Green Refrigeration & Cooling Techniques for Food Preservation in Rural and Livelihood Sector.

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Abstract—

The use of refrigeration for food and its preservation is undoubtedly the most extensive technique. Low temperatures at less than 5 ° C retard the development of micro-organisms, chemical and enzymatic reactions that cause spoilage. The majority of microorganisms do are more capable of metabolic activity at temperatures below -5 ° C. The two cooling processes that use for preservation like refrigeration and freezing. The globally concern on energy conservation with environmental security revealed the provision of green and energy efficient refrigeration techniques. The employment of solar integrated vapor absorption and adsorption refrigeration provides sufficient cooling for food/milk/vegetables and grain preservation in rural and remote rural areas in cost effective manner. This paper explains the fundamental, applications and technological feasibility of green refrigeration system and its commercial availability.

Keywords -: Green, Refrigeration, Vapor Adsorption Refrigeration, Preservation.

Introduction

Refrigeration and air conditioning (RAC) are responsible for a significant share of global greenhouse gas emissions. Especially in developing and emerging countries, the demand for cooling equipment is rising. Low efficiencies and high leakage rates of refrigerant gases with high global warming potential will increase these emissions drastically. Our goal is to accelerate the transfer of environmentally friendly technologies in the refrigeration and air conditioning sectors to and within developing countries.

A major way "going green" was beneficial to the refrigeration side of operation is : Energy Saving as an owner or manager of a food service operation, there are a number of strategies can adopt in

commercial use to positively impact of bottom line. a "green" solutions as part of a smart business strategy, with goals of reducing energy usage and utility expenses, sustainability and enhancing our customer's productivity.

Green refrigeration

Green Refrigeration is what we call environmentally friendly air-conditioning and refrigeration (RAC) with minimum negative impacts on the environment. The negative environmental effects of cooling appliances are due to their direct and indirect emissions. To avoid emissions, green cooling RAC equipment involves two main factors: Climate-friendly refrigerant and high energy efficiency.

Ozone-Layer Depletion and Global Warming

Chlorofluorocarbons (**CFCs**) and other halogenated **ozone depleting** substances (ODS) are mainly responsible for man-made chemical **ozone depletion**.

- **Environmentally friendly:** Harnesses the energy of the sun to reduce dependence on fossil fuels and eliminates the need for batteries that can be damaging to the Earth upon disposal.
- **Longevity:** Operates continuously for years as proven by prototype units tested at various locations around the world.
- **Scalable:** Suits applications in a wide range of sizes, from portable 50-liter coolers to building-size air-cooling systems.

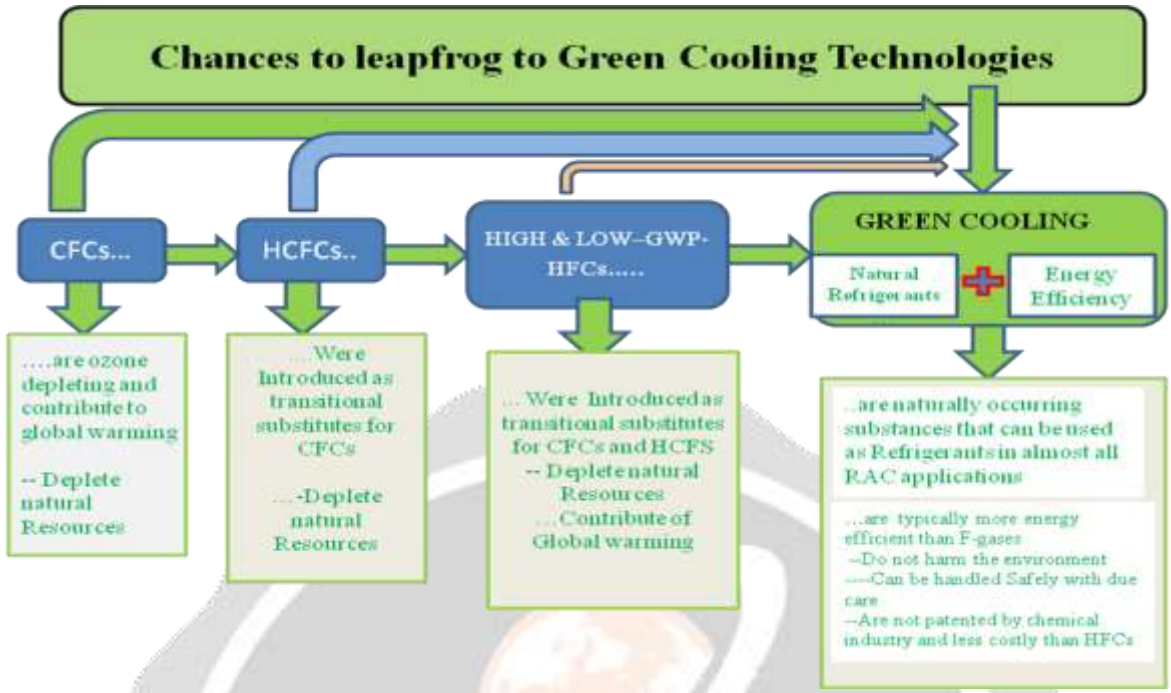

Figure.1 Leapfrogging to green cooling technologies

Vapor Adsorption Refrigeration System

Adsorption refrigeration technologies such as absorption and adsorption are thermally driven systems, in which the conventional mechanical compressor of the common vapor compression cycle is replaced by a thermal compressor and adsorbent. The adsorbent can be either solid in the case of adsorption systems or liquid for absorption systems. When the adsorbent is heated, it desorbs the refrigerant vapor at the condenser pressure. The vapor is then liquefied in the condenser, flows through an expansion valve and enters the evaporator. When the adsorbent is cooled, it reabsorbs vapor and thus maintains low pressure in the evaporator. The liquefied refrigerant in the evaporator absorbs heat from the refrigerated space and vaporizes, producing the cooling effect.

Adsorption refrigeration unlike absorption and vapor compression systems is an inherently cyclical process and multiple adsorbent beds are necessary to provide approximately continuous capacity. Adsorption systems inherently require large heat transfer surfaces to transfer heat to and from the adsorbent materials which automatically makes cost an issue. High efficiency systems

require that heat of adsorption be recovered to provide part of the heat needed to regenerate the adsorbent. These regenerative cycles consequently need multiples of two-bed heat exchangers and complex heat transfer loops and controls to recover and use waste heat as the heat exchangers cycle between adsorbing and desorbing refrigerant.

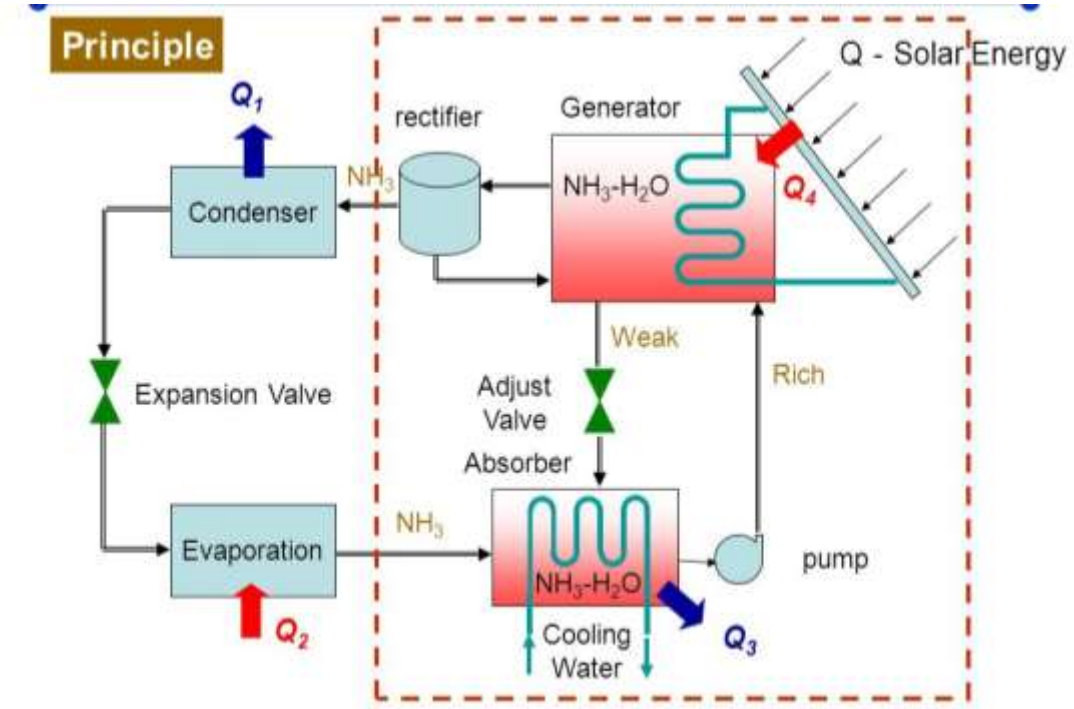

Figure-2, Concept of Green Refrigeration

Application of Green Refrigeration/Cooling

Space Cooling

There are many benefits to Solar Cooling systems. For one the sun is a clean energy resource that using more often. It also produces no emissions and replenished naturally, it reduces greenhouse gases, it saves the release of 1.6 lbs. of carbon dioxide (CO2) for each kilowatt-hour (kWh) produced, it saves the use of one-half gallon of water for each kWh of solar energy produced, it saves the release of other emissions that result from the burning of fossil fuels such as nitrogen oxides, sulfur dioxide or mercury and it provides customers with options to reduce their electric bills. But up to this point Solar Cooling systems are not widely used at all.

Industrial Space cooling

The system works day and night in the summer with the daytime with the daytime solar heat collected the same way as a conventional solar wall system, while also simultaneously shading and ventilating the roof. The heat can either dissipated or used to heat water or industrial processes. At night these same panels will cool air as much as 10 degree F below ambient when connected to economizer on typical HVAC units.

Milk chilling

The milk vat solar powered milk cooler uses a multi-point power tracking module that does the job of effectively cooling milk down without losing power on this open vertical type of solar bulk cooler. The battery backup is 6 hours. It comes with under and over voltage protection. Its even designed to be protected from lightning. The LED display on this piece of equipment also gives you a visual indication of any faults going wrong with the machine or the process. If anything does go wrong, the whole system is equipped with an emergency stop switch that should prevent any faults produced while the machine is one.

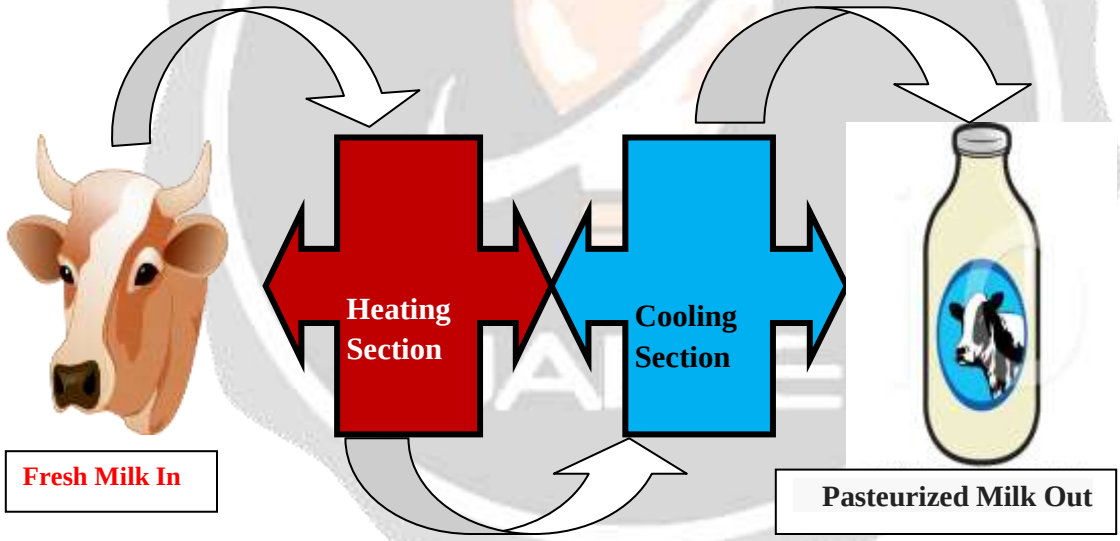

Figure: 3 Pasteurization and Milk Preservation

Ice making

The 'Intermittent Solar Ammonia Absorption Cycle' (ISAAC) Solar Icemaker operates in two modes. During the day, solar energy used to generate liquid ammonia refrigerant. During the night, the generator is cooled by a thermo siphon and ice is formed in the evaporator compartment as ammonia is reabsorbed to the generator. The ISAAC Solar Icemaker is an Intermittent Solar Ammonia-water Absorption Cycle. The ISAAC uses a parabolic trough solar collector and a

compact and efficient design to produce ice with no fuel or electric input, and with no moving parts. The daily ice production of the ISAAC is about 5 kg per square meter of collector,. The construction of the ISAAC Solar Icemaker involves only welding, piping and sheet metal work, and there are no expensive materials. It estimated that, when produced in-country where wages are low and transportation costs can be minimized.

Food preservation

The oldest known method of food preservation is drying food using the heat from the sun. Unfortunately it has become the least used as freezers and pressure canners have taken its place. While these methods of food preservation are certainly effective, they have drawbacks when compared to solar food drying. Freezing is quick and easy but requires purchasing an expensive freezer if you don't already own one. It also requires electricity (or other form of energy) to operate. Unless off-the-grid a power outage can result in food loss.

Conclusions

Vapor absorption systems, and vapor compression system has been carried out on various aspects of energy analysis, the type of cycles analyzed, working pairs used and energy analysis. With regards to vapor absorption cycles, it is found that mostly the studies are carried out on large capacity systems and the investigation had been carried out with in a limited range of system design parameters. The literature on small vapor absorption systems is scant and very few studies have been done on smaller systems.

In view of the increase in the cost of energy and existing resources, the advantage of minimizing losses in the use of this energy is very important and essential. Energy analysis is a prime area for effective improvement of the systems. In the present work energy and energy analysis of the refrigeration and heat pump systems done in order to improve the system thermodynamically. The main objective of the study is to provide the green cooling techniques for rural and livelihood sector like dairy, food & vegetables preservation. Most of Indian villages are suffering with less electricity, so solar integrated refrigeration systems support to preservation of milk and food-vegetables with low cost and eco-friendly.

FUTURE SCOPE

The units of energy production can be developed in the various regions by using thermoelectric modules. In these days the society face the energy crisis but also the harmful effects of pollution . The thermoelectricity is a Green Technology" to generate electricity without any harmful effect. The educational institutions, furnace regions, metro cities, industrial areas, universities and other locations can be selected for the establishment of such energy centres where the waste heat can be easily available and can be recycled after conversion to the same system.

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