Performance Analysis of Ice Plant Test Rig

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***Abstract*- The exploration is essentially founded on examining the impact of mass stream rate of refrigerant on coefficient of execution. For this reason, a few scopes of evaporator refrigerant stream rate are considered and tried. The measure of refrigerant stream rate is changed regarding the evaporator load. Measurement of connection between mass stream rate and refrigeration. Coefficient of execution (COP) may assume a fundamental job in structuring cooling framework. A few has been featured in the paper**

Index Terms- Refrigerant, Mass stream rate, Evaporator, Coefficient of Execution Condenser.

1. INTRODUCTION

"Uncool Cooling Framework is characterized as a cooling framework which is utilized to improve the indoor space conditions as per the human solace. Through Unicool cooling framework the indoor air temperature and dampness can be controlled consistently". The idea of cooling was first presented by Willis Transporter in 1902 in Bison, New York. It depended on air pressure cycle. Here air just work as a warmth exchange liquid medium. Be that as it may, cooling cycle basic depend just on the exhibition of the cycle. The presentation is estimated in type of Coefficient of Execution (COP). The upside of air is it is accessible openly yet the disadvantage is the COP of air pressure refrigeration cycle is low.

The hardware working on air refrigeration cycle have high working expense and low productivity. Because of low COP of air pressure refrigeration cycle, another and productive mode of warmth exchange is imagined for example Refrigerant. Here, refrigerant is the liquid medium which is essentially used to extract the warmth from the adapted space and through it outside. There are a few refrigerants which have high effectiveness and low working expense. For instance, R-11 (Trichloro-monofluoromethane) R-12(Dichloro-difluoro-ethane). They have high effectiveness and yet they have hurt full effect on condition. For the most part it has two unfavorable impacts on environment.

1.lobal Warming Potential. 2. Ozon Layer Depletion

ASHRAE (American Culture of Warming Refrigeration and Cooling Designers) has built up some twisted refrigerant which are useful to improve the productivity and furthermore appropriate for nature. It has been recognized that these twisted refrigerants are not destructive to the Ozon layer and they are assuming exceptionally enormous job in limiting in the temperature of earth and contributing an unnatural weather change. Some new refrigerants have likewise been presented which are inorganic in the nature and effectively accessible.

The best piece of utilizing those refrigerants is that they are neither exhausting the Ozone layer nor in all respects exceedingly contributing in the a dangerous atmospheric devation on the earth. For instance: -

R-744 (carbon dioxide), R-717 (smelling salts gas). Some hydrocarbon gases are additionally have higher effectiveness and no effect on condition and yet are profoundly combustible in the nature. R-290(propane gas), R-600a (isobutene) The refrigerant isn't just medium to improve the presentation of cooling framework, in the event that we manage the other working parameters in vapor pressure cycle.

If we focus our attention on the modern air conditioning system they have some star rating system which is based on their COP. Now a day's inverter air conditioning system also introduced into the market. So now the question is how the inverter ac is more impactful and more economical at the same time as compare to ordinary ac. In inverter ac we are using compressor which is operated in variable drives, according to the comfort required it will compress the refrigerant and according to the compression ratio the power is consumed.

Here fundamentally two blowers are utilized one is fixed speed blower which covers the base working

limit and another is variable speed blower which covers the inordinate cooling load. Sub-cooling, Superheating, De-superheating are some different procedures that we can use to improve the productivity of air refrigeration cycle.

2. EQUIPMENT LAYOUT

Unicool cooling framework is one of the frameworks which is working on the vapor pressure refrigeration framework. Here because of weight contrast the buildup and dissipation process is finished. This cooling framework gear is essentially used to examine the air at various diverse working molding

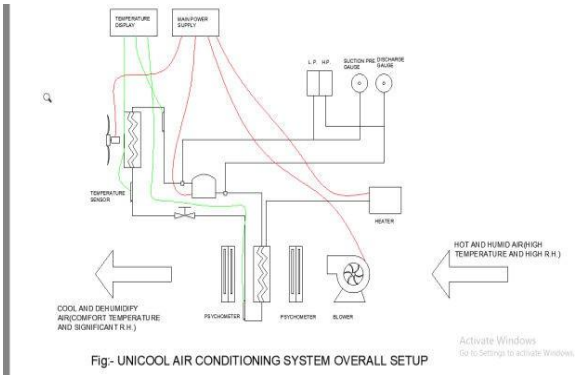

Figure.1. Unicool Air Conditioning System Overall Setup

In the event that the progression of refrigerant changes, at that point what it will bestow on the properties of air and indoor solace conditions. Here the air quality and temperature in investigated in this gear. For humidification or dehumidification process one radiator alternative is accessible there to present the water vapor or expel the water vapor. The setup is competent to gauge the temperature and weight at a specific point and investigated the properties of air. Suction weight measure and release weight check to

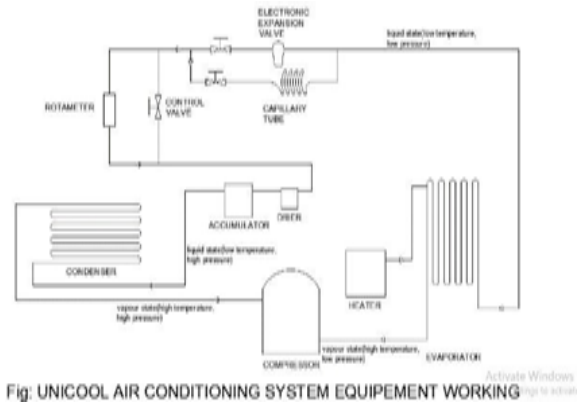

Figure.2. Unicool Air Conditioning System

The encompassing air accessible at high temperature and high R.H. is presently permitted to go through the evaporator curl and because of warmth exchange the temperature of air decreased however the mugginess is still high. Presently the air is permitted to pass toss the warming loop, because of warming the air water vapor complete vaporized and dehumidification is.

3. THEORETICAL ANALYSIS

1. Compression Work

Compressor work can expressed as

$W = h\ q$ (1)

2. Compression Horsepower

Compression horsepower can be expressed as $P = W / 42.4$ (2)

where

P = compression power (hp)

W = compression work (Btu min) Alternatively

$P = c / (42.4\ COP)$ (2b)

where

P = compression power (hp) c = capacity (Btu/min)

COP =Coefficient of Performance

3. Compression horsepower per Ton

$p = 4.715 / COP$ (2c)

where

p = compressor horsepower per Ton (hp/Ton) COP = coefficient of performance

4. COP - Coefficient of Performance

$COP = NRE / h$ (3)

where

COP = Coefficient of Performance

NRE = Net Refrigeration Effect (Btu/lb) h = heat of compression (Btu/lb)

5. Net Refrigeration Effect

Net refrigeration effect can be expressed as $NRE = hl - he$ (4)

where

NRE = Net Refrigeration Effect (Btu/lb)

hl = enthalpy of vapor leaving evaporator (Btu/lb) he = enthalpy of vapor entering evaporator (Btu/lb)

6. Capacity

$c = q\ NRE$ (5)

where

c = capacity (Btu/min)

q = refrigerant circulated (lb/min)

NRE = Net Refrigeration Effect (Btu/lb)

7. Compressor Displacement

$d = c\ v / NRE$ (6)

where
d = compressor displacement (ft3/min) c = capacity (Btu/min)
v = volume of gas entering compressor (ft3/lb) NRE = Net Refrigeration Effect (Btu/lb)

8. Heat of Compression

$$h = hlc - hec \quad (7)$$

where
h = heat of compression (Btu/lb)
hlc = enthalpy of vapor leaving compressor (Btu/lb)
hec = enthalpy of vapor entering compressor (Btu/lb)

9. Volumetric Efficiency

$$\mu = 100\ wa / wt \quad (8)$$

where
μ = volumetric efficiency
wa = actual weight of refrigerant
wt = theoretical weight of refrigerant

10. Compression Ratio

$$CR = ph / ps \quad (9)$$

where
CR = compression rate
ph = head pressure absolute (psia) ps = suction pressure, absolute (psia)

4. OBSERVATION/ EXPERIMENTAL DATA

The observation is basically made on the variable parameters. The parameters varied slightly then the performance of system is being observed.
Operating Conditions:

1. Evaporator temperature = 5℃
2. Condensation temperature = 44℃
3. Outside air temperature = 37 ℃
4. Indoor air temperature = 18 ℃
5. Suction pressure = 6.0259 bar
6. Discharge pressure = 17.725 bar
7. Capacity of setup = 3.51 KW
8. Mass flow rate = .766 kg /sec
9. Super heating temperature = 10 ℃
10. Sub cooling temperature = 3 ℃
11. C.O.P = 3.456
12. Compressor work = 60 kj/kg
13. Discharge temperature = 65 ℃
14. Suction temperature = 16 ℃

Performance at variable parameter:
Disturbance status so the air with uniform properties was enters each cylinder bank Mass stream rate of the air to be accepted as a uniform conveyed over the entire curl face paying little respect to the loop and fan separate areas. So each curl was related with a similar air mass stream rate. Likewise it was expected that the air stream going through the curl with an adequate

S. NO	MASS FLOW Kg\sec	AIR TEMP. ℃	SUPER HEAT ℃	C.O.P
1.	.765	18	10	3.455
2.	.620	20	13	3.323
3.	.552	21	16	3.151
4.	.455	23	17	3.011

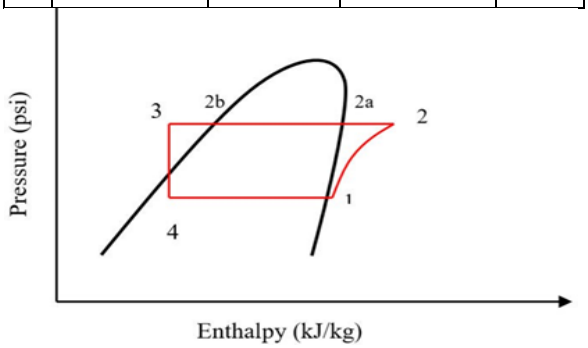

Figure.4. p-h Diagram for R-22

The capacity was determined by measuring the mass flow rate and enthalpy difference of both air-side and refrigerant-side. For each evaporation type, all experiments were performed at least twice (on different days), to check the repeatability of the data, which was proved to be good. Since the information showed repeatability, just outcomes one of the tests will be exhibited here. The vulnerabilities for significant parameters and estimations made amid the ebb and flow examine have been done based on the strategy proposed by Moffat [13].

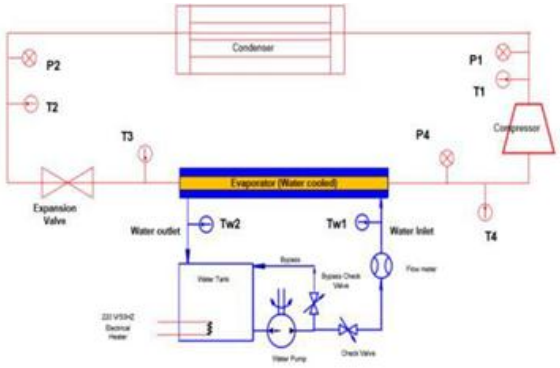

Figure 5. Schematic diagram of the air- conditioning system with modifications and sensors

4. CONCLUSIONS:

The presentation parameter of Unicool Cooling framework is learned at variable mass stream rate. At the point when the mass stream rate of refrigerant

shifts in the funneling of setup the exhibition parameter additionally differs there. The real parameter which influence the presentation of setup is mass stream rate which improve the coefficient of execution of refrigeration cycle and the air quality is being flowed noticeable all around.

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