EXPERIMENTAL SETUP ON HEAT RECYCLING IN A REFRIGERATION SYSTEM TO IMPROVE SYSTEM EFFICIENCY

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Abstract - ***Heat exchangers are gadgets intended to move heat starting with one liquid then onto the next, without the liquids coming into contact. There are a wide assortment of uses for heat exchangers, for instance: radiators, cooling and power plants. Energy crisis is a big problem in the world, so there is a need of decreasing power consumption in electricity. Vapour refrigeration system requires large amount of energy to operate. Energy consumption can be reduced by recycling the waste heat using heat exchanger. As in the experiment, the coefficient performance of refrigeration system is increased the energy consumption may reduce. An attempt is made to recover the waste heat from air compressor plant used in industrial purpose. As indicated in this paper, recovered heat can be utilized in heating the cold dry air for pneumatic conveying, so one can save lot of energy. The study provides the following conclusions: The study showed that there is a definite improvement in the COP of the refrigeration system by 82%. Thus the system efficiency is improved. The experimentation has indicated that it is worth to introduce the Heat Exchanger as its effectiveness is found to be 47.4 % by calculation which is a positive outcome.***

Keywords — ***Heat exchangers, power, energy, waste, COP***

I. INTRODUCTION

Heat exchangers are fundamentally characterized by their stream plans. There are two essential kinds of hotness exchangers: Parallel stream and Cross stream. Furthermore purported regenerative hotness exchangers are utilized in certain ventures.

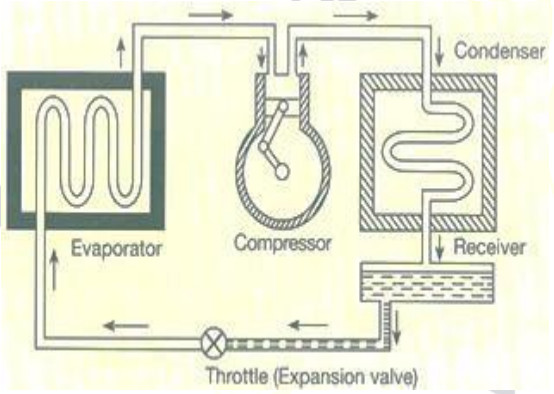


Fig.1 Working of VCRS System

1.1 TYPES OF REFRIGERATION SYSTEMS

1.1.1 VAPOR COMPRESSION REFRIGERATION

It is working substance in a refrigeration unit like blood in the human body. Its determination relies upon numerous contemplations like temperature to be delivered, idle hotness, ozone exhaustion potential, an unnatural weather change potential, poisonousness, inflammability, dormancy, consumption, disintegration, activity with water and greasing up oil, cost, accessibility, spill identification and power necessities for a specific measure of cooling required. Different normally utilized refrigerants are halogenated soaked hydrocarbons like R-134, R-22 and inorganic mixtures like smelling salts and air. Most normal recently utilized refrigerants like R-12 and R-11 has been prohibited due to their high ozone exhaustion and an unnatural weather change possibilities..

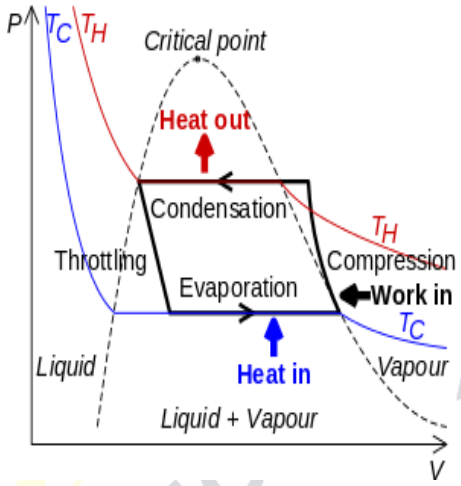
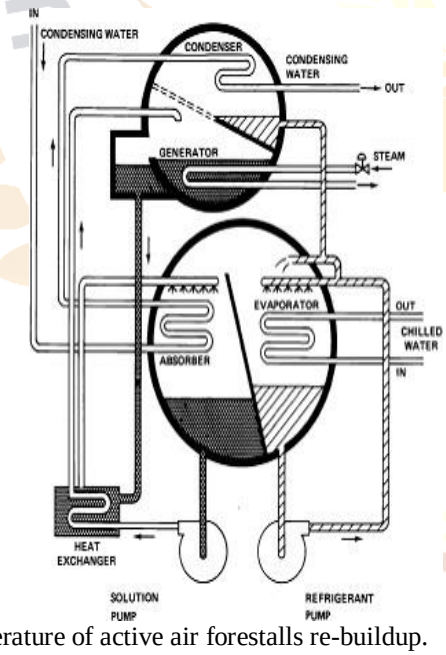


Fig 2 Pressure-volume diagram for a typical refrigeration cycle

1.1.2 VAPOUR ABSORPTION REFRIGERATION SYSTEM

Refrigeration dryers utilize two hotness exchangers, one for aerial and one for air-to-refrigeration. The blowers utilized in this sort of dryer are normally of the airtight kind and the most well-known gas utilized is R-134a and R-410a for more modest air dryers up to 100 cfm. More seasoned and bigger dryers actually use R-22 and R-404a refrigerants. The objective of having two hotness exchangers is that the virus active air chills off the hot approaching air and diminishes the size of blower required. Simultaneously the expansion in the



temperature of active air forestalls re-buildup.

Fig 3 Vapour absorption system

METHODOLOGY OR THE STEPS FOLLOWED FOR THE EXPERIMENTATION :

A Digital IR Thermometer is utilized for estimating the temperatures at different central issues of the trial framework introduced at HEG Co Ltd.

b) In the framework there are three principle parts viz. Evaporator, Moisture Separator and Heat Exchanger through which the drying specialist packed wind currents.

c) There are 4 marks of temperature estimation. Viz. Hot and Moist air from the Compressed air Plant entering the Heat Exchanger (TH) , Partially Hot and Moist air entering the Evaporator (Th2) , Cold and Dry air emerging from the Moisture Separator (TC1) and going into the Heat Exchanger, and Warm and Dry air emerging from the Heat Exchanger (TC2). This large number of temperatures are estimated by the advanced IR thermometer and are recorded in the Table nos : 5.1, 5.2, 5.3, and 5.4 separately.

d) Since the computerized IR thermometer was extreemly precise and was aligned and affirmed by NABL, any conceivable blunder in estimating the temperature was disregarded cosidering site condition.

e) As our goal is to further develop COP, the worth of COP against each put forth of temperature line are determined and classified for both the conditions for example without and with the air going through the Heat Exchanger by choosing a by-pass valve.

f) We observed that the COP is moved along.

g) Similarly we compute the hotness recuperation and adequacy of the Heat Exchanger, to lead us to the end

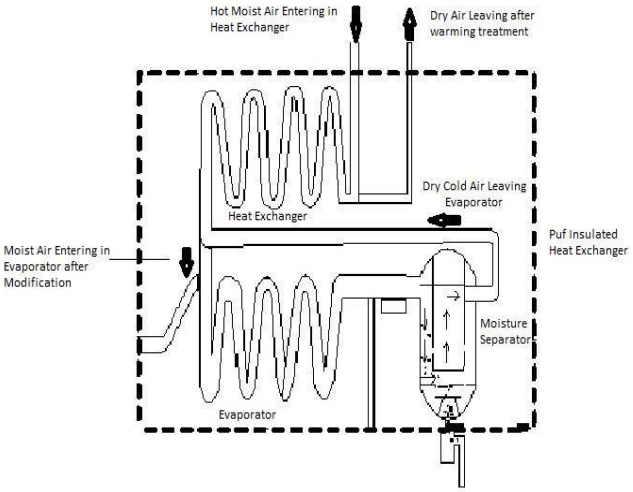


Fig. 4 Vapour Absorption Refrigeration System

II. EXPERIMENTATION

Experiments are conducted in the Air Handling unit section at HEG Plant, Mandideep, Bhopal, where dry air is used for pneumatic conveying of the Graphite powder. Dry graphite Powder is used for producing Graphite Electrodes for industrial use.

Temp of Hot moist Air entering in to the Evaporator directly from Compressor plant (TH) and the Temp of Cold Dry Air coming out from the Evaporator (TC) is measured by digital thermometer in a set of observation is noted before the introduction of the Addl. Heat Exchanger. Similar sets of Temperature readings / Observations were taken after the introduction of the Addl. Heat Exchanger (after modification).

CALCULATION OF THE LMTD OF THE HEAT EXCHANGER

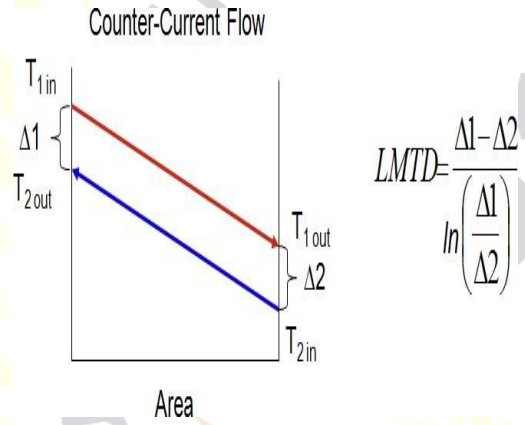


Fig.5 Temp. Distribution in a Counter Flow Heat Exchanger

T1 in = Average Temp of the Moist- Hot Air entering the Heat Exchanger = 47.7 ^{0}C

T1 out = Average Temp of the Moist- Hot Air leaving the Heat Exchanger = 38 ^{0}C

T2 out = Average Temp of the Dry Outgoing Air leaving the Heat Exchanger = 14.2 ^{0}C

T 2 in = Average Temp of the Cold Dry Air entering the Heat Exchanger = 9.6 ^{0}C

Δ1 = T1 in - T2 out = 47.70C - 14.20C = 33.5 ^{0}C
Δ2 = T1 out - T 2 in = 38 0C - 9.6 ^{0}C = 28.4 ^{0}C
LMTD = (Δ1-Δ2) / ln (Δ1/Δ2)

LMTD= (33.5 - 28.4) / ln(33.5/28.4)

= 5.1/0.165

= 30.91

III. CONCLUSION

Energy crisis is a big problem in the world, so there is a need of decreasing power consumption in electricity. Vapour refrigeration system requires large amount of energy to operate. Energy consumption can be reduced by recycling the waste heat using heat exchanger. As in the experiment, the coefficient performance of refrigeration system is increased the energy consumption may reduce. An attempt is made to recover the waste heat from air compressor plant used in industrial purpose. As indicated in this paper, recovered heat can be utilized in heating the cold dry air for pneumatic conveying, so one can save lot of energy. The study provides the following conclusions

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