refridgeration  
  
refridgerants are primarrially selected due to several factors:  
performance- economically  
safety –toxidiy  
environmental impact –ozone layer  
  
essentially defined as lowering the temperature of an enclosed space by removing the heat from that space and transferring it to a sink. according to the second law of thermodynamics, heat cannot spontaneously flow from a colder region to a hotter region. Thus work is required to accomplish this in the form of a compressor.  
  
first law of thermo Win = Qh - Ql  
  
circulates a liquid refrigerant that has properties that allows it to absorb heat in one compartment and remove the heat from the space.  
  
Every refrigeration system has 4 components: the compressor, condenser, thermal expansion valve (threading valves), and an evaporator.   
  
ideal: does not take effects such as frictional pressure drops in the system, the thermodynamic irreversibility during compression due to entropy generation, and non ideal gas behavior. And heat transfer to or from surroundings  
  
1-2  
Refredgerant enters the compressor as a saturated vapor, supported by the liquid resivor that makes sure that no condensed liquid enters the compressor, which would result in damage due to the water hammer effect.  
The compressor inputs work onto the liquid from electrical power from the wall plug and compresses the refrigerant vapor to a higher pressure, resulting in a higher temperature.   
  
2-3-4  
The throughout this process the refrigerate is currently in the thermodynamic state of superheated vapor. at this point the refrigerant can be condensed with cool air. The hot vapor passes through the condenser where it isa cooled from a superheated vapor to saturated vapor then mixture while its under the vapor dome. and then changes phase into a saturated liquid  all at constant pressure.  
  
4-5  
The saturated liquid passes through a throttling device and undergoes an abrupt decrease in pressure. The refrigerant undergoes an adiabatic flash evaporation where some of the liquid vaporizes resulting in a mixture. this is an isenthalpic process and results in some of the liquid becoming auto-refridgerated.  
  
5-1  
The mixture passes through the evaporator where it is completely vaporized from warm air that comes from the space being refrigerated. occurs at constant pressure where it returns to the compressor and the cycle repeats. the evaporator usually adds a few degrees extra of super head in order to superheat the refrigerate to ensure that the refrigerant is fully vaporized before the compressor.  
  
  
Evaporator   
Qin = m\_dot (h1-h4)  
  
Compressor  
Wc = m\_dot (h2-h1)  
  
Condensor  
Qout = m\_dot(h2-h3)  
  
Expansion (troddling)  
H4=h3  
  
COP   
  
COP = h1-h4/(h2-h1)  
  
  
Carnot COP  (maximum theoretical COP)  
COPmax = Tc/(Th-Tc)  
  
  
Actual Cycle:  
Heat transfer between refringerant and cold and hot regions  are not reverable  
  
Refridgerant  temp in evaporator less than Tc  
  
Refridgerant temp in condenser greater that Th  
  
Irrenversabilities have negative effect on performance therefore COP decreases as a result of the compressor requiring more work as a result of  
  
as the temp of Evaporator refridgerant is reduced relative to Tc  
as the temp of the condenser refridgerant ins increased relative to Th  
  
irreverabilities  during compression cycle are indicated by  dashed line from states 1 to 2 due to the increase in entropy and is adiabatic. Requiring more work than the isentropic theoretical process  
  
isentropic compressor efficiency:  
nc = h2s –h1/(h2-h1)  
  
  
Christopher R. White  
Mechanical Engineer  
whitec@lafayette.edu  
856-495-3634  
Lafayette College, Class of 2015