Energy Conservation and Energy Saving Techniques apply on a Small Scale Cold Storage through Energy Audit

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ABSTRACT

Energy is now a costly and scare commodity in everywhere. So it essential for each place to carried out an energy audit to find the energy conservation opportunities and methods to reduce energy consumption. In this paper Energy study was conducted in a small scale cold storage to determine the energy consumption. Also we measured for different storage temperatures. Suction temperature and pressure temperature of the compressor and working time of the compressor were determined to reach evaporator set up temperatures.finally observed that the actual energy consumption of a cold storage by a compressor for one chamber is 32 KW per hour and theoretical energy consumption is 26 KW per hour.so minimize this gap then savings of Rs. 23652/- per month will be obtained which will amount to Rs. 283824/- per year.

Keyword:- *Energy Audit, Cold Storage, Refrigeration.*

1. INTRODUCTION:-

ENERGY Audit is defined as the verification, monitoring and analysis of energy use including submission of technical report containing all the recommendations for improving energy efficiency with cost analysis and an action plan to reduce consumption [2]. Energy auditing in a integral part of energy conservation and energy management is also part and parallel of conservation [1].

For a typical cold storage, after wages, electricity is the second largest operational cost. With the huge increases in electricity network and renewable energy charges (RECs) in recent time. Cold Storage is a special kind of room, the temperature of, which is kept very low with the help of machines and precision

instruments. India is having a unique geographical position and a wide range of soil thus producing variety of fruits and vegetables like apples, grapes, oranges, potatoes, chillies, ginger, etc [1]. Marine products are also being produced in large quantities due to large coastal areas. the cold storage industry renders other advantages and benefits to both the farmers and the consumers. The farmers get opportunity of producing cash crops to get remunerative prices. The consumers get the supply of perishable commodities with lower fluctuation of prices. Commercially apples, potatoes, oranges are stored on large scale in the cold storages.

Energy consumption of an experimental cold storage was measured for different storage temperatures. Suction temperature and pressure temperature of the compressor and working time of the compressor were determined to reach evaporator set up temperatures. Capacity of compressor, condenser, and evaporator were 10460 kJ/h, 12552 kJ/h , and 10460 kJ/h, respectively. Refrigerant was R22 [3]. Objective of this research is to determine energy consumption of a cold storage for different storage temperatures. Energy consumption of the system elements such as compressor, condenser and fan of the evaporator were measured and evaluated. In addition, suction and pressure temperatures of the compressor, condenser output temperature and required time to reach to the each set up temperature were determined and evaluated.

2. MODEL ANALYSIS AND RESULT:

2.1. Technical analysis :-

I visit a cold storage at Ahmedabad, Gujarat, INDIA and collect the data which is given below:-

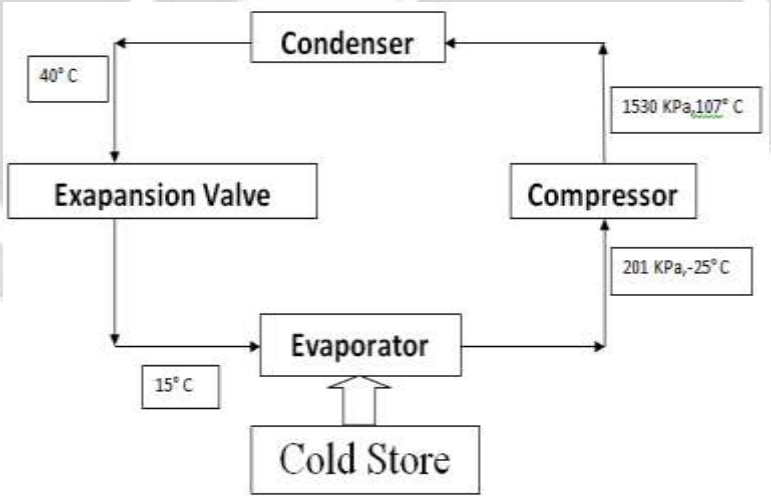

Fig 1: Block-Diagram of Cold Storage

$T_1 = -25^\circ\ C, T_2 = 107^\circ\ C,$

$T_3 = 40^\circ C, T_4 = 15^\circ\ C,$

$P_1 = 2.01 \frac{Kg}{cm^2}, P_2 = 15.3\ Kg/cm^2$

At first I take the data of actual energy by a compressor for one chamber from reading, this is equal to = 32 KW per hour.

Table 1: Electricity bill of Four Month

Month	Electricity Bill
March, 2014	28562 KWh
April, 2014	36482 KWh
May, 2014	41263 KWh
June, 2014	32434 KWh

So, the average of this three months electricity bill = $\frac{28562+36482+41263+32434}{4}$ = 34685.25KWh

This unit is for one month and for 2 chambers only. The running time for a month is 540 Hours. Now, Total unit consumption for one hour and for one chamber = $\frac{34685.25}{2\times540}$ = 32.11 KW per hour

In this Cold Storage, 126 pieces of Fans and 382 Lights are running.

Unit consumed by the fan = 0.06 KW

Unit consumed by the light = 0.016 KW

So, the total unit consumed by this three

= [.06+.016] = .076 KW

So, unit consumed by a compressor is = [32.11 - .076] = 32.034 KW.

E_{actual} = 32 KW per hour

I have done this theoretical energy calculation with Two process :

We know that

$E_{theoritical}$ = work done by a compressor

$$E_{theoritical} = \frac{n}{n-1} P_1 V_1 \{(\frac{P_1}{P_2})^{\frac{n}{n-1}}-1\} \quad [4] \qquad (1.1)$$

Where,

n = 1.4

P_1 = 2.01 kg/cm^2 = 201 KPa

P_2 =15.3 Kg/cm^2 =1530 KPa

$V_1 = \frac{\Pi}{4} D^2 L$ where D = Bore = 160 mm (1.2)

L = Stroke = 110 mm

V_1 = .00221 m^3

$E_{theoritical}$ = 1.22 joule

Here the speed of motor for compressor is = 1440 rpm and number of cylinder is one, then

$E_{theoritical} = \frac{1.22 \times 1 \times 1440}{60}$ = 29.32 KW per hour

Co-efficient of performance (COP) = $\frac{Q}{W}$ [4] (1.3)

Also, COP=$\frac{dt_1}{dt_{1-dt_2}}$ (1.4)

Where, dt_1 = Condensing temperature difference , dt_2 = Evaporating temperature difference

Comparing equation (1.3) and (1.4) we find the value of W,

Here Q = 55 KW per hour [3].

W = 22.16 KW per hour

$E_{theoritical}$ = 22.16 KW per hour

Now , the average of this two, $E_{theoritical} = \frac{29.32+22.16}{2}$ = 25.74 KW per hour

So, when I take approximate value of compressor is

$E_{theoritical}$ = 26 KW per hour

2.2. Energy Gap Analysis :-

Gap energy = $E_{actual} - E_{theoritical}$

Gap energy = 32 – 26 = 6 KW per hour

If I take per month then it becomes:

Gap energy = (6 × 540) = 3240 KW per hour

If I take per year it becomes:

Gap energy = 3240 × 12 = 38880 KW per hour

2.3. Cost Analysis :-

Table 2:Cost Analysis of Four Month

Month	Unit	Cost
March	28562 KWh	208502.6
April	36482 KWh	266318.6
May	41263 KWh	301219.9
June	32434 KWh	236768.2

So, the average cost of one month = $\frac{208502.6+266318.6+301219.9+236768.2}{4}$ = Rs. 253202.32 /- per month

Now the excess energy for a month is equal to 3240 KWh and for a year is equal to 38880 KWh.

So the saving money is = 3240 x 7.3 = Rs. 23652 /- in a month.

= 38880 x 7.3 = Rs. 283824 /- in a year.

3. CONCLUSION:-

As we conducted our extreme efforts to justify our aim for this Audit, finally we concluded some results, It has been observed that the actual energy consumption of a cold storage by a compressor for one chamber is 32 KW per hour and theoretical energy consumption is 26 KW per hour. So, a gap of 6 KW per hour is found between the theoretical and actual energy consumption by a compressor. If we try to minimize this gap then savings of Rs. 23652 /- per month will be obtained which will amount to Rs. 283824 /- per year.For saving energy in Cold storage. we must be Uses of latest energy saving equipments, Use Proper Insulation. To increase the efficiency, conventional lights will replaced by energy efficient devices that is LED, CFL etc. If we replace two compressors for two chambers with a single equivalent compressor which will deliver the same amount of load, then maximum energy will be saved.

4. REFERENCES:-

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