"SOLAR-DRIVEN REFRIGERATION SYSTEM"

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ABSTRACT:
The use of mechanized devices for heating and cooling has also resulted in enormouslyhigh consumption of energy and globally HVAC forms a major component of the increase in energy demand. Beside this, there are now graveenvironmental concerns for global warming, ozone depletion and climate change which are closely associated with energypollution.Thus, technologies which are sustainable and dependent on renewable energy sources are now being widely preferred with a renewed interest.
In the above context, this review report covers various hybrid solar air conditioning and refrigeration techniques. The study also summarizes the various parameters related to performance; heatoperating temperature, innovations in technology & their performance, and future scope of above technologies. This report also highlights the use of different techniques for different applications.

Keywords: *HVAC, COP (coefficient of performance), EER (energy efficient rate), heat transfer.*

INTRODUCTION:

A review of refrigeration technology is under taken following which the solar insulation of India is reviewed to expand further on the rationale for solar refrigeration made earlier on in the document. A focus on the solar refrigeration pathways through photovoltaic and solar thermal leads into the analysis document of the document.

The idea of **a solar-driven refrigerator** was first recordedin the Paris in the year 1872. A is used to supply heat to a crude absorption machine, resulting in a small amount of ice.

Later, solarpowerrefrigeration systemshavebeen used inworldwide in many countries e.g.Australia, Spain, and the USA. Most of them are thermally driven absorption, designedforair-conditioning purposes. Energy supply to refrigeration and air- conditioning. System constitutes a significant role in theworld.TheInternationalInstituteof Refrigeration has estimated that around 15% of the electricity produced worldwide is used for refrigeration and air-conditioning purposes of various kinds.It has been estimated that the demand for the air conditioner is increasing day by day at the rate of 17%.

What is Refrigeration?

The term **Refrigeration** maybe defined as the process of removing the heat from a substance under controlled conditions. It also includes the process of reducing and maintaining the temperature of a body below the general temperature of a body below the general temperature of its surroundings. Refrigeration has many applications including domestic, commercial, industrial, marine, air conditioning, food preservation and many others.

REFRIGERATION SYSTEM COMPONENTS

The refrigeration system consists of five basic parts that are evaporator, compressor, condenser, expansion valve and refrigerant. In order for the refrigeration cycle to operate successfully, each component must be present within the refrigeration system. The description of each of the components of a refrigeration system is discussed below**.**

The Evaporator

The evaporator is an important device used in the low-pressure side of a refrigeration system. The purpose of removing unwanted the product with the help of liquid refrigerant. Liquid refrigerant contained within the evaporator is boilingat a low pressure. this pressure is determined by two factors: The rate at which the heat is absorbed by the liquid refrigerant which the low-pressure vapor is removed from the evaporator from the compressor. To enable heat transfer, the temperature of the liquid refrigerant should be low than that of the temperature of the product is cooled.

The Compressor

The screw and reciprocating compressors are the most commonly used compressor used for the refrigeration purpose because reciprocating and screw compressor is compact and create less noise. At full load, they work more efficiently. But at the part load reciprocating compressors works more efficiently. We will discuss them in briefly. There are some screw machines available which are capable of operating at higher pressures by using cast steel casings on the machines but these are not commonly used because of there high capital cost and low availability. The purpose of the compressor is to draw the low-temperature, low-pressure vapor from the evaporator via the suction line. Once drawn, the vapor rises in temperature. Therefore, the compressor is used to convert the low-pressure vapor to the high-pressure vapor.

The Condenser

The condenser is used to extract the heat from the refrigerant to the outside air. A condenser is usually installed on the reinforced roof of a building, which enables the proper transfer of the heat. Fans are mounted on the above of the condenser unit, which is used to draw air through the condenser coils. The temperature of the high-pressure vapor will help us to determine the temperature at which the condensation will begin. As heal has to flow through the condenser to the air, condensation temperature should be higher than that of the air: usually, it operates in between – (12°C -1°C). The high-pressure vapour is cooled in the condenser to the point where it becomes a liquid refrigerant once more while retaining some amount of heat.

The Expansion Valve

The expansion device (also known as the metering device or throttling device) is an important device that divides the high-pressure side to the low-pressure side of the refrigerating system. It is connected to the receiver (containing liquid refrigerant at high pressure) and the evaporator. The expansion device is used to perform the following operations:

1. It reduces the high-pressure liquid refrigerant to low-pressure refrigerant before being fed to the evaporator.
2. It maintains the desired pressure difference between the high and low-pressure sides of the system.
3. It controls the flow of refrigerant according to the load on the evaporator.

The Refrigerant

The refrigerant is a heat-carrying medium during the cycles (compression, condensation, expansion and evaporation) in the refrigeration system, which absorbs the heat from the low-temperature side and discards the heat so absorbed to a higher temperature system. The natural ice and a mixture of ice and salt were the first refrigerants. There is no ideal refrigerant.

OBJECTIVE

The main objective of this paper is to create control algorithms and operating procedures that can reduce the energy consumption of the industrial refrigeration system. The approach here is to create a database of different operating parameters and utilize that database to create a model or system energy consumption. Compared to the physical model, the data-driven model will account for the dynamic behavior of the refrigeration system. A driven model will be used to predict the performance of compressors provides the energy-efficient capacity control. Control algorithms developed in thisstudy will also identify maintenance and operational problems up to a certain extent in future and indicate the operator about those possible problems beforehand. An algorithm is developed for changing the discharge pressure set- point (floating the discharge pressure) for reducingthe energy consumption of the wholesystem.

The objectives that identify the scope of this project are deciding floating discharge pressure set point for energy optimization, compressor performance prediction and selecting most efficient compressor(s) in predicted conditions and compressor capacity control by a real lime model-based energy optimization ina multi-compressorsystem.

Solar Cooling Options and Technologies

The concept of ' solar cooling path ' from the energy source to the cooling service is introduced. Before going into detail for each solar-driven refrigeration system, definitions, suitable efficiency terms and thermodynamic limitations of solar cooling are described. Subsequently, an overview of possible solar-driven refrigeration and air –conditioning presented, including all possible and available cooling cycles.

Solar cooling path

The solar cooling system is generally comprised of three sub-systems: the solar energy conversion system, refrigeration system, and the cooling load. The appropriate cycle in each application depends on cooling demand, power, and the temperature levels of the refrigerated object, as well as the environment. A number of possible " paths" from solar energy to "cooling services" are the inflow of solar energy there are obviously two significant paths to follow; solar thermal collectors to heat or PV cells to electricity. For solar thermal collectors, different collector types produce different temperature levels. This indicates that the temperature level can be matched to various cycle demands. The Rankin cycle requires a high driving temperature whereas the desiccant cycle manages at a lower temperature level of heat supply. The same type of temperature matching is important for the cold side of the solar cooling path, i.e. in the cold object. Since several cycles typically operate with water as a working fluid, it is impossible to achieve temperatures below 0°C for some cycles. The solar thermal-driven air conditioning cycles can be based on absorption cycles, adsorption cycles, duplex Rankin, desiccant cooling cycles, or ejector refrigeration cycles. When using low-temperature applications for food storage at 0 to 8°C, various cycles can be applied, i.e. the vapor compression cycle, thermoelectric cycle, absorption cycle, adsorption cycle or a chemical reaction cycle, i.e.iceproduction.

ENERGY EFFICIENCY

No mention of Coefficient of Performance (COP), a ratio of cooling to energy input has been made. This is partly because of the difficulty of comparing systems under different conditions, but also to avoid the inference that COP is the most important parameter. Commercialization will depend on the total cost of capital equipment. Maintenance and fuel over the lifetime of the plant.In a solar thermal systemwherethecollectorsprobablydominate the capital cost, and the fuel cost is zero, it can be argued that a high COP reduces collector area and thus the total cost. However, if the consequences of a high COParccomplexityandunreliabilitythenotheir costs may rise. As a rough guide one may say that internal COP (cooling/heat lo generator) of thermal systems canrangefrom0.1 (typical) to0.5(best) for a Platen- Munter's machine,0.2to0.5 for intermittent absorption systems and up to 0.7 for intermittent regenerative cycles. Vapor compression machines with electricityinput would have typical COP of 1.0 to 1.5.Gas pace between themetal surfaces andadjoining grainshasahigh thermal resistance.Since grain packing near a wall is less densethan within thebedtheeffectivebedconductivityisreducednear the wall. This is normallymodeled by assuming a low heat transfer coefficient (or high thermalresistance) between wall and bed. The use of a monolithic block of carbon reduces the thickness of the gas space, but its thermal resistance still limit the heat transfer

SOLAR DRIVEN ABSORPTION SYSTEM

This was the first type of solar refrigeration system to be introduced. It is now available on the market as small packaged systems. Heat is supplied to a device called the generator. The generator temperature can be lower than 100°C, depending on the refrigerant- absorbent pair, e.g., ammonia/ water or water/lithium bromide. Low generator temperature's normallylead to significantly larger heat exchanger surfaces. Electricity is normally required for circulating the refrigerant-absorbent pair. The coefficient of performance (COP) of these refrigeration cycles is higher than the COP of other thermally operating cycles. With the single-stage cycle, a COP is obtained at about 0.6 -0.8 and increased to 1.35 for a so-called double effect two-stage cycle (Gordonand Ng, 2000). It can be used in both refrigeration and air-conditioning applications. The absorption refrigeration cycle can be designed in different configurations as for example, the basic single effect cycle, the multi-stage absorption cycle, and the Platen Munterscycle, which can be operated without apumpor theopen cycle type.

The Single- Effect Absorption Cycle

The single effect can be either operated intermittently or continuously. An ammonia-water solution is used as the working fluid pair for low-temperature applications and water- lithium bromide is used for air-conditioning applications.

The Multi-Effect Absorption Cycle

The multi-stage design can improve the COP of the system at the cost of a higher driving temperature. There are several designs for multi-stage absorption system s: double effect, triple effect, absorber heat exchanger (AHX) or generator-absorber heat exchanger (GAX). In general, the COP is improved by adding extra heat exchangers and arranging them in a way that heat can be utilized at different temperature levels. This means, in essence, that the same heat is utilized internally several times and of course, increased complexity and cost.

The Diffusion Absorption Cycle

The system type is also called the Electrolux refrigerator Ithas been called a *non-moving-part* and *no-auxilimJ' energy supply* system. isused to maintain a constant in the whole system. The refrigerant partial pressure is allowed to be low in the evaporator, achieving the refrigeration effect. Ammonia is generally used as a refrigerant, water is used as an absorption media and hydrogen is used as the inert gas. The principle of the eye & similar to the single stage absorption cycle. The difference is that the total pressure is the same in the entire system. Hydrogen is circulated between the evaporator and the absorber, compensating for the pressure difference between and low - pressure side. Ammonia vapor in the generator is condensed in the condenser before it flows to the evaporator.In the evaporator, liquid ammonia is exposed to the hydrogen atmosphere and a cooling effect is achieved when liquid ammonia evaporates due to its low partial pressure. Next, the ammonia-hydrogen mixture continuous to the observe (passing through the internal heat exchanger) in which ammonia will be absorbed in the water solution the hydrogen returns to the heat exchanger and the evaporator while the aqueous ammonia solution is pumped to the generator by a thermosyphon pump. The poor ammonia aqueoussolutionthen goesback to the absorber by gravitational flow. The generator temperature varies typically 120 to 180°C, depending on the operating temperature.

Application

Desiccants substances have a strong affinity towards water and, because of this, can absorb moisture from an air stream. Desiccants can be solids such as lithium chloride, silica gel or molecular sieves, or Liquids such as glycol, sulphuric acid or lithium bromide solution. There is a partial pressure of water vapor that can exist in equilibrium with a desiccant at a particular temperature. If the actual vapor pressure is above the equilibrium value, moisture will be absorbed, but if it is lower than moisture will evaporate from the desiccant. The process is thereforereversible.

CONCLUSION

Solar energy as a renewable energy source for driving cooling machines has for a long time been a favorite for many researchers. All electricity- driven systems so far are designed for refrigerating perishable materials. Most thermal driven Systems are designed for air conditioning in different climates and different capacities. Researchers have proposed other novel refrigeration systems but most of them are still under development. Solar cooling systems are strongly depended on local conditions e.g. solar radiation, ambient temperature, or cooling load. Systems should, therefore, be specifically designed for each location, thereby obtaining the best performance.

For thermally driven systems, a solar cooling system requires less solar collector area per cooling demand (kWh) in tropical areas than in areas above the Tropic of Cancer or below the Tropical of Capricorn, provided that the building has a reasonable climate shell.

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