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Bulk Logistics Optimisation

Best Practice Guidelines

BULK LIQUID UNLOADING SCENARIO'S

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In no order of preference the 4 most common scenarios for unloading bulk liquids are:

1. **Bottom unloading by pump and vapour return**
2. **Bottom discharge by pump without vapour return**
3. **Bottom unloading by compressed air or inert gas**
4. **Top Discharge**

For each of these scenario's the text below describes the key characteristics, main advantages and disadvantages and conditions for safe practice.

The document focuses on (un)loading operations both through the top or via the bottom of vehicles, this is commonly done with a flexible hose but an (un)loading arm can be considered too.

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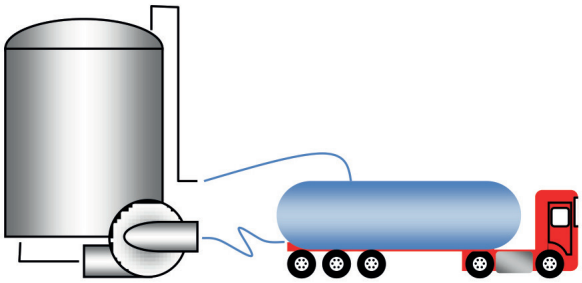
Bottom unloading by pump and vapour return



The pump will be filled with liquid by gravity and will provide the necessary energy to the product to overcome the gravitational backpressure and flow restrictions. The pump will be connected to the vehicle by a flexible hose of sufficient diameter (usually 80mm -3"). The liquid flowing will simultaneously create more vapour-space in the vehicle and less in the site tank. A flexible hose (minimum 25mm -1") connecting both vapour-spaces will balance the pressure and prevent vacuum in the vehicle.

Main advantage

In case of emergency the power to the pump is cut which immediately cuts the flow of product. This is a significant safety advantage over pressurized discharge.

Vapour in the site tank will flow to the truck and not be lost to the atmosphere.

Main disadvantage

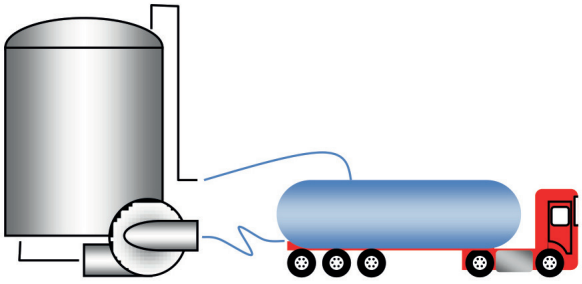
For connecting the vapour return, access to the top of the vehicle is often required. An exception to the rule is a ground-operated truck.

Condition of use

Any obstruction in the vapour return line (a closed valve, a lump of frozen or polymerized material, etc.) will create an overpressure in the site tank and a vacuum in the vehicle. Positive proof of flow in the vapour return line is required.

The pump should be site-owned. A mobile pump on the truck might be a cheaper solution in the short term but adding a pump to the transport company's equipment increases the tare weight which in turn reduces the net weight carried. A truck-owned pump increases the cost and CO2 burden of the supply chain unnecessarily.

Bottom discharge by pump without vapour return



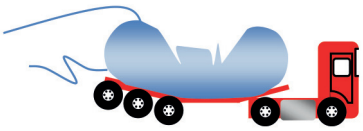
The pump will be filled with liquid by gravity and will provide the necessary energy to the product to overcome the gravitational backpressure and flow restrictions. The pump will be connected to the vehicle by a flexible hose of sufficient diameter (usually 80mm -3”). The liquid flowing will simultaneously create more vapour-space in the vehicle and less in the site tank. The Site tank’s vapour will exit the tank to the atmosphere (possibly through a scrubber or Vapour-recovery-unit). The vehicle’s tank needs to be opened at the top to allow air to enter the tank.

Main advantage

In case of emergency the power to the pump is cut which immediately cuts the flow of product. This is a significant safety advantage over pressurized discharge.

Main disadvantage

For opening the vapour valve, access to the top of the vehicle is often required. Working at height needs to be considered by the site. An exception to the rule is a ground-operated truck.



The site tank vapours will need to be taken in consideration. Vacuum collapse of the vehicle tank has to be considered. Vehicles are not process equipment. Because of their purpose they cannot be considered to have effective vacuum protection of sufficient size to accommodate discharge. Often vehicles do have sufficient protection to compensate vacuum created by absorption or cooling, but these are processes that are significantly less demanding on the equipment.

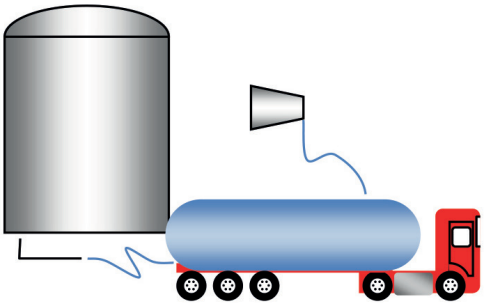
Condition of use

Vapour exiting the site tank needs to be considered. Depending on the nature of the product a scrubber or vapour recovery unit might be required to eliminate emissions of chemicals to the environment.

The pump should be site-owned. A mobile pump on the truck might be a cheaper solution in the short term but adding a pump to the transport company’s equipment increases the tare weight which in turn reduces the net weight carried. A truck-owned pump increases the cost and CO^2 burden of the supply chain unnecessarily.

The pump should be of self-suction design and not require the tank to be put under pressure. Putting the tank under pressure to flood the pump means the tank has to be opened quickly as soon as the pump starts to avoid vacuum damage. For ‘Flexitanks’ (bag-in-box-containers) the risk of vacuum collapse is evidently non-existent.

Bottom unloading by compressed air or inert gas



The liquid will flow to the tank powered by the pressure of the air or gas flowing from the compressor. The site tank will be connected to the vehicle by flexible hose of sufficient diameter (usually 80mm -3”). The site tank’s vapour will exit the tank to the atmosphere (possibly through a scrubber or Vapour-recovery-unit if installed). After discharge the vehicles’ tank needs to be brought to atmospheric pressure before the vehicle can be allowed to exit the site.

Main advantage

Since there is no pump, you do not have to worry about the cleanliness of the pump. The compressor does not come in contact with the product so there is less risk of contamination.

Main disadvantage

After discharge the vehicle's tank is under pressure. For connecting the compressor to the vapour valve, access to the top of the vehicle is often required. An exception to the rule is a ground-operated truck. The Site tank's vapours will need to be taken in consideration.

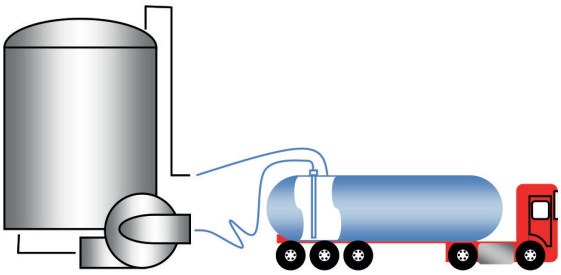
Condition of use

Of course you cannot blow pressurized air into a flammable atmosphere. Use of inert gas is then required. When using inert gas the safety of the tank cleaning personnel needs to be considered. Attach a nitrogen-warning label to the manlid. Make sure the tank can resist the maximum pressure from the compressor so to avoid over-pressurizing the vehicle's tank. At the end of the discharge the pressure in the vehicles tank will blow the lines to the site tank and pressure will be transferred to the site tank.

It is not acceptable to return a pressurized truck on the road after discharge. Neither tank cleaning stations nor transport companies have the equipment to reduce this pressure before opening the tank for cleaning. Simply opening a vapour valve en-route is environmentally unacceptable. The pressure in the vehicle's tank has to be reduced to atmospheric at the discharge site. Vapour exiting the site tank needs to be considered. Depending on the nature of the product a scrubber or vapour recovery unit might be required to eliminate emissions of chemicals to the environment.

The compressor should be site-owned. A mobile compressor on the truck might be a cheaper solution in the short term but adding a compressor to the transport company's equipment increases the tare weight which in turn reduces the net weight. A truck-owned compressor increases the cost and CO2 burden of the supply chain unnecessarily. An exception to this rule are tilting-trailers. Those can use the compressor that drives the hydraulics of the tilting mechanism.

Top Discharge



Some vehicles are designed with 'dip-pipes' to accommodate top-discharge. The same possibilities exist as for bottom discharge except that – since access to the top of the vehicle is already required for connecting the liquid-hose. Having to access the top of the vehicle for connecting or opening the vapour connection is no longer a disadvantage. (Provided of course the site has taken the relevant working at height precautions).

Main advantage

Since there are no openings under the liquid-level, the risk of tampering is significantly reduced.

Main disadvantage

Access to the top of the vehicle is required.

Condition of use

Working at height needs to be considered by the site and the transport company. Clear indications of which connection is 'liquid' and which is 'vapour' is critical. It is not possible to unload product wrongly connected but loading the truck with connections reversed will immediately flood the vapour-return lines.

Get in touch

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