Installation Tips and Considerations for Ambient Vaporizers

Ambient vaporizers use the ambient air as the heat source for vaporizing cryogenic fluids and have been used in countless cryogenic applications all around the world and in every climate. Although designed to perform for the particular locations and applicable ambient conditions, the installation and piping layout of these units are important aspects of the performance. There are many factors that contribute to the performance of ambient vaporizers besides weather conditions. The installation considerations below will help promote proper performance.

Situation 1 – Clearances Between Ambient Vaporizers and Surroundings

One of the most important aspects when installing ambient vaporizers is to make sure the fog and cold air downdraft being created has the clearance to properly disperse and dissipate to allow new warm air into the vaporizer array. This is done by having the proper clearance from the ground and other surrounding objects. Walls, tanks, and other vaporizers are common obstructions that prevent the proper dispersal of cold downdraft. When obstructions prevent proper air flow, the downdraft dissipates at a very slow rate and can even become stagnant at the bottom of the vaporizer. This can lead to insufficient air flow circulation, low discharge temperatures, reduced runtimes, and longer defrost periods. Though a recommended minimum distance between ambient vaporizers and obstructions is approximately 1 meter, this has to be used in conjunction with the number of vaporizers, surroundings, and available height the vaporizers can be mounted from grade. Many sites are very footprint limited and do not allow for the clearances between a vaporizer and obstructions. In these situations the vaporizers can be raised off the ground on plinths to help offset these other factors. Ultimately the downdraft must have enough escape area to dissipate and mix out the fog over a fair distance from the vaporizers. Cryoquip has a clearance guide that can assist in the layout of ambient vaporizers. By using a simple calculation which accounts for the overall vaporizer footprint areas and escape distances between obstructions, whether it be a single vaporizer or a bank of switching units, a proper footprint layout and plinth height can be determined.

In a situation where the site layout limits distances from obstructions or plinths, a Fog Reduction Module (FRM) can help reduce the fog. The FRM is a fan assembly that mounts on the top of existing ambient vaporizers and forces air through the array. This promotes better mixing of the downdraft and improved performance. Please see the Fall 2012 issue of FrostByte at cryoquip.com for more information on the FRM.

Situation 2 – Gas Side Switching Valves

An ambient vaporizer naturally begins to build up ice as it's running, decreasing its performance over time. Continuous flows require switching to an idle vaporizer to maintain the proper discharge temperatures. There are two different ways of positioning the switching valves on a switching ambient vaporizer system. In the first, you have the valves on the liquid side of the vaporizers. This is a common setup which does not allow liquid cryogen to enter into the idle vaporizer. However liquid valves tend to be expensive because they are designed for cryogenic service. The alternative is to have the switching valves on the gas side (discharge side) of the vaporizer, which does not require cryogenic valve construction. A problem that arises in a gas side switching system is the continued flooding of liquid cryogen into the liquid header of the idle vaporizer. This liquid will remain in the inlet header of the idle vaporizer and create continued ice growth even during the defrost cycle. This problem will increase over time and promote permanent ice growth on both vaporizers which reduces available surface area and adds stress to the inlet headers. One solution to this is to install vertical loops on the liquid piping just before it enters each vaporizer. The loops create a vapor trap that stops the liquid cryogen from entering the idle vaporizer. A recommended liquid loop height is about 1m. Liquid loops are a practical fix to this problem and can also be installed into existing systems if needed.

Situation 3 – Downstream Regulators

Creating proper backpressure on an ambient vaporizer is important to ensure proper heat transfer and proper distribution within and among vaporizers. This is commonly done by placing a regulator station immediately downstream of the vaporizer(s). By creating proper back pressure on an ambient vaporizer, the potential for fluid expansion is reduced. Expansion happens when there is too large a pressure difference between the inlet and outlet pressure of the vaporizer. When the pressure difference between the inlet and outlet of a system is too great, the fluid can mal-distribute through the volume of the vaporizer. The larger the pressure difference, the faster the fluid moves, which reduces the amount of heat being transferred to the fluid. A downstream regulator produces the proper back-pressure to the vaporizer creating the proper pressure difference between the inlet and outlet of the vaporizer and allows the fluid to have the proper distribution and residence time in the vaporizer. This is also very important when the vaporizers are fed by a cryogenic pump. Without the proper backpressure on the pump the flow of the pump can increase (i.e. the pump rides out on its flow curve) as the downstream pressure falls too low and can lead to overcharging of the vaporizer.

Situation 4 – An Uninsulated Liquid Line Location

The location of an uninsulated liquid line that feeds the vaporizers is very important, and improper installation can result in unnecessary problems. The liquid line should not be installed directly underneath or too close to the array of the vaporizer, or too close to the ground. When an ambient vaporizer's runtime cycle ends it begins to defrost. If the liquid line is directly beneath or too close to the vaporizer, water resulting from the defrosting and melting ice will freeze on the liquid line. That liquid line, which is still holding the liquid cryogen, will freeze the water and melting ice, creating increasing layers of ice. This can cause cracks in piping, foundations and large ice formations. To avoid this problem, set the liquid line away from the defrosting section of vaporizers, lift off the ground, or insulate.

Situation 5 – Dead Legs

When designing liquid feed lines to ambient vaporizers, dead legs should be avoided. A dead leg is a piece of piping or tubing that branches off from the mainstream and dead ends. Having dead legs in the liquid-side piping can lead to surging or "cryo-pumping". When liquid cryogen is introduced in the liquid line, the dead leg will fill with liquid. This trapped liquid will eventually boil off and create vapor that mixes into the main line and can result in misdistribution within the vaporizer and also promote pressure surging in the system. When surging exists, it becomes difficult to maintain a flow rate, proper performance and distribution throughout the unit. Eliminating dead legs is a very simple tip to help promote proper vaporizer performance. Placement of liquid side switching valves should reduce the potential volume of 'dead legs'. In some cases dead legs are unavoidable, but they should be minimized.

Situation 6 – Hybrid Units and Systems

A frequent installation error occurs when installing hybrid ambient vaporizers. Hybrid ambient vaporizers have a variety of fin counts, some of the most common having a combination of 4-finned and 12-finned extrusions. Hybrids are typically used in long freeze period locations, where the ambient temperature remains under 32° F for long periods of time. The installation error occurs when a hybrid ambient vaporizer is installed backwards, putting the high density fin extrusions on the inlet side of the system. Because the majority of heat transfer occurs in the boiling region of the vaporizer, the high density fin extrusion (more surface area) is thought to be placed where the most heat transfer is needed. Although this logic might make intuitive sense, the performance of hybrids degrades when installed in this way. A 4-finned extrusion is designed for ice buildup due to the large gap between fins. This large gap reduces the possibility of ice from bridging across fins and allows the ice to shed under its own weight much easier than high density fins. When installing hybrid ambient vaporizers, be sure to install the low fin density section on the liquid side of the system.

For further information, please visit www.cryoquip.com.