# REFRIGERATION REVIEW

## Side Port Economizers -- What a Misnomer!

I'd like to spend some time talking about compressors and compressor efficiencies. Prior to screw compressors, the way of calculating condenser tons was to simply take the low side evaporator tons and motor HP required of the compressor and convert the HP to BTUs and add this to the low side evaporator tons. This would give you the condenser tons -- a very straightforward calculation. This would apply to high side machines, or, for low side machines, the required tons for the high side compressor.

The theoretical HP of compressors can be found by looking at a Mollier diagram and determining the theoretical isentropic efficiency, which is a curved line on the right side of the Mollier diagram. When you translate that to BTUs/lb and compare it to the BTU/lb required by the motor, you can determine the efficiency and the friction losses of the motor during compression. These are straightforward calculations for high side machines and low side machines.

Then along comes screw compressors and, as has been discussed, makes this model impractical to use to calculate condenser tons, and as a result, screw compressors use the heat of rejection plus additional factors to determine the total condenser requirements. The additional factor is applied per manufacturers' data. The impetus for this is to cool the compressor discharge to help maintain the oil at around 180°F, rather than the normal 200° to 300° in the case of compressors discharging to normal ambient conditions. This lets the oil stay in “droplet” form rather than “smoke” form, so it can more easily be separated by a de-misting pad. In order to cool the oil during compression, the oil is either cooled with a separate heat exchanger and then injected into the screw compressor, or liquid ammonia is injected directly into the barrel of the screw compressor. This is an effort to flood the screw

lobe with oil to help the efficiency. This, of course, is at the sacrifice of generating additional heat of churning oil constantly and requires additional heat of rejection in the condensers. While this technology is pretty well-defined, in addition to the compressor efficiency the cycle efficiency of the whole system needs to be considered, especially in a single-stage or two-stage system.

The term "economizer" is used as though it's a super-efficient technology for screw compressors. In reality, compared to reciprocating technology, it is just the opposite. Economizing ports are intended to provide a means of subcooling receiver liquid and extracting some sensible heat out of the liquid prior to being passed on to the low side evaporator. While it sounds all rosy, in reality a side port in the barrel of a screw compressor causes a 5% to 8% loss of efficiency because of the blow-by of gas that transverses the lobe in the compression and decompression as the lobe passes the economizer port. If the purpose of the economizer is to subcool liquid as it passes to the low side of the system, the most efficient way is to provide a subcooling coil in a vessel, such as an intercooler, that doesn't use the inefficiency of a side port in the middle of the barrel of a screw compressor.  There is a sense of false economy when they talk about an economizer port. True, it is better than not having any liquid subcooling -- in the case of a single-stage screw compressor serving a low temperature application -- but the two-stage efficiency will always be better with separate subcooling, rather than doing it with a side port in a screw compressor. The same applies to intermediate loads, which are sometimes a side port. Again, the built in inefficiencies would play in in that instance, as well.

Generally, this becomes an issue in systems that try to get by with a minimum number of compressors -- one or two compressors -- with a fixed load, which may have some applications, but usually a central system would be far more efficient set up with two-stage compression and a liquid subcooling system served by the high stage compression.

Just don't be deceived by the buzzword "economizer." In reality, you're talking about liquid subcooling.