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Understanding Performance

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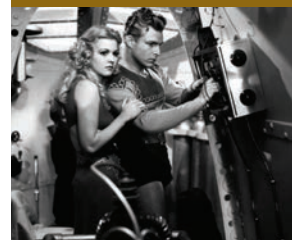
Last month, we looked at a future where quantum sensors would provide a wealth of information about system performance and product quality, but there will be little point in getting there if we can't make sense of the sensors in the first place.

There are a few basics that are really vital if a proper understanding of system performance is desired. It is necessary to know the compressor suction and discharge pressures. Discharge pressure needs to be correlated to the temperature of whatever is providing the system cooling (fresh air, condenser water from a cooling tower or other source of cool). If there is more than a few degrees between the incoming coolant temperature and the condensing temperature of the refrigerant, then it is likely that the system could operate more efficiently. How few depends on the type of condenser, but the difference should not need to be more than 20°F (about 12 K).

Do you think the suction pressure should be as low as that?



In a similar way the suction pressure of the compressor needs to be compared to the cold temperature of the product. However, it is also vital to measure the pressure at the evaporator as well as the compressor; a poorly performing system might be suffering from too much pressure drop in the suction line (between the evaporator outlet and the compressor inlet) or the evaporator itself could be underperforming for many reasons. In the former case there will be a small difference between the saturated evaporation temperature and the product temperature and a big difference between saturated evaporation temperature and saturated compression suction temperature. "Saturated" in this context means the temperature at which the refrigerant boils or condenses for a given pressure. In the latter case, the big difference will be between product and evaporating temperatures.

It is also necessary to know the actual suction and discharge temperatures. If the actual suction temperature is much higher than the saturated suction temperature, then it is likely that something is wrong. For some reason the evaporator is not receiving enough liquid to do the required job, and so the compressor suction pressure is too low and the temperature is too high. On the discharge side if the actual discharge temperature is too high, there might be a fault in the compressor or oil-cooling circuit. If it is too low, there is a risk that liquid is coming into the compressor with the suction gas and might cause an expensive breakdown. Also, condenser performance can be assessed if the inlet and outlet temperature and pressure are known and can be matched to the cooling temperature.

All of this is meaningless if there is not a proper understanding of what the system is expected to do. For example if a cold store is supposed to be at –10°F (–23.3°C), but is never colder than +5°F (–15°C), then the compressor will seem to be very efficient but the produce in the store will not meet the quality requirements. Likewise if an air-handling unit is meant to deliver air at 59°F (15°C) within a tolerance of ±1°F (0.6 K) ,but the temperature swings from 50°F (10°C) to 68°F (20°C), then on average the control system is accurate but the building occupants will moan.

Commissioning the system (I don't just mean making it go cold) involves measuring its performance, comparing that to the design intent and providing feedback to the system designer to let him know whether he did a good job or not. The first step is usually done, the second is rare and the third is virtually unheard of. Faced with a pressing need to improve energy efficiency, we need somehow to do better than this.

Looking beyond plant handover, we should be providing the owner (who has paid a lot of money for the privilege) with the means of continually checking whether his system is staying on point, or drifting off toward inefficient operation. Keeping the system in good shape is not rocket science—it just needs the few key pieces of information recorded and compared over the life of the plant. I am amazed at the number of end-users who don't seem to care about this. As one told me many years ago "You can fit them fancy screens at your own cost if you want them. I'm not paying for them!" That may be so, but by now he will probably have paid many times over for not having them. ■

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