REFRIGERATION REVIEW

Thermosyphon Oil Cooling, Part 2

The “simplest” thermosyphon feed systems operate effectively under ***steady state conditions***. A refrigeration system in the real world, however, can experience many “dynamics” that are far from steady state. Primary of these “dynamics” is the intermittent disruption of system flows and pressures from the periodic use of hot gas. Principal of these are:

1. Hot gas defrosting of air units
2. Heat reclaim heat exchangers
3. Harvesting ice makers
4. Load shedding techniques (wide swings in compressor discharge and use)
5. Power failures
6. Start-up

One of the most interesting phenomena we have observed in the operation of thermosyphon systems is what we call the geyser effect. Under certain conditions (generally accompanied with a sudden decrease in discharge pressure) sufficient quantities of liquid refrigerant will flash, boiling rapidly enough to cause the thermosyphon heat exchangers to “blowout” both the downcomers and the risers. Under these circumstances, the saturated liquid will instantaneously boil. In multiple compressor applications, the blowout happens very rapidly and can recover in many cases quickly enough to prevent high oil temperatures from occurring in the heat exchangers.

As happens in a geyser or percolator fluid flow, the liquid becomes trapped behind rapidly expanding gas and flow will occur both out of the downcomers, as

well as the risers. After all liquid is evacuated from the heat exchanger, the liquid will then quickly return by gravity and convection flow commences once again. If, during this period, oil temperatures have not become excessive, screw compressors would continue to operate. If, however, recovery time is sufficiently long or the heat exchanger size marginal, recovery will not be in time to prevent normal safety controls from shutting down the screw compressors.

It is important to minimize percolation or geysering because of the hydraulic shock it imposes on the piping system.

The "geyser" phenomenon rarely occurs in large plants (above 2000 TR) with multiple condensers (more than five), or with plants with steady operating conditions. It is more prone to happen in the hot summer months when the machinery room air temperature approaches or exceeds ambient outside air temperature.

This occurrence can be prevented or minimized in several ways. Primary of these is maintaining steady discharge pressures (temperatures). If this is not possible, taking the hot gas supply from the receiver rather than the plant discharge, and using open condenser drains (rather than trapped drains) will permit a more rapid recovery. Induced gas flows through the condenser in the direction liquid or gas normally drains will also facilitate establishing convection flow again.

There is less tendency for percolation or blowout to occur where thermosyphon oil coolers are inclined to help induce flow in the proper direction. Also, more rapid recovery is provided by using a drafting nozzle, shown below, in the riser system returning vapor to the discharge line. Generally, we would try to induce enough flow to equalize the pressure drop normally experienced in the evaporative condenser serpentine coil. Condenser coils would normally experience pressure drops in the range of ½ to 2 psi, which can be neutralized with a riser drafting nozzle header.

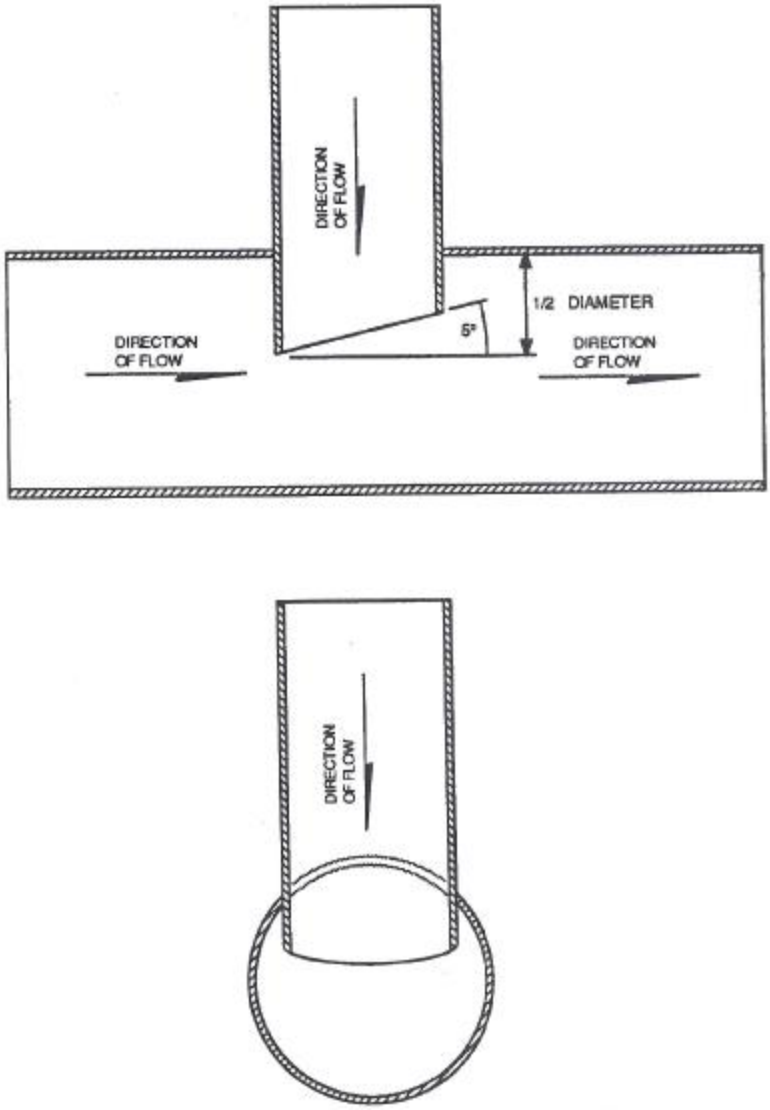

Illustration of a Drafting Nozzle