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PLUS: DISTRIBUTORS DEFEND THEIR POSITION AGAINST THE HILL ✯ CHINA OPENS UP TO TANK CONTAINERS ✯ SHIPPING WORLD MAKES TRACKS TO HAMBURG ✯ EUROPEAN REGULATORS START WORK ON 2013 CHANGES

From top to bottom

BOTTOM LOADING Changing over from top loading offers a number of safety and efficiency benefits but some technical issues need to be taken into account. Gary Schriever, global product manager for OPW Fluid Transfer Group, explains

As operations at liquid storage terminals have evolved, so have the ways in which the vessels that transport the commodities stored there are loaded. In the past, loading of tank trucks, transport trailers and rail tank cars were generally loaded from the top, meaning that terminal personnel had to get up on the top of the tank to initiate and carry out the loading process.

This type of loading brings with it a unique set of concerns, both in terms of safety and potential environmental impact. The simple act of climbing on to a tank trailer or rail car carries potential safety issues, as the personnel tasked with this job face the risk of injury due to falls. Top loading also requires the use of expensive loading gantries, racks and loading arm equipment.

Another concern in top loading is the potential for static electricity generation during the loading process. This build-up of static electricity can pose a potential fire or explosion danger for the rack operator. Finally, there are concerns with just how effective top loading systems can be in preventing product vapours from leaking into the atmosphere.

Top loading of tanks can still be a safe, efficient and cost-effective method of product loading in many situations, but many terminal operators have begun moving to bottom loading of petroleum that has proven to be safer, faster and more efficient than traditional top-loading operations.

Benefits and risks

There are many advantages to bottom loading. The most obvious is safety: employees are no longer required to climb to the top of the transport vessel in order to complete the loading process. Also, because bottom loading occurs in a closed-loop arrangement, the chance of static electricity build-up causing a fire or explosion is greatly reduced since the potential for a fuel/oxygen mixture is reduced. Operators have no need to open a large hatch on the truck and release large volumes of vapour to the atmosphere. When bottom-loading equipment is installed correctly, the desired level of near-zero vapour emissions can be achieved.

When converting to bottom loading, rack layout needs to be reconsidered

Operationally, advances in bottom loading equipment have also made it more ergonomic and less physically taxing on the loader. This also benefits the terminal by making loading operations faster. Bottom loading also allows for the simultaneous loading of several tank compartments at the same time, which again increases the speed and efficiency of product loading. In a nutshell, safer, more ergonomic and faster loading is what bottom loading is all about.

Despite all of these benefits, however, there is one concern that terminal operators must be aware of if they are to initiate bottom loading at their facilities: during bottom loading operations, an effect known as 'thermal expansion' may occur. Thermal expansion is defined as "the tendency of matter to change in volume in response to a change in temperature". In other words, when a substance is heated, its particles begin moving and create a greater average separation. If the material is a fluid, this amount of expansion is represented as a change in volume.

Meeting the spec

Hand in hand with this change in volume is an increase in pressure. In a bottom loading application, this means that product trapped between the loading coupler and the loading valve has a tendency to become over-pressurised, which can lead to equipment damage that can result in product leaks that can be harmful not only to terminal personnel, but also the environment. Research has shown that an increase in temperature of 6°C to 12°C can result in an increase in system pressure of 300 psi to 500 psi.

To tackle the potential deleterious effects of thermal expansion, the American Petroleum Institute has published API Recommended Practice 1004 (RP-1004), Bottom Loading and Vapor Recovery for MC-306/DOT-406 Tank Motor Vehicles. RP-1004 provides an industry standard for bottom loading and vapour recovery of proprietary and hired carrier MC-306/DOT-406 tank vehicles at terminals operated by more than one supplier. MC-306/DOT-406 vehicles are those that feature atmospheric pressure cargo tanks made of single-shell aluminium with a liquid capacity of 9,000 gallons (34 m^3).

RP-1004 covers common interfaces such as product, vapour and overfill prevention between the storage terminal, which in the US are regulated by the US Environmental Protection Agency (EPA), and tank trailers, which are regulated by the Department of Transportation (DOT). Specific to thermal expansion, RP-1004 dictates that "the rated pressure of terminal bottom-loading systems shall be a minimum 75 psi (517 kilopascals) and shall not leak at 1.5 times the rated pressure" and that "adequate pressure relief shall be provided to ensure a maximum

pressure in the loading-arm system that does not exceed 75 psi".

A solution emerges

The solution to meeting these RP-1004 requirements is the incorporation of a check valve or pressure relief valve into the loading-arm configuration. Frequently, a 1/8-inch check valve around a control valve is sufficient to relieve thermal expansion and its harmful effects. However, a pressure relief valve may be required for thermal expansion relief under some piping configurations. Furthermore, the installation of a maximum indicating pressure gauge on the loading arm is recommended to ensure that the relief system is functioning properly.

A properly installed and monitored check valve or pressure relief valve can help guarantee that the maximum pressure in the loading arm does not exceed 75 psi, which is the pressure threshold set out in API RP-1004. Meeting the RP-1004 standard for loading arm pressure will result in a safer working environment, as well as a decrease in the chance that equipment damage leading to product leaks will occur.

There is no question that the use of bottom loading in liquids terminal transfer applications has been a boon to terminal operators, namely in terms of increased safety, time saved and efficiency of operations. However, any terminal operator contemplating a switch from an exclusively top loading operation to one that features bottom loading must be aware of the potential risks involved.

Liquids terminal bottom loading only delivers the above-mentioned benefits if the equipment is installed and operated properly. This means that the inclusions of check valves or pressure relief valves, along with the use of a maximum indicating pressure gauge, are essential components of any loading arm configuration used in bottom loading applications.

Recognising these requirements, OPW Engineered Systems, based in Lebanon, Ohio, has developed a complete family of bottom loading equipment, from booms to hoses to API couplers, designed to safeguard terminal personnel as well as the environment.

Simply put, bottom-loading islands are simpler and cheaper to build than top-loading racks. This leads to safer loading in a shorter period of time with less chance of spillage and vapour loss. Specific benefits of bottom loading systems and equipment from OPW Engineered Systems include:

- increased safety for the person operating the loading arm since that person remains on the ground and is no longer required to climb to the top of the vehicle, where falls can occur;
- loading arm connections to the vehicle are made more quickly so overall loading time is reduced;
- the creation of less turbulence in the tank, reducing the danger associated with the generation of static electricity;
- an overall reduction in vapour emissions, with the capability to fully recover any vapours that may escape; and
- faster tank filling, with a number of compartments able to be loaded simultaneously

These characteristics make the bottom loading equipment designed and manufactured by OPW Engineered Systems ideal for any type of terminal loading application, whether the commodities involved are petroleum products, chemicals or liquefied gases.

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