

A Review of Solar Thermal Refrigeration and Cooling by Absorption Method

Hitendra J Patel¹ Ramesh N Mevada²

¹P.G. Student ²HOD

^{1,2}Department of Mechanical Engineering

^{1,2}Smt.S R Patel Engineering College, Unjha, Gujarat, India

Abstract—Solar energy is most important technology in the world today due to its usefulness like easily accessible and available. But it is also important that, how can we use such energy for the other purposes for the benefits of the mankind. In this review paper, a work done by the various scientists, researchers and engineers among the world worked on the solar refrigeration. Now a days, due to the global warming there is an adverse effect on the environment. Hence, the solar refrigeration is a viable alternative for the reduction of the global warming and make the life happier.

Key words: Solar Thermal Refrigeration, Cooling by Absorption Method

I. INTRODUCTION

Capacity of anybody to do work is simply termed as an energy. Now it is a global problem because it has wide applications in the world. As per the law of energy conservation that, energy neither been created nor been destroyed but it generally converts its one form into the other form. But the conversion of one form into the other form is also very important phenomena due to the global warming, pollution in the environment. [1-3].

As per the world famous protocol like Kyoto protocol that, the world consuming much energy and it produces the energy very less so in future, there will be a problem in the energy as well as its conversion [4].

A. Renewable Energy

The energy which renews itself, generally it terms as a renewable energy. Now various researchers from the world now talk on the renewable energy. Because it is not polluted and it is non-conventional and easily available. Solar energy, wind energy and many other energy are the types of the renewable energy or non-conventional energy. Also such energy can produce the power and it is termed as non-conventional power. Tidal power, geothermal power and many other power sources are used by the foreign countries for the research work. Because the conventional sources of energy are depleting very fast and its conversion is also not rapid. Generally, the solar energy is very famous among all the renewable energy because it gives us electricity as well as heat. Solar photovoltaics is generally produces the electrical energy by use of solar energy and solar collector, captures the sunlight for the purpose of heat storage. Some researchers are also worked on hybrid system, in which the solar panel not only produces the electricity but the waste heat from it can be used for the purpose of heat production for the water heating or air heating. [5-9] Fig.1 shows the generation of electricity during the year 2005.

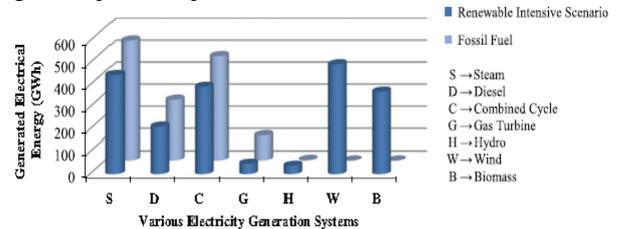


Fig. 1: Graph of generation of energy as electricity 2005 [10].

B. Solar Energy

As said earlier that, solar energy is top among all the renewable energy sources. Hence, the scientists, researchers and engineers from all around the world now working on the potentials on it. Generally, among all countries of Asia and Africa, India is only a country, which has potential of around 6 to 7 kWh/m²/day solar intensity. Hence, the India is chosen for the solar park for generation of the electricity by use of solar panels. [11]

Japan and other countries have not so much potential compared with the India but they are ahead than it. Because of the technologies available them. Germany is a only country in the entire world, who has very less sun light, but for the production of solar panel and power production from the sun is second among the all the countries. This is a reason that, now a days the people from all around the world demanding the solar panel made from the Germany.[12-13]

C. Solar Refrigeration

Solar refrigeration is a system which used the solar energy for the purpose of cooling. In the world, cooling requirement is increasing due to increment in the global warming and Greenhouse gases. Hence, it will be compulsion from all around the world that, refrigeration or air conditioning system will be the prominent in the next few years. In the Refrigeration system, the main and powerful component is known as a Compressor. It is a source that, which consumes the maximum energy from the electricity. [14].

In our Domestic refrigeration system, the tariff is also depends on the watt consumption of the compressor. It is also run by the solar panel, hence if the solar energy is used to run the compressor then it will be a good alternative, that the power required to drive the compressor is found by the sun. Hence, such technologies now available in the World.[15]. Lithium bromide and water is a system which used as an absorption refrigeration system. It has many advantages like the water is easily available, hence it is used as an absorber.[16]

D. Solar Thermal Cooling Systems

Cooling system is a system which produces the temperature lower than the atmospheric temperature. Generally if the solar energy is used for the cooling system and thermal components are used, then such system is termed as a solar

thermal cooling system. It has many advantages compared with the system used by the photovoltaic. Because such system can be used for the higher capacity and can be dismantled easily and not required skilled manpower. Hence, the research and developments on the cooling system are increasing in all around the world. Solar photovoltaic is also a proven technology but it has some shortcomings and they all are shown in Figure 2. Which shows that, it is gradually decreasing from the one end to the other end. [17-20]

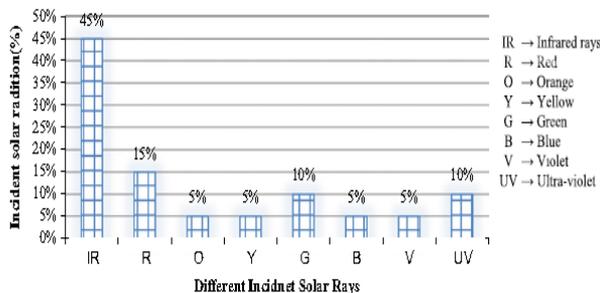


Fig. 2: Distribution of incident solar rays used in a PV system [21]

Also the effect of the incident solar rays on the photovoltaic is also considerable. Generally the solar collectors are used in the solar thermal system which provides the hot ness to the thermal storage tank. It is as shown in Fig. 3. It is clearly represented that, the hot water from the solar collector is stored in the thermal storage tank and then its latent heat is transferred to the thermal AC unit. Where its temperature is drastically reduced and it creates the cooling effect and then further it transferred to the thermal storage tank. [21-24].

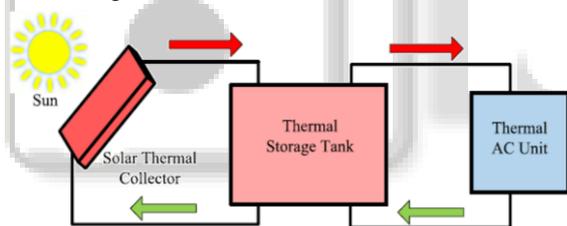


Fig. 3: Schematic diagram of potential solar thermal cooling system [22].

II. SUMMARY

Solar energy is a renewable energy and it is available freely and also nonpolluting energy. But due to its low awareness among the world, it is not used widely. Solar refrigeration system has plenty of advantages compared with the conventional refrigeration system but due its higher capital cost, it is not used.

REFERENCES

- [1] Hassan HZ, Mohamad AA, Al-Ansary HA. Development of a continuously operating solar-driven adsorption cooling system: thermodynamic analysis and parametric study. *Applied Thermal Engineering* 2012; 48:332–41.
- [2] Hassan HZ, Mohamad AA. A review on solar-powered closed physisorption cooling systems. *Renewable and Sustainable Energy Reviews* 2012; 16: 2516–38.
- [3] Afshar O, Saidur R, Hasanuzzaman M, Jameel M. A review of thermodynamics and heat transfer in solar refrigeration system. *Renewable and Sustainable Energy Reviews* 2012;16:5639–48.
- [4] Wang DC, LiYH, LiD, Xia YZ, Zhang JP. A review on adsorption refrigeration technology and adsorption deterioration in physical adsorption systems. *Renewable and Sustainable Energy Reviews* 2010; 14:344–53.
- [5] Hassan HZ, Mohamad AA. A review on solar cold production through absorption technology. *Renewable and Sustainable Energy Reviews* 2012;16: 5331–48.
- [6] Anisur MR, Mahfuz MH, Kibria MA, Saidur R, Metselaar IHSC, Mahlia TMI. Curbing global warming with phase change materials for energy storage. *Renewable and Sustainable Energy Reviews* 2013;18:23–30.
- [7] Lucas T, Raoult-Wack AL. Immersion chilling and freezing in aqueous refrigerating media: review and future trends: Réfrigération et congélation par immersion dans des milieu réfrigérants: revue et tendances futures. *International Journal of Refrigeration* 1998;21:419–29.
- [8] Balaras CA, Grossman G, Henning H-M, Infante Ferreira CA, Podesser E, Wang L, et al. Solar air conditioning in Europe—an overview. *Renewable and Sustainable Energy Reviews* 2007;11:299–314.
- [9] Abu Hamdeh NH, Al-Muhtaseb MtA. Optimization of solar adsorption refrigeration system using experimental and statistical techniques. *Energy Conversion and Management* 2010;51:1610–5.
- [10] Mirasgedis S, Diakoulaki D, Papagiannakis L, Zervos A. Impact of social costing on the competitiveness of renewable energies :the case of Crete. *Energy Policy* 2000;28:65–73.
- [11] Li ZF, Sumathy K. Technology development in the solar absorption air- conditioning systems. *Renewable and Sustainable Energy Reviews* 2000;4: 267–93.
- [12] Kalkan N, Young EA, Celiktas A. Solar thermal air conditioning technology reducing the foot print of solar thermal air conditioning. *Renewable and Sustainable Energy Reviews* 2012;16:6352–83.
- [13] Choudhury B, Chatterjee PK, Sarkar JP. Review paper on solar-powered air- conditioning through adsorption route. *Renewable and Sustainable Energy Reviews* 2010;14:2189–95.
- [14] (<http://en.cidconsulting.com/en/io/mr/mr/ei/webinfo/2012/08/1344301920241919.htm>). *International Journal of Hydrogen Energy* 2009;34:7075–80.
- [15] Koroneos C, Nanaki E, Xydias G. Solar air conditioning systems and their applicability—an exergy approach. *Resources, Conservation and Recycling* 2010;55:74–82.
- [16] Yeo THC, Tan IAW, Abdullah MO. Development of adsorption air- conditioning technology using modified activated carbon—a review. *Renewable and Sustainable Energy Reviews* 2012;16:3355–63.
- [17] Abdul-Wahab SA, Elkamel A, Al-Damkhi AM, Al-Habsi I, Al-Rubai'ey HS, Al-Battashi AK, et al. Design and experimental investigation of portable solar thermo electric refrigerator. *Renewable Energy* 2009;34:30–4.
- [18] Thirugnanasambandam M, Iniyar S, Goic R. A review of solar thermal technologies. *Renewable and Sustainable Energy Reviews* 2010;14:312–22.

- [19] Saidur R, Masjuki H, Hasanuzzaman M, Mahlia T, Tan C, Ooi J, et al. Performance investigation of a solar powered thermo electric refrigerator. *International Journal of Mechanical and Materials Engineering* 2008;3:7–16.
- [20] Solangi KH, Islam MR, Saidur R, Rahim NA, Fayaz H. A review on global solar energy policy. *Renewable and Sustainable Energy Reviews* 2011;15:2149–63.
- [21] Otanicar T, Taylor RA, Phelan PE. Prospects for solar cooling—an economic and environmental assessment. *Solar Energy* 2012;86:1287–99.
- [22] Otanicar T., Taylor R.A. , Phelan P.E. Prospects for solar cooling—an economic and environmental assessment. *Solar Energy* 2012.
- [23] Chidambaram LA, Ramana AS, Kamaraj G, Velraj R. Review of solar cooling methods and thermal storage options. *Renewable and Sustainable Energy Reviews* 2011;15:3220–8.
- [24] Hassan H, Mohamad A. A review on solar cold production through absorption technology. *Renewable and Sustainable Energy Reviews* 2012;16:5331–48.

