CRYOGENIC INDUSTRIES

FROSTBYTE

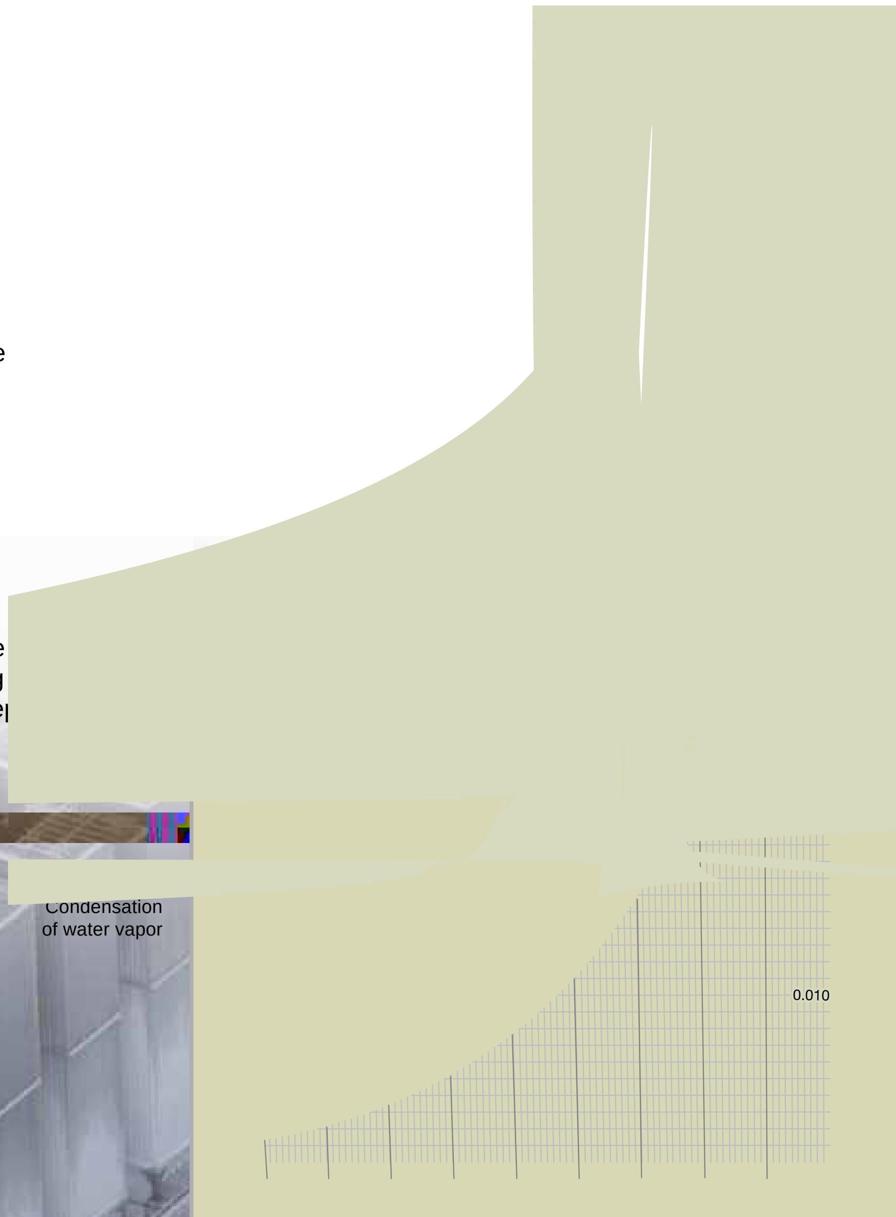
A NEWSLETTER FROM CRYOGENIC INDUSTRIES WINTER 2012

Psychrometrics

One of the key challenges associated with the use of ambient air as the heating medium for vaporization of cryogenic uids is the formation of fog. Ambient air is a two-component mixture of dry air and water vapor. The amount of water vapor in the air varies from zero (dry air) to a maximum which is known as the dew point. The dew point represents the maximum amount of water vapor that can be contained within the air for a given temperature and pressure. Air that is at the dew point is referred to as saturated air, or air at 100% relative humidity.

As air ows through the vaporizer, its temperature begins to drop as it sheds its heat to the colder cryogen. This initial cooling is illustrated on the psychrometric chart in Figure 1.

If the air sheds enough heat, it will reach the dew point. Any additional cooling will cause condensation of water vapor that is trapped in the air. This is illustrated in Figure 2 as cooling along line. Much of this condensed water vapor is de vaporizer as frost.



As the cold dry air leaves the bottom of the vaporizer, it mixes with the warm moist air in the surrounding area. As it mixes, it cools the surrounding warm air, which condenses its moisture and generates fog. This mixing is illustrated on the psychrometric chart in Figure 3. Notice that the mixing line falls outside of the saturation line. This indicates that the cold air is cooling the warm air enough to condense its water vapor, and the further the line falls outside of the saturation line, the greater the potential for fog formation.

Figure 3.
Fog formation

One of the best ways to prevent this fog potential is to force additional air through the vaporizer by adding one or more fans. The additional air mass forced through the unit will take less temperature drop than its natural draft counterpart, and therefore will have less potential of fog formation as illustrated in Figure 4. Since the mixture line falls well within the saturation line, it is unlikely that signi cant condensation of the water vapor will occur as the air re-mixes with the surrounding ambient air.

For more information on this article contact Josh Kriesler at Cryoquip at +1 951 677 2060 or jkriesler@cryoquip.com

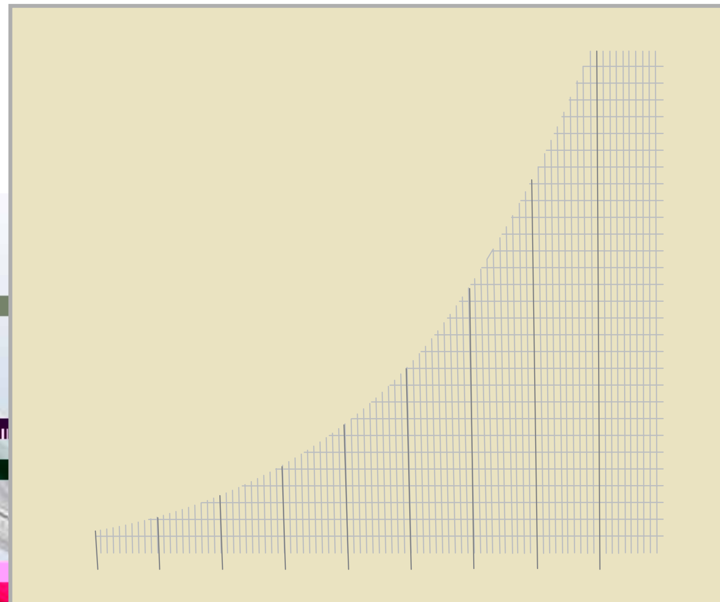


Figure 4.
Adding fans