and nest, which makes it difficult to clear and maintain a clean pumping environment; especially when handling liquids with higher viscosities.
Bayonet-and-plunger couplers can be at a disadvantage with closed-loop fluid-transfer systems due to the number of valves deployed. At some point the closing of two valves will leave product trapped in the hose between. The pressure that is created when the downstream valve is subsequently opened has the potential to damage the coupler ahead of it.
Lastly, bayonet-and-plunger couplers are harder to repair or maintain inline because of the number of parts they contain. In fact, many bayonet-and-plunger suppliers require the coupler to be removed and returned to the manufacturer for repairs. If the coupler can be repaired in the field, the number of steps in the repair process, along with the number of parts to consider can make it difficult or confusing for the maintenance technician.

The New Age Of Disconnects

While bayonet-and-plunger dry disconnect couplers have performed admirably in chemical-manufacturing over the years, an advanced technology has emerged that overcomes the shortcomings found in poppet-style couplers. This innovative technology is a low-spill dry disconnect coupler that operates via a double-ball-valve design. It features a convex ball that rests in a concave ball, resulting in the elimination of any cavity between the mating halves and guaranteeing that no

residual fluid will be trapped there, lowering the risk of spills and giving the liquid virtually no place to collect or hide, which eases cleaning.
Specifically, upon disconnection, there will be less than 0.5 ml (0.02 ounces) of fluid left on the face seal of the coupler, an amount that is less than one-quarter of a teardrop.

Dissconects with Safety Incorporated

The design also incorporates multiple safety interlocks that allow the valve to open and close only through a deliberate action by the user, preventing any accidental opening, which lowers the risk of unintentional spills and catastrophic chemical releases. This is not only critical when transferring raw materials from large storage vessels, but also during the numerous tote-filling operations that are a staple of chemical manufacturing.
This constant on-and-off filling of smaller-capacity containers can put undo strain on the couplers, but the double ball-valve design and unique method of operation nullify the harmful effects. The ball-valve design also provides for an unrestricted flow path, thus minimizing pressure drops, which results in less than 1 psi in pressure drop at a flow rate of 150 gallons per minute (568 liters per minute). In other words, a liquid-transfer system that calls for a 2" hose can utilize a 2" double ball-valve coupler model without any reduction or restriction to the flow rate.
Another benefit of double ball-valve couplers when compared to bayonet-and-plunger styles is the double ball-valve coupler's ease of maintenance. Because the design incorporates fewer parts than competitive technologies, it can be repaired on-site very easily, with no need for time-consuming and costly returns to the manufacturer or the need for in-the-field repair personnel to battle with complicated and confusing repair or maintenance instructions.

Safe an Sound Operation

Furthermore, for extremely product-sensitive operations, the double ball-valve style dry disconnect offers a keyed interface option that locks out and isolates transfer lines. This means a specific coupler can only be used with a specific hose or loading arm which helps to prevent cross-contamination.
Achieving safe operation and cost-effectiveness is a day-to-day challenge for chemical manufacturers and handlers, especially when the finished products that are created and raw materials that are used are both hazardous and expensive. With many production operations requiring large tank farms and the transfer of thousands of gallons of raw materials and end products on a daily basis, the type of dry disconnect coupler used, and the technology's ability to optimize reliability, safety and cost is a critical consideration.

The Final Frotier of Couplings?

While bayonet-and-plunger coupler technologies have proven to be effective in meeting the basic needs of liquid transfer, the process can be taken to the next level with the use of a next-generation technology like the double ball-valve dry disconnect coupler.
This best-in-class technology provides the operational advantages – reliable, safe and leak-free product containment; full-flow capability; regulatory compliance; and ease of repair and maintenance – that will enable manufacturers and

handlers to get a good night's sleep and hopefully eventually help put organizations like the National Response Center out of business.
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ADDITIONAL INFORMATION

Technology Compared
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A leader in the development of double ball-valve dry disconnect technology has been OPW Engineered Systems, Lebanon, OH. Specifically, it has developed the Epsilon®, which is a low-spill double ball-valve dry disconnect coupling that has been designed to provide for product flow through an unrestricted flow path with double shutoff reliability in the coupling connection. The illustrations below show how the Epsilon's method of operation can outperform traditional poppet-style couplers when handling hazardous or dangerous chemicals

Poppet-Style Design

When utilizing poppet-style disconnects, liquid transfer is initiated when the poppets are opened by the operator (Step 1). The liquid transfer is completed when the operator closes the poppets (Step 2). However, at this time, a small of mount of liquid can be trapped, and during disconnection it is possible that the trapped liquid can escape, leading to a minor product spill (Step 3).

Ball- Valve-Style Design

The unique ball-valve operation of the Epsilon disconnect allows a convex ball to seat with a convex ball when the valve is opened (Step 1). This straight-through design allows the liquid to transfer through the adaptor and coupling with no reduction in flow rate (Step 2). Upon disconnection there are no cavities created in which product can nest, meaning no product will be spilled (Step 3). This no-spill operation is accomplished through the use of five independent and redundant mechanical interlocks that require deliberate sequential action by users, thereby eliminating unintentional spills and catastrophic chemical releases.