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Part One

Be More Specific

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For years I have been hearing that coefficient of performance (COP), sometimes called energy efficiency ratio (EER), is the most important parameter in refrigeration systems if you care about energy performance. These are the ratio of cooling effect (or heating effect for heat pumps) to the energy input, often expressed as a dimensionless ratio because both parameters can be measured in kW.

Sometimes it can be given as Btu per kWh or even, more confusingly, hp per ton; horsepower being the shaft input to the compressor, so a measure of work input and ton being the "ton of refrigeration," equal to 12,000 Btu/h or 3.52 kW. Note that COP and EER are heat divided by work, so a big number is a good thing, whereas hp/ton is work divided by heat, so the inverse, which confuses me no end.

An obvious problem with COP as a measure of system "goodness" is that it doesn't say anything about how well the system is achieving its mission, only about how effectively it does what it is doing. These might not seem so different, but consider that it is easy to improve the COP of a cold store system by leaving all the store doors open. This will cause the room temperature to rise and so the compressors will operate with a higher suction pressure and will be "more efficient." However, the room temperature will no longer satisfy the design requirement, and the plant will probably run all day and all night (at least in summer), so the electricity bill will be very high and the performance will be very unsatisfactory.

Be more specific.

A more subtle difficulty is that the COP gives a number for comparison under certain operating conditions. It's very common when project bids are being compared to see emphasis placed on the performance of the plant under the maximum expected ambient conditions. Sometimes, buying decisions are based on the energy performance at that operating point alone. However, if the system is designed to run that way year-round, its performance will again be very unsatisfactory. Many reasons exist why a designer may want to keep the compressor discharge pressure relatively high, for example to ensure a good defrost, to make the oil cooling system work or to provide steady flow through the expansion valve. All of these constraints can be eliminated by good system design, and it should be possible to allow the compressor to run to as low a discharge pressure as it can handle. Anything higher than that will indicate wasted energy.

A further difficulty, and one which has been bothering me more and more in recent years, is that the investment decision is based on statements given about the operation of the system when it is brand-new and squeaky-clean. No consideration seems to be given to the way in which the plant ages or is maintained. Many systems are installed without much thought having been given to this topic, so, for example, there is no way to clean the fins of the evaporator or condenser, no way to stop oil from fouling the inside of the evaporator and no attempt to measure performance degradation over time. Again, good system design can avoid these pitfalls, but despite the possibility they are all too often ignored.

When buying a refrigeration plant, purchasers should be far more specific about their expectations if they want to avoid long-term disappointment. Next month, in Part Two of this column, we will look at a better way to judge cold store efficiency and consider the benefits and disadvantages of the "specific" approach. ■

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