International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 6, Issue 12, ISSN No. 2455-2143, Pages 299-301
Published Online April 2022 in IJEAST (http://www.ijeast.com)

LPG AS A REFERIGERANT FOR COOLING WATER SYSTEM

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***Abstract*— This document explains how to use LPG as an refrigerant in an chiller for cooling purposes. LPG is naturally found in high pressure. As this high pressure is not required at the user side, It's possible to utilize this high pressure for cooling. LPG is a byproduct of the petroleum industry. propane is produced in petroleum refineries and contains 24.4 percent propane. Butane and isobutene make up 56.4 percent and 17.2 percent of the mixture, respectively.**

By employing LPG gas as a refrigerant, we can create a simple water cooler or chillier that will provide chilled and cold water in the shortest amount of time as compared to our regular refrigerator. This system will be comprised of automatic filling arrangements, temperature controlling sensors, and a leakage detecting device. LPG (liquefied petroleum gas) as a refrigerant is a helpful approach to contribute to our environment. As It has no potential to deplete the ozone layer (ODP).

***Keywords*— LPG, Refrigeration, Chiller, Evaporator, COP, Expansion valve, Latent heat, Gas Presssure, ODP**

I. INTRODUCTION

LPG is available in high-pressure cylinders. When this high-pressure LPG is pushed through a small-internal-diameter capillary tube, the pressure drops due to expansion, and increase in volume of LPG that results in the drop of temperature and a refrigerating effect is produced. and the LPG phase changes in an isenthalpic process. The liquid refrigerant gains latent heat as it transitions from liquid to gas, and the temperature declines.

Table -1 Properties of LPG

Properties	LPG
ODP	0
Latent heat of vaporization	428.25kJ/kg
Boiling point	-6°C
Specific gravity	1.52 to 2.01

It works on the principle that during the conversion of LPG into gaseous form, expansion of LPG takes place. Due to this expansion there is a pressure drop a This refrigerating effect can be used for cooling purposes.

After evaporator it passes through the gas burner where it burns. In this system compressor and condenser are not used hence, it is cheap and eco-friendly. Around the world 17500 metric tons of conventional refrigerants is consumed for Refrigeration purpose like CFC and HFC which are the main elements in depletion of ozone layer causing global warming. The use of LPG replacing CFC have obtained good results just by modifying our domestic refrigerators. So, LPG can be used instead of CFC and HFC refrigerant in the system.

II. COMPONENTS OF SYSTEM

There are main four parts in this system along with LPG supply :

1. Copper Tubes : Copper is the preferred material for use with most refrigerants. Because of its good heat transfer capacity as well as corrosion resistance and cheaper in cost.
2. Capillary tube : It is known as Throttling device or pitot tube. the material used for capillary tube is copper. The pressure drop of refrigerant take place due to this device to obtain cooling effect. It has small bore diameter, length of capillary is more as the evaporator pressure is low.
3. Valves : Gas supply control valves are installed along with pressure gauges.
4. Evaporator : It acts as a heat exchanger. Evaporator tube can be given any shape according to dimensions and Water circulates around the evaporator thus cooling effect take place.

III. WORKING OF SYSTEM

LPG is stored under high pressure in the LPG storage tank. When the gas supply control valve is opened, high-pressure LPG travels via the high-pressure pipe and into the capillary tube. At the capillary tube, high pressure LPG is converted to low pressure while the enthalpy remains constant.

After passing through the capillary tube, low pressure LPG is turned into low pressure low temperature vapour and travels into the evaporator, which absorbs heat from the water. As a result, the water cooled down.

We get a cooling effect this way. After passing through the evaporator, low pressure LPG is routed through the pipe to the burner, where it is burned. The operation of an instantaneous water cooler is identical to that of a storage type water cooler.

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Thermostats or temperature sensors are installed with the water flow tube to control the temperature of chilled water. Thus, water will enter the tube from the higher section and cooled water will be collected from the lower section of the setup as water will flow down owing to gravity.

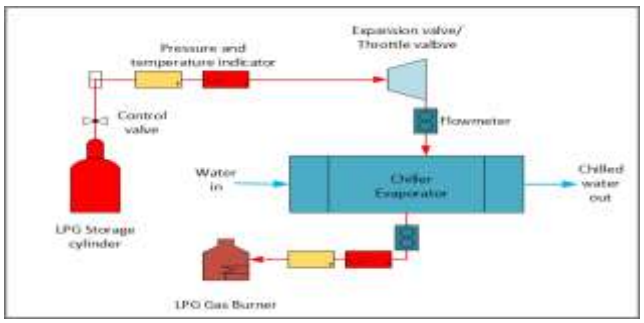

Fig.1: LPG Refrigerating process

A continuous supply of cold water will be available. The water from the second tube can now be stored in containers that are properly insulated. Consequently, water stays chilled for a long time and can be replenished when needed. After leaving the evaporator, the LPG gas is supplied to burner for burning.

In this system, the evaporator tube is spiraled and held vertically, and a copper tube other than the evaporator tube, referred to as the 2nd Tube (1st tube= evaporator tube, 2nd tube= water flowing tube), is put in between the spirals of the evaporator coil. This second tube contains the flow of water that will be cooled. It is designed to establish intermediary contact between the evaporator coil and the water flow tube. The second tube has a smaller diameter than the evaporator coil. As a result, conduction occurs quickly. As a result, water is cooled in less time.

This is only possible if a large section of the second tube is in contact with the evaporator tube. The simple copper tube can only make a line or point contact with each other, but the second tube in this case is manufactured to make maximum contact.

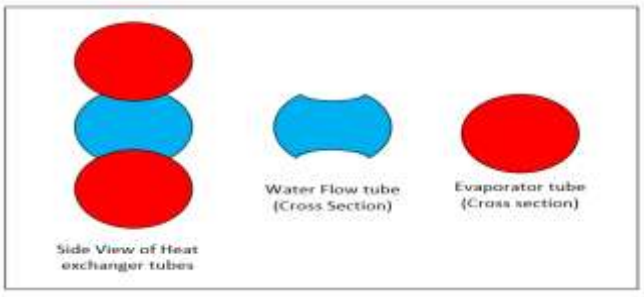

Fig.2 : Cross Section and Design of Water Flow Tube and Evaporator Tube.

Soft copper tubing is utilised for such purposes as our second tube; soft copper tubing may be bent easily and given any shape to move past obstructions in the course of tubing. Work The drawing procedure, which is used to size the tubing, hardens the copper tube. It's gently annealed to restore its softness. For refrigerant lines, soft copper is the most common material. With the exception that the water is instantly cooled due to superior evaporator fittings and system arrangement.

IV. EXPERIMENTAL RESULT

Table -2 Experiment Result

Time (Min.)	Capillary inlet Pressure (Bar)	Evaporator Outlet Pressure (Bar)	Evaporator Temperature (°C)
5	10	3	28
10	9.60	2.50	22
15	9.80	3	16
20	10	2.50	10
25	10	2.50	5

Table 2 shows Decrease in Evaporator Temperature with respect to time.

It can be observed that:
1)This model of instantaneous water cooler is advantages for the purpose of cooling the water.
2) It can also use instantaneously and quickly for purpose because it takes least and minimum time to the water and perform its function.
3) This type of system is not used by any of the companies ,if this project or cooler is made by any standard companies, then some standardization and excellent quality will be achieve economically and cost will also be reduced.
4) In industry where LPG is continuously consumed on large scale there this system can be used for producing chilled water for process cooling.
5) This system is eco friendly and non polluting machines so we can prefer this water cooler over the other coolers. The total energy consumption is none because the work done is instantly.

V. APPLICATIONS :

1) In schools and colleges for drinking purpose.
2) In industries like ice plants, refrigeration unit.
3) It is generally used for domestic purpose.
4) At railway stations, air ports bus stands.
5) In hospitals and laboratories.
6) It is important in laboratories and chemistry labs.
7) It is generally used in hotels, restaurants, various parties and marriage events. (The cooling of water take place simultaneously with cooking food) Chilled water will be provided to the guest with minimum cost.

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VI. MERITS:

1) Time required for cooling is very less as compared to other water coolers.
2) Produce low noise and working is effective.
3) It does not create hazardous situation.
4) Easy to use.
5) Eco-friendly cooling and working.
6) Reliability is much better.
7) By designing effectively, we can use it for high-capacity applications.
8) Eliminates the compressor and condenser
9) It saves electricity

VII. DEMERITS:

1) LPG is explosive in nature
2) After the refrigeration process, the exhaust of LPG is burn into burner. Because of the exhausted vapor LPG cannot converted into liquid phase again, because the process is very costly.
3) The main disadvantage of the system is that, the process is not continuous. As, we switch off the burner whole cycle stops and no further cooling takes place. The system is applicable whenever there is use of burner.
4) Smell is pungent.

VIII. CONCLUSION

It was found that the cooling of water in a heat exchanger or evaporator is dependent on the following factors:
1) Flow rate of incoming water in the heat exchanger.
2) Refrigerant flow through copper tube
3) Super heating.
4) Amount of water to be cooled.
5) Overall component capacity, performance, and efficiency.
It was observed and discovered that chiller system has excellent performance with good chilling of water and also has superior efficiency by comparing other high water cooler with this water chiller system.
It does not require an external sources to run the system and moving part is absent in the system. Henceforth, maintenance cost is less as well less silent operation. This system is most suitable for hotel, industries, refinery, chemical industries where consumption of LPG is very high. The COP of the demonstrated system is 2.40.
The temperature of the outflow water is between 5 and 10 degrees.

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