

"REFRIGERANTS"

Desirable properties of refrigerant or selection of refrigerant:- The properties can be studied under thermodynamic, & chemical & physical properties.

1) Thermodynamic properties:-

a) Critical temperature:- The critical temp. of refrigerant must be as high as possible. The critical temp. of CO_2 & ethylene are very low & hence these are not suitable in India because their critical temp. is less than ambient summer temps. in India.

Refrigerant	Critical temp. ($^{\circ}\text{C}$)
H_2O	371
NH_3	132.4
R-12	111.5
R-22	96.5
R-134	101.2
	31
Undesirable { CO_2	10.6
{ Ethylene	

b) Specific Heat:- We know that

$$C = T \cdot \left(\frac{ds}{dT} \right)$$

For liquids, the entropy change ds must be small for lesser irreversibilities & hence, specific heat of liquid must be small. Similarly for smallest work input, the degree of superheat dT must be small & hence specific heat of vapour must be large.

c) Enthalpy of vaporisation :- Large latent heat (enthalpy of vaporisation) is desirable because for a given capacity of plant, larger the enthalpy of vaporisation, smaller is the mass flow rate. [Large FOV represents large RE]

Refrigerant	Enthalpy of vaporisation (kJ/kg)
H ₂ O	2261
R-22	234.7
NH ₃	1369
R-12	165.7
R-134	197.3

d) NH₃: Of all common refrigerants, NH₃ has large latent heat of vaporisation.

d) Condenser & evaporator pressure :- The evaporator pressure must be as close to atmospheric pressure as possible & condenser pressure must be moderate. If the evaporator pressure is low then atm. air can leak into the

system.

e) Pressure ratio:- Pressure ratio must be small. Higher pressure ratio results in lower volumetric efficiency. The general pressure ratio in 'V-C' cycle is 3-5.

f) Freezing point:- The freezing point must be as low as

Refrigerant	Freezing point ($^{\circ}\text{C}$)
R-22	-166.5
R-12	-157.4
NH_3	-77.3
R134a	-101.2

g) Specific volume at the inlet to the compressor:- Specific volume at the inlet to the compressor must be small. If it is high then it results in larger size of compressor.

NOTE:- R-11 & R-113 are generally used with centrifugal compressors because of their larger specific volume.

h) COP:- For lower running cost COP of refrigeration system must be high.

NH₃: Though the LH of vaporisation of NH₃ refrigerant is very high, it does not help in the improvement of COP because of its larger work input ($\gamma = 1.31$).

i) Compressor discharge temperature: The compressor discharge temp. must not be very high. If it is high then it results in overheating of compressor & this higher heat must also be rejected to condenser resulting in larger size of the condenser. NH₃ compressors are generally water cooled because the compressor discharge temp. is very high.

Refrigerant	Temp. (°C)
R-11	52
R-12	48
R-22	71
R-717	120