BASICS OF TANK BLANKETING

PRESSURE & SAFETY SYSTEMS

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Tank blanketing is the process of providing and maintaining a blanket of gas in the vapour space above the liquid in a closed storage tank. This blanket of gas, also known as pad, is maintained at very low pressure, usually less than one psig.

There are other common names for tank blanketing, including inert gas blanketing, padding and makeup. In most industries, tank blanketing is also referred to as Nitrogen blanketing because Nitrogen is one of the most commonly used gases for tank blanketing due to its inert characteristics.

Tank blanketing is used for the following reasons:

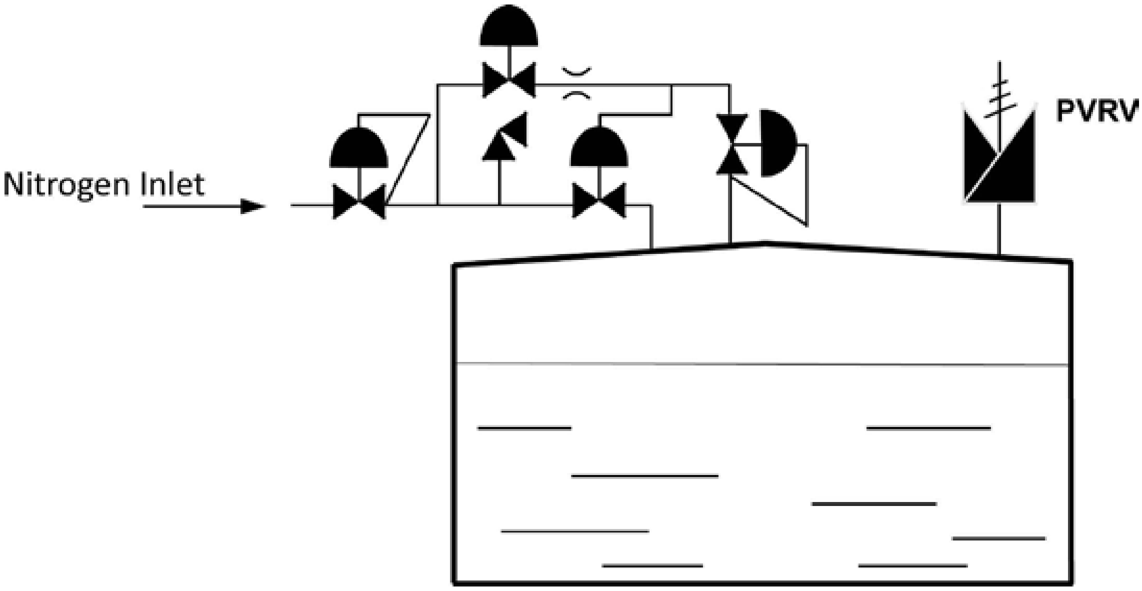
1. To keep air and moisture out of the storage tank to protect the product integrity. Certain chemicals would experience deterioration if in contact with air and/or moisture.
2. To dilute Oxygen content in the vapour space above the liquid to below the flammable range (LFL – lower flammable limit). This is a main criteria for safety as it will ensure that the vapour is too lean to burn.
3. To enrich the vapour space, so the vapours are beyond the flammable range (UFL – upper flammable limit), meaning that the vapour is too rich to burn. The table below gives an example of selected gases with their LFL and UFL values.

Gas	**LFL (% by volume of air)**	**UFL (% by volume of air)**
Ammonia	15	28
n-Butane	1.86	8.41
Diesel Fuel	0.6	7.5
Ethylene	2.75	28.6
Fuel Oil No. 1	0.7	5
Glycerol	3	19
Methane	5	15
Methanol	6.7	36
Naphthalene	0.9	5.9
Propylene	2.0	11.1
Styrene	1.1	6.1
Vinyl Chloride	3.6	33

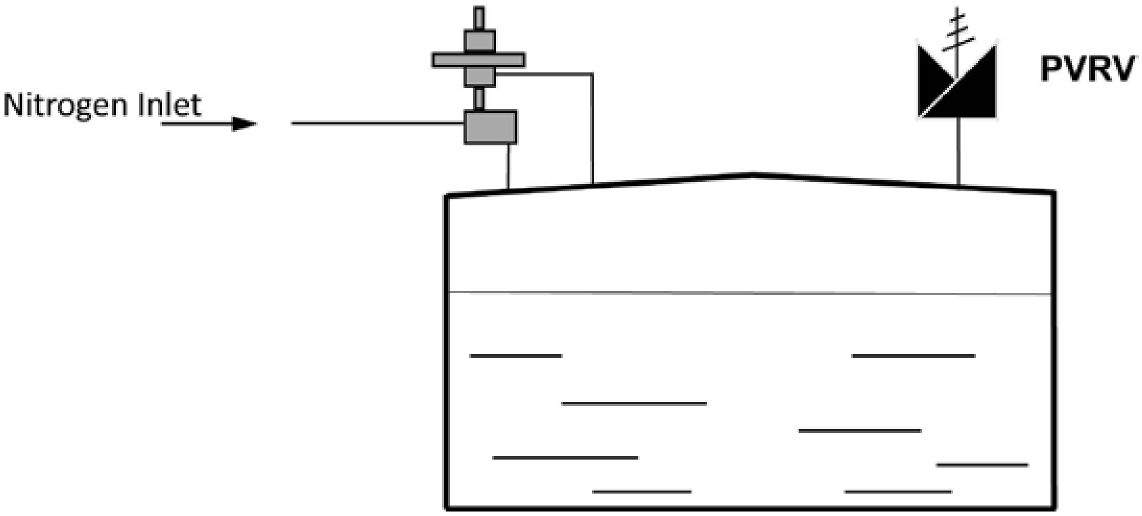
4. To dilute toxic vapours for safer emission levels.
5. Help to prevent internal tank corrosion. This can be achieved by replacing Oxygen in the tank with an inert gas, for example, Nitrogen.
6. This is also a requirement for tank standards as per specifications of API 2000, especially for storage tanks built to API 650.

Traditionally, tank blanketing has been achieved by using a multiple regulator or valve system. As the required blanketing pressure is very low and the pressure has to be maintained at a very stable value, it has always been a challenge for tank makers and/or designers to find a suitable system that will provide all the required controls to meet the necessary blanketing criteria.

Here is an example of how a multiple regulator system is deployed to perform tank blanketing.



Through advances in pilot operated valve technology, the first single valve system specifically designed for tank blanketing was introduced in 1987. Today this type of single valve system is the de facto standard for blanketing of storage tanks all over the world.



In a single valve tank blanketing system depicted above, the tank blanketing valve is used to inject the inert gas into the vapour space of the tank at a typical controlled pressure range of 0.5"WC to 5"WC.

When liquid is being pumped out from the tank, the valve supplies gas to replace that volume and maintain the pressure in the vapour space. When there is a pressure drop in the vapour space due to thermal effects (otherwise known as thermal inbreathing) the valve will also performs the same function.

In such a system, the blanketing valve is always used in conjunction with a pressure vacuum relief valve (PVRV) or breather valve. The breather valve is used to prevent pressure or vacuum from exceeding the design limits of the tank, thus protecting the tank from exploding or imploding.

To ensure that a suitable blanketing valve is selected for each individual tank, two important requirements must be met:

1. The valve capacity must meet or exceed the total inbreathing requirement before allowing air to enter the tank. This must be done at the minimum supply pressure of the inert gas.
2. The valve must achieve bubble tight shut-off before reaching a pressure that would allow gas loss through the breather valve.

API Standard 2000 7th Edition (March 2014) provides the guidelines to venting of atmospheric and low pressure storage tanks, which also includes inert gas padding.

In API 2000 7th Edition, article 3.2.5.3 has this to say about "Inert Pads and Purges":

"…Failure of the supply regulator can result in unrestricted gas flow into the tank and subsequent tank overpressure, reduced gas flow, or complete loss of the gas flow."

And in article 3.5.2 "Design Options for Explosion Prevention":

"Inert-gas Blanketing — An effective means of reducing the likelihood of a flammable atmosphere inside a tank, when engineered and maintained properly…"

And article 3.5.3 "Inert-gas-blanketed Tanks" states:

"An inert-gas system may be used to avoid drawing air into the tank during vacuum conditions…

For tanks that use an inert-gas supply system, the likelihood of a potentially explosive atmosphere is reduced and there can be benefits related to a less severe hazardous area classification."

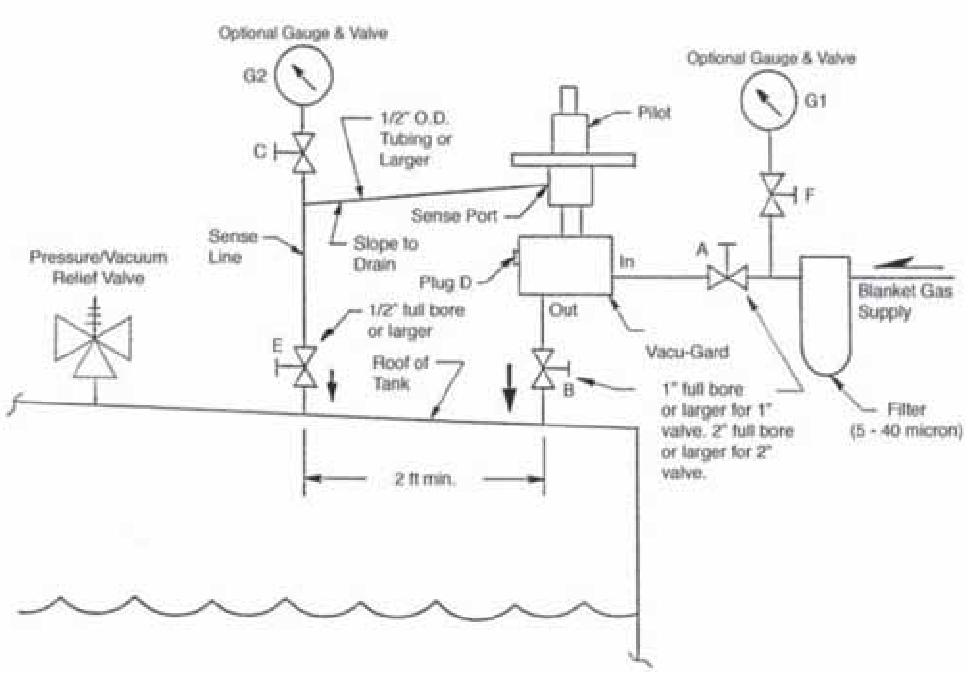
API 2000 also has a "Guidance for Inert-gas Blanketing of Tanks for Flashback Protection" as detailed in Annex F and summarized below:

There are 3 levels of inert-gas blanketing:

1. Level 1 – Minimum inert-gas blanketing requirement in combination with a specific flame arrester classification.
    a. Has the minimum volume of inert-gas flow and the minimum volume of reserve inert-gas.
    b. The inert-gas supply must be monitored – measuring the tank pressure and the O_2 concentration in the tank and an alarm should be triggered when the set vacuum is reached.
    c. An end of line deflagration arrester good for Group D vapors and endurance burning in accordance with IEC 60079-10 can be used.
2. Level 2 – Has more stringent inert-gas blanketing requirements with a different flame arrester classification.
    a. Has a higher volume of inert-gas flow and a higher volume of reserve inert-gas.
    b. The alarm specified in Level 1 will now activate the shutdown of liquid outflow.
    c. An end of line flame arrester tested for atmospheric deflagration Group D vapours can be used.
3. Level 3 - Has the highest inert-gas blanketing requirements with no flame arrester required.
    a. Has the maximum volume of inert-gas flow and the maximum volume of reserve inert-gas.
    b. Tank pressure shall be kept above atmospheric pressure and the monitoring system shall have redundancy in design.
    c. The shutdown of liquid flow out of the tank should occur before tank equals atmospheric pressure.
    d. No flame arrester is required.

In conclusion, tank blanketing offers significant benefits in terms of product quality and process safety. When implemented properly, it pays dividends in terms of efficiency, effectiveness and cost. Choosing the most appropriate tank blanketing system is important in maximizing the desired safety and quality results while minimizing capital and operating expenses.

An example of a Pilot Operated Tank Blanketing Valve and PVRV and how it can be applied in a proper tank blanketing system



Vacu-Gard® Pilot-operated Tank Blanketing Valve

Pressure/Vacuum Relief Vent

Pictures courtesy of Cashco/VCI Inc. and Pressure and Safety Systems

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