

Tecumseh Products Company



Challenges

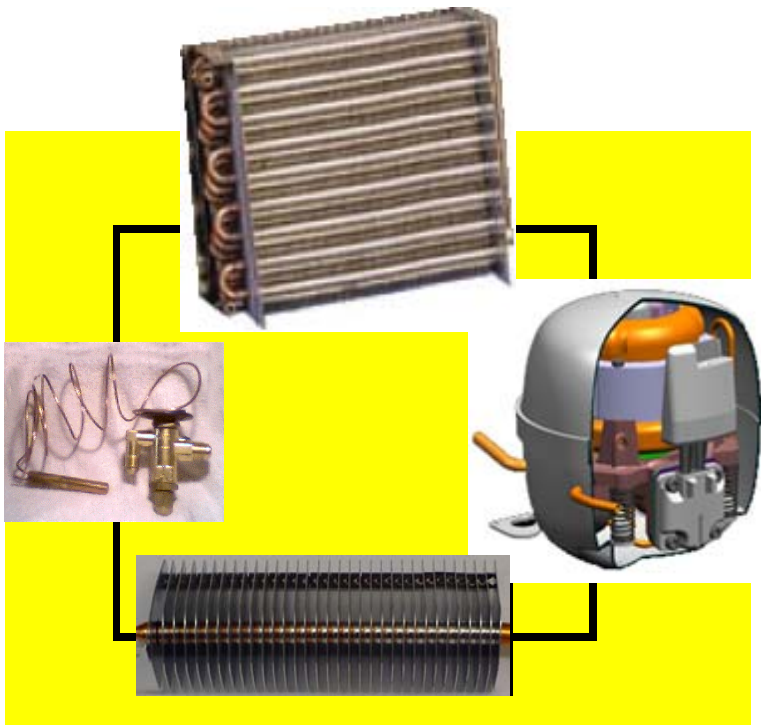
in Lubricating Compressors

for Transcritical Refrigeration Systems

Dan Manole

ASHRAE Winter Meeting Chicago, Jan 24, 2006

Refrigeration System Components

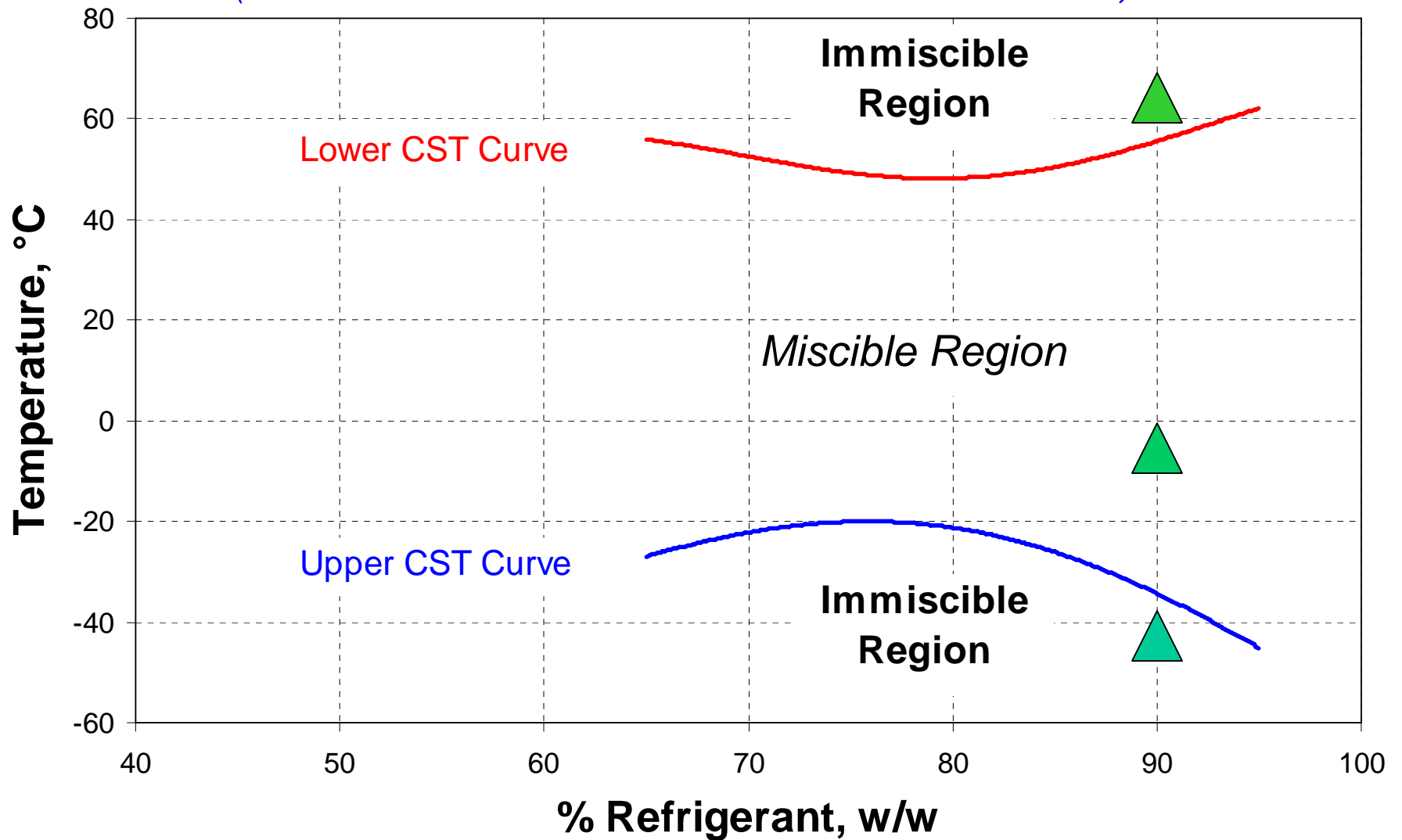


Refrigerant

Lubricant

- Circulation
- Retention

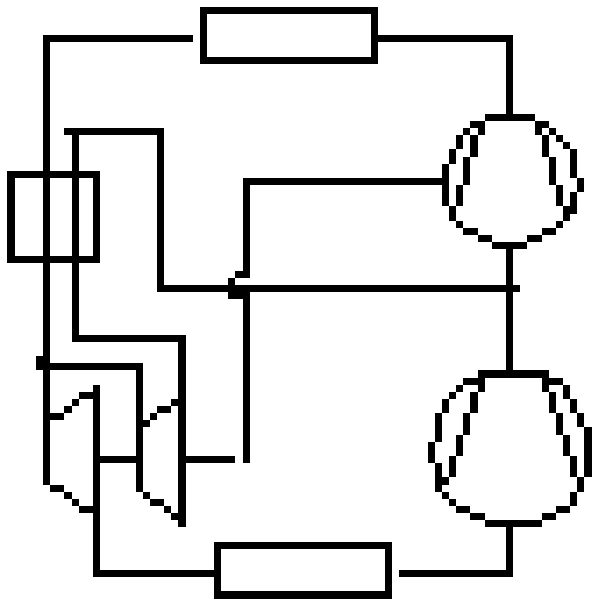
Lubricant and Refrigerant Miscibility (POE ISO68 and R410a)



What is happening? What is new?



CO₂ Refrigeration System Components



Additional components:

- Gas cooler
- High pressure and temperature
- Multiple stages
- Expansion devices
- Flash tanks
- Microchannel HX
- Capacity control

New Standards

Challenges

- No consensus in lubricant selection (POE, PAG, PAG/AN, PAO, AB, AN, or Mineral;)
- Lubricant effect on HX performances;
- High pressure friction and wear testing machine rare, expensive, and heavy;
- Large range of pressure and temperature values;
- Density inversion;
- Field testing and experience in testing various mechanisms;
- Lack of standards to test components and systems: test conditions, MOT, and system configuration;
- Incomplete experimental and analysis data.

Analysis and Experimental Data Availability

- Detailed physical properties of lubricants and lubricants mixture - *but no reference to component or system performances;*
- Detailed component performances with limited number of refrigerant/lubricant mixtures - *but not integrated in a system;*
- Some system testing - *but no data about the oil circulation rate and component performances;*
- System simulations - *but oil effect is usually neglected;*
- Various compressors available - *but no standard to compare performances;*
- 2000 psi Pressure Friction and Wear Testing Machine available to the industry through a consortia.

Current Society Activities

- **Technical Committee 3.4**
Lubrication
- **Technical Committee 10.10**
Management of Lubricant in Circulation
- **Technical Committee 8.1**
Positive Displacement Compressors;
- **Standard Program Committee 186**
*MOT for Rating Positive Displacement Compressors
that Operate at Supercritical Temperatures*

Compressor Lubrication

- a few pieces of information -

- PAG/AN 68 cSt for selected compressor models and operating conditions;
- High Pressure Friction and Wear Testing Machine;
- Testing various mechanisms over a large range of cooling capacity.
- CO₂ compressors: fractional HP to 3 ton;
- Exceeded the 1.25 COP CO₂ system at 'C' conditions;
- Minimum oil circulation rate encountered: 1% (0.2% if oil separator is used;)

Conclusions

- Choice of lubricant depends on many factors: system configuration, market, operating conditions, etc.;
- The miscibility of the mixture in the system must be carefully analyzed;
- Component performance data are available, equipment is available, but information is dispersed ;
- Restricted and limited communication;
- Need of comprehensive studies.

Thank you for attention!

Discussions time