REFRIGERATION REVIEW

Air Unit Capacity

One of the most confusing technical aspects of defining the refrigeration requirements for a room is how the air unit coils are rated. While there are ARI standards for rating methods, the ton rating of an air unit can get very confusing. We all know the ton rating is defined as 12,000 BTUs/hour, and originally it was based on the heat necessary to freeze one ton of ice in 24 hours. So, if you want to do the math, that would be:

2,000 x 144 BTUs/lb (the latent heat of ice to water) = 288,000 BTUs/24 = 12,000 BTU/hour

Having that basic lesson behind us, now let's talk about the normal way refrigeration coils are rated. Generally, you can assume the rating of the coil is a dry condition, that is to say, before it has frost on it or before it is laden with water. In years past, some manufacturers would take advantage of a coil that had a little frost on it because it would actually increase the transfer rate. Assuming the coil is a dry coil, the empirical value for rating is called the basic rating, which is BTU-hours/1° temperature difference (TD) between the inside of the coil and the air outside the coil. Unless you know the basic rating of a coil to compare to another coil basic rating, you really don't know the capacity of the coils. As one knows, air passes through multiple rows of tubes in the coil and a coil is designated by the number of rows deep and the fin spacing, which

enhances the transfer rate through the coil. The air temperature passing through the coil obviously changes from the intake temperature to the outlet temperature. Technically, the average temperature is referred to as the log mean temperature difference between the average air temperature and the refrigerant temperature inside the tubes.

Generally, for economic reasons and temperature control reasons, coolers and docks are figured at a 15° TD, while freezers, blast freezers, and ice cream freezers are figured at 10° TD.

Depending on the psychrometrics of the air, one could normally assume the air temperature change passing through the coil is approximately 1/3 of what the operating TD of the coil design. For instance, if a dock is designed for 45° with a coil that has a 15° TD, your air change would be approximately 5° as it passes through the coil.

Several noteworthy things about room designs: for large production facilities, we would normally set the ammonia system up for four different temperatures. The highest temperature would be for process room air units – what we would normally consider a V-2 vessel – that would operate at or near 32°F, and operate with unfrosted coils. Coils for these applications can be closer-finned (4fpi, even 6 fpi) where the air is filtered.

The next level we would designate as V-3/Intermediate, which would be for rooms operating in the range of 25° - 35°. These coils would normally have 3 to 4 fpi, depending on the severity of moisture and infiltration. These coils would

have defrost, either electric or hot gas. In addition, depending on the application, whether it's a room or dock, we may add a couple of rows of reheat to keep the air unit active, such as on a dock in the wintertime. Also, as you increase the TD, you will tend to lower the relative humidity of the space being refrigerated.

Occasionally, we would have what we could call V-4 requirements, which would be temperatures in the range of 15° - 20° for ice makers, heat exchangers, and Votators for "mush-meat" coolers.

Lastly, V-5 would be for freezer applications, either storage freezers or blast freezers, and these air units would normally operate in the range of 8° - 10° TD, and would have 3 fpi spacing; in blast freezers, sometimes a variable fin spacing with leading rows having 1½ fpi spacing to permit longer run times between defrost.

In ammonia, 0 pounds of pressure is -28°F. We have, on several occasions, been able to provide ice cream rooms a -15° to -18° room and still maintain positive pressure, which minimizes air entering the refrigeration system as a vacuum. To do this, the design TD of the coil may be 6° - 8°, which means it would have more coil surface than a 10° TD design, but the room would operate far more efficiently with minimal air infiltration, since the ammonia gas is operating at positive pressure, not in a vacuum.

So, when all is said and done, when sizing coils, the tonnage is a function of the TD, not the coil size. Many people are snookered with a TR rating without considering the basic rating of the coil, which is the only true comparison

between coil capacities.