SOLAR BASED VAPOUR ABSORPTION REFRIGERATION SYSTEM

Naveen Kumar Sain[a] , Naval Kishore Jain[b]
Raja Agrawal[c], Simran Thind[d]
[a,b] Assistant Professor, Poornima Group of Institutions, Jaipur 302022, India
[c,d]B-Tech Scholar, Poornima Group Of Institutions, Jaipur 302022, India

Abstract
The prices of energy have been increasing exponentially worldwide. There is need of refrigeration system which uses minimal amount of energy. Solar is one of the cheapest and most easily available source of energy. Developing a solar based absorption refrigeration system will be beneficial in two ways. It cuts down the cost of energy as well as preserves the environment as it does not include the use of CFC's. Its structure is simple compared to the existing refrigeration system and it also consumes less amount of energy. This paper describes use of solar energy as a source for vaporising the refrigerant solution that is NH_3 and H_2O, instead of electricity. The aim is to cool some product or space to the required temperature.
Keywords: *Solar Refrigeration; Vapour absorption; Environment; CFC's; Refrigerants*

Introduction

The refrigeration is defined as a process of removal of heat and it is the techniques of producing cooling effect by abstraction of heat so that temperature below that of surroundings is produced in a substance or within a space. A refrigeration system uses a suitable working substance called refrigerant which condenses and evaporates at temperature and pressure close to the atmospheric condition. Air, water and iceare the oldest refrigerants. The Chinese were the first to find out that ice increase the life and improve the taste of drinks and for centuries Eskimos have conserved food by freezing it. In 1880, the first ammonia compressors and insulated cold stores were put into use in the USA. At the beginning of the century electricity begins to play a part and mechanical refrigeration plants became common. But, in today's scenario the price of electricity is going high day by day. Thus, it becomes costly to install refrigeration system which is based on electricity. The alternative for the purpose is use of solar energy, which is radiant energy produced by sun.Solar Energy produces no air or water pollution and is a free and widely available energy source.

System Methodology:

The system operates on the principle that NH_3 and water trough completely soluble in each other have different boiling point at the same pressure. When the high solution is heated, the NH_3 vapours are driven out because of boiling point of NH_3 is lower than that of water.The vapour absorption system is a heat-operated system in which the refrigerant is alternatively absorbed and liberated from the absorbent. In this system solar energy is used to drive out the volatile component from the solution and built up the pressure. The vapour is then condensed. The condensed liquid is than expanded to absorb heat from the space where refrigeration is needed.

The vapours are once again absorbed in the solution. The cycle is continuously repeated. Sub zero temperature can be reached by absorption refrigeration system.

System Working:

This requires a working pair of refrigerant and absorbent. High pressure or heat separates the two elements during the generating phase and refrigeration takes place through the absorption of the pair. Ambient cooling is an intermediate phase, which takes place to reduce high-pressure vapour into refrigerant working liquid. Water and ammonia are most common working pair in which water is an absorbent and ammonia is refrigerant. Ammonia is a colour less gas possessing a characteristic pungent smell and strongly alkaline reaction and it is lighter than air. It is extremely soluble in water. One volume of water at zero degree temperature and normal pressure absorbs 1148 volumes of ammonia. Initially the collector receives energy from sun light. Subsequently, the energy is transferred to the refrigeration system. NH_3 solution is heated and water vapours are generated and these vapours are then transferred to the condenser.In condenser cooling of vapours is done by circulating running water.Then at low temperature and pressure the water is throttled and sent to evaporator where evaporation takes place.Now water vapour are transferred to the absorber where they are absorbed in the concentrated NH_3solution and heat is rejected to the cooling coils. After that water is again pumped to the generator and the cycle is repeatedas shown in Fig. 1. The performance of the system is governed largely by the temperature difference between the generator and the condenser and absorber units. Since the generator temperatures in solar driven systems are only moderate, it is important to keep the condenser and absorber temperatures as low as possible. The NH_3 system is preferred over Li-Br systems for solar energy applications because of the lower generator temperatures required.

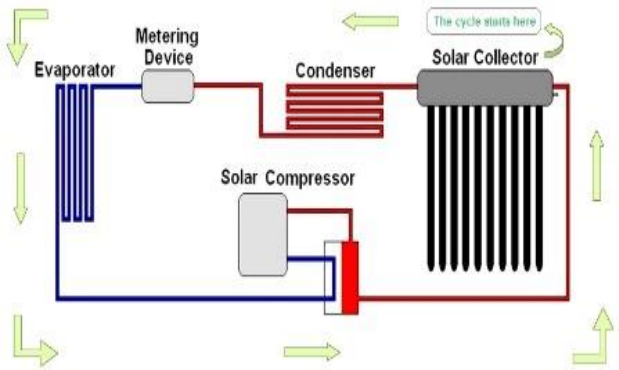

Fig. 1: Solar based vapor absorption refrigeration system

Economic Aspects:

More than 1000 cooling system based on solar thermal collector and thermally driven chillers have been installed in descends years and the interest in this products continuous to increase. This is most evident where solar thermal collectors can be used for cooling in summer. As high prices for electricity and more frequent electricity outages occur the attractiveness of solar thermally driven cooling system will continue to grow. India has second highest population in the world with an escalation energy demand. Electricity meets a major portion of this energy

demand and is notably related to socioeconomic progress of the country, which is growing at the rate of 8%. Although India is one of the best recipients of solar energy due to its favourable location in the solar belt, a meagre of 66MW capacity solar systems are installed in the country. The cost comparison between solar and conventional system is shown in Fig. 2

As we can see by the graph that the conventional type refrigeration costs more in comparision to solar type refrigeration. Since years the costing of conventional refrigeration has been increased, meanwhile solar technology reveal its use without much costing which ultimately make the constant graph as shown by the blue line. In this way we can say that the reliability for the solar refrigeration is more than that of conventional types.

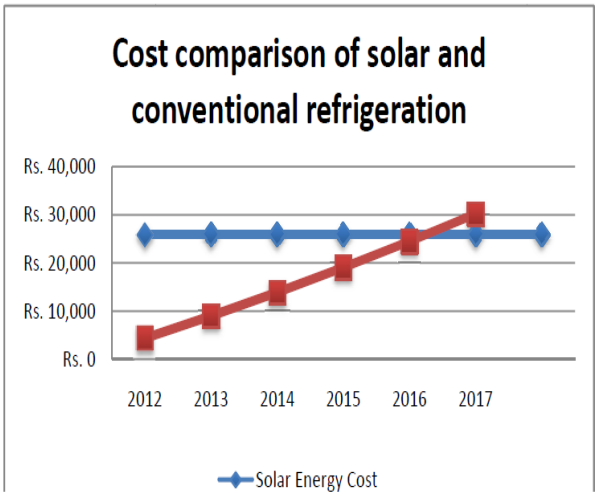

Fig. 2: Cost comparison of solar and conventional refrigeration

Conclusion:

After comparing both the refrigeration systems it can be concluded that solar based refrigeration is better in both the term, technically and economically. It saves good amount of money. Emissions in solar based refrigeration are very less as compared to conventional one. The problem of CO2 can be completely removed my solar based refrigeration. This system would be very effective in the areas where electricity is a major crisis and the regions of hot climate.

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