To Switch Or Not To Switch…..

That is the question…facing industrial gas engineers

Ambient air vaporizers are simple, zero maintenance devices used for the vaporization of liquid cryogens. They are used in a variety of applications in a broad range of industries. They have no moving parts and utilize the heat of the atmosphere to provide the energy of vaporization and are 100% reliable, (*see figure 1*). Ambient vaporizers have been in use in the industrial gas industry for decades virtually unchanged. Operation is simple. Liquid cryogens are passed through aluminum extrusions connected in series or parallel paths. The extrusions have several fins connected to a central hub containing the cryogen. These fins provide a large surface area to absorb the heat of the atmosphere and conduct that heat into the cryogen. Cryogens are extremely cold (circa – 300F -200C) and, therefore, even the coldest ambient conditions provide sufficient temperature difference for adequate heat transfer.

Figure 1.

As the heat of the atmosphere is exchanged to vaporize the cryogen, moisture in the air is frozen out and builds on the surface of the extrusions as frost. After several hours the frost build up becomes several millimeters and the space between the fins fills with frost and the effective surface area is diminished. When the vaporizer becomes completely frosted the gas exit temperature becomes too low and unacceptable to the customer.

Figure 2

In typical customer station applications the customer's requirement is for a continuous supply of gas. Ambient vaporizers are able to operate at their designed flow rate for several hours, but not continuously. Process engineers have two solutions to this problem, use two small vaporizers and switch between them when they become heavily covered in frost, either switching on the gas or liquid side of the vaporizers, *(see figure 2)* or use one large vaporizer designed to operate continuously. Providing each option is designed with sufficient surface area to provide enough energy for the vaporization, either solution is viable. The question is which is the best solution?

A switching system (*see figure 3*) enables vaporizers to run one-at-a-time, typically alternating at regular intervals. This allows the offline vaporizer to defrost while the online vaporizer operates at high efficiency. Piping "flutes" are built into the liquid inlet line to ensure that liquid is cut off from the vaporizers in the case where switching takes place on the exit gas side of the vaporizers. Switching times are variable so the system can operate efficiently regardless of location or ambient conditions and systems can be controlled by time or by temperature.

In simple terms it would seem that the decision to switch or not to switch becomes self evident, when the cost of the two vaporizers plus the switching system is greater than the single vaporizer. However, the vaporizer switching system is an electro mechanical device which requires power and maintenance and by definition affects reliability. A single vaporizer eliminates these issues. Two vaporizers may need more space than a single vaporizer, but the

Figure 3

operation is more flexible. The switching system also provides the opportunity for controlling the exit temperature of the gas which in some applications is critical. The latter control method also affords the opportunity to provide the installation with a low temperature shut down feature protecting down stream piping which might be susceptible to low temperatures and possible catastrophic failure. So to switch or not to switch is not quite so simple a question, and requires process engineers to carefully review a number of issues relating to the installation of ambient vaporizers.

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