A Review Paper On Solar Energy Opearted Vapour Absorption System Using Libr-H_2o

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ABSTRACT: In present world fossil fuel reserve of the world is continuously decreasing & use of non-conventional energy resources is gaining high importance. Solar energy is considered best nonconventional energy available free. Also the time of the day when the heat energy is maximum of the solar energy the utilisation of solar energy in air-conditioning will be more effective. Ozone layer depletion potential (ODP) is considered a very high threat to the environment. Under these circumstances ODP of solar driven vapour absorption system is zero.This gives us tremendous environmental benefits vis a vis refrigerants. Also global warming & Carbon dioxide emission are producing very big environmental hazards.Using solar energy instead of fossil fuels in case of vapour absorption system provides with big environmental benefits in terms of the above mentioned effects Looking at the advantages of solar driven vapour absorption system(VAS) in modern day environment ,we are motivated to work towards the system because a large part of solar driven VAS remains unexplored which has tremendous potential in the future of Refrigeration & Air-conditioning.

Key Words :ODP(Ozone Depletion Potential),GWP(Global Warming Potential),VAS(Vapour Absorption System)

INTRODUCTION

A thorough literature review has been done from many international papers .CFC & HCFC gases used as refrigerant in conventional vapour compression cycle of air-conditioning system not only have high global warming potential (GWP) but also high Ozone Depletion Potential (ODP).These effects can be remedied by using environment friendly air conditioning system likeH^2O-LiBr or NH3-H2O vapour absorption refrigeration system.

To define the environmental impacts of GWP and ODP ,we are providing the information on effects on the environment as follows.

CFC (ChloroflouroCarbon gases react with ozone (O_3) in the higher level of atmosphere and produce Oxygen(O_2) as by product . The reaction is given below:

CCl_2F_2(R-12) =$CClF_2$+Cl

Cl + O_3=ClO + O_2

Ozone layer works as protective shield for ultraviolet rays of the sun. This Ozone layer(O_3) disintegrates to O_2 and thus protective shield from ultraviolet rays are removed. Ultraviolet rays enter the earth and produces tremendous health hazard like skin cancer etc.For that reason it has become essential to remove CFC Refrigerants from use in Refrigeration & Air-conditioning Industry.Solar operated vapour absorption system with H_2O-LiBr & NH_3-H_2O as refrigerant-absorbent solutions serves that purpose very well.

Another important effect is Global Warming Potential (GWP).CO & CO_2 emitted from thermal power plants (which generate electricity produces a blanket like layer over the earth environment, thus producing global warming from reflected sunlight from CO/CO_2 layers. To reduce CO_2/CO production we are to cut down the capacity of thermal power plants. Vapour absorption system uses very less amount of electricity (for pumps only) thus decreasing GWP to a large extent.

Also energy consumption for the industry,agriculture,commerce & residence in many countries has been increasing recently has been increasing recently which leads to the increase in demand of alternative energy. Fossil fuels like oil and liquefied petroleum gas are commonly used today. Both kinds of fuel are required to generate power for equipment & machines. At current consumption rate fossil fuels will be exhausted within 50 years. Therefore alteration or renewable energy like solar energy is of great interest to scientists' world over to replace the conventional energy. Solar operated vapour absorption systems provide with very good alternative opportunity in that aspect.

SOLAR OPEARATED ABSORPTION CHILLER FOR AIRCONDITIONING SYSTEM- A SUMMARY OF LITERATURE REVIEW

A new concept of vapour absorption system with compressor has been introduced. Compressor compresses air which is used to heat the generator thus increasing COP of the system. Also now a days double glazed glass collector is being used..The performance is high & cost is lesser than evacuated tube solar collectors. The double glasses pass the incident radiation but restrict reflected heat to pass through it thus producing green house effect. Also the collector absorbs heat and transfers the same to generator. More the generator heat higher is the absorption system cooling effect.

Absorption system uses various refrigerants out of which H_2O-LiBr or NH_3-H_2O combination are generally used.H_2O-LiBr combination works at temperature above 5 ^{0}C because of probability of water freezing at low temperature. NH_3-

H_2O system can be widely used in low temperature applications since freezing point of NH_3 is -77^0C.

Parabolic Trough Collector (PTC) is now a days is finding increasing use as solar collectors. The only thing is tracking of the collector needs to be done throughout the day.

Use of NH_3-H_2O system is found to be (8-10) times costlier than the conventional refrigeration system. Thinking about the future prospect of NH_3-H_2O solar driven vapour absorption system. Government policies should be made providing high subsidy for solar energy driven applications.

Environment plays an important role in terms of clearness index. The places where pollution is high , the clearness index is also high. A reduction of clearness index increases solar energy input which subsequently increases the COP of solar operated Vapour Absorption System. The energy crisis and environment pollutions are two problems we are facing .About 30% of total energy are consumed by buildings. This value will be higher in future with development of global economy & increasing living standards. Two major advantages of solar energy are (i) Availability of solar collectors in the market (ii) Problems in CFC refrigerants use because of environmental hassles. However compared with vapour absorption system, solar cooling has some disadvantages like low system efficiency (COP=0.6). A comparative study of energy consumption shows that by 2050, solar energy installations will supply around 45% energy demand in the world. Currently conventional energy sources constitute around 80 % of global energy consumption. .Due to rapid growth in conventional fuel prices and environmental constraints industries are not attracted to use fossil fuels anymore . By applying renewable energy in the industries green house effect can be reduced. The peak demand in solar air-conditioning is happening when the solar radiation is high. Thus they complement each other.

GAPS IDENTIFIED FROM LITERATURE REVIEW

It has been noticed through various papers that maximum of experiments regarding solar absorption driven vapour absorption system are LiBr-H_2O with LiBr (absorbent) and H_2O (refrigerant).The main feature of the system is that H2O being the refrigerant it cannot work below 5^0C because there is chance of water being frozen. So this system can be applied for comfort air-conditioning system where temperature requirement for water as secondary refrigerant is above 6^0C.

But several areas of LiBr-H_2O system remain unexplored. It has been found that the areas requiring attention are changing the vital parameters of the system & observing Coefficient of Performance (COP) of the system. The following methodology shall be followed :

(1) Increasing evaporator temperature/pressure & measuring COP of the system.

(2) Decreasing evaporator temperature/pressure &measuring COP of the system.

(3) Increasing condenser temperature/pressure & measuring COP of the system

(4) Decreasing condenser temperature/pressure & measuring COP of the system

(5) Comparing COP season wise i,e summer & monsoon

CONCLUSION

Considering the impact of Ozone Depletion Potential(ODP) & Global Warming Potential (GWP) solar driven vapour absorption system shows a very prospective alternative in refrigeration system. Solar energy is available free & environment friendly. The next decade is going to be very important for use of solar energy. The disadvantage of solar energy driven refrigeration is low system efficiency (COP) and cost is higher as compared to conventional energy system. For that reason proper government policies and increased subsidies are required for renewable energy sources. Also solar energy intensity is high in northern part of India. That gives it the tremendous future potential as environment friendly energy source.

REFERENCES

[1] Francis Agyenim, Ian Knight, Michael Rhodes," Design and Experimental Testing of the performance of an outdoor LiBr/H_2O solar thermal absorption cooling system with a cold store" Solar Energy, Vol.84(2010),pp 735-744

[2] Guangmin Chen and Eiji Hihara," A new absorption refrigeration cycle "Solar Energy, Vol.66 (1999),pp479-482

[3] Olivier Marc, Jean-Philippe Praene, Alain Bastide and Franck Lucas," Modeling and experimental validation of the solar loop for absorption solar cooling system using double-glazed collectors" Applied Thermal Engineering, Vol.31(2011),pp 268-277

[4] N. Hartmann, C. Glueck, F.P. Schmidt "Solar cooling for small office buildings : Comparison of solar thermal and photovoltaic options for two different European climates" Renewable Energy,Vol.36(2011),pp 1329-1338

[5] N. Molero-Villar, J.M. Cejudo-Lopez, F. Dominguez-Munoz and A. Carrillo-Andrez "A comparison of solar absorption system configurations "Solar Energy,Vol.86 [2012],pp 242-252

[6] M.I. Karamangil, S. Coskun, O. Kaynakli, N. Yamankaradeniz," A simulation study of performance evaluation of single-stage absorption refrigeration system using conventional working fluids and alternatives" Renewable and Sustainable Energy Reviews,Vol.14(2010),pp 1969-1978

[7] M.Mazloumi, M. Naghashzadegan, K. Javaherdeh," Simulation of solar lithium bromide-water

absorption cooling system" Energy Conversion and Management,Vol.49 (2008),pp2820-2832

[8] G.A .Florides, S.A. Kalogirou, S.A. Tassou and L.C. Wrobel," Modelling and simulation of an absorption solar cooling system for Cyprus "Solar Energy,Vol.72(2002),pp 43-51

[9] S.O. Enibe," Solar refrigeration for rural applications "Renewable Energy, Vol.12(1997),pp 157-167

[10] L.A. Chidambaram, A.S. Ramana, G. Kamaraj, R. Velraj," Review of solar cooling methods and thermal options "Renewable and Sustainable Energy Reviews, Vol. 15 (2011), pp 3220-3228

[11] M. Izquierdo, R. Lizarte, J.D. Marcos, G. Gutierrez," Airconditioning using an aircooled single effect lithium bromide absorption chiller:results of a trial conducted in Madrid in August 2005" Applied Thermal Engineering,Vol.28(2008),pp 1074-1081

[12] M.M. Ardehali, M. Shahrestani, Charles C. Adams "Energy simulation of solar assisted absorption system and examination of clearness index effects on auxiliary heating" Energy Conversion and Management"Vol.48(2007),pp864-870

[13] Andre Aleixo Manzela, Sergio Morais Hanriot, Luben Cabezas-Gomez, Jose Ricardo Sodre "Using engine exhaust gas as energy source for an absorption refrigeration system "Applied Energy, Vol.87(2010),pp 1141-1148

[14] Z.F. Li, K. Sumathy "A computational study on the performance of a solar airconditioning system with a partitioned storage tank" Energy,Vol.28 (2003),pp1683-1686

[15] K. Sumathy, Z.C. Huang, Z.F. Li "Solar absorption cooling with low grade heat source-A strategy of development in South China" Solar Energy,Vol.72(2002), pp 155-165

[16] Xavier Garcia Casals "Solar absorption cooling in Spain : Perspectives & outcomes from the simulation of recent installations" Renewable Energy, Vol. 31(2006), pp 1371-1389

[17] R. Lizarte, M. Izquierdo, J.D. Marcos, E.Palacios "An innovative solar driven directly aircooled LiBr-H_2O absorption chiller prototype for residential use "Energy and Buildings,Vol.47(2012),pp 1-11

[18] Y.L. Yin, Z.P. Song, Y. LI, R.Z. Wang, X.Q. Zhai "Experimental investigation of a mini type solar absorption cooling system under different cooling modes" Energy and Buildings,Vol.47(2012),pp 131-138

[19] Tawatchai Jaruwongwittaya, Guangming Chen "A review : renewable energy with absorption chillers in Thailand "Renewable and Sustainable Energy Reviews , Vol.14(2010),pp 1437-1444

[20] S.B. Riffat, Guoquan Qiu "Comparative investigation of vapour compression and vapour absorption airconditioners" Applied Thermal Engineering, Vol. 24 (2004),pp 1979-1993

[21] S. Mekhilef, R. Saidur, A. Safari "A review on solar energy use in industries" Renewable and Sustainable Energy Reviews , Vol.15 (2011),pp 1777-1790

[22] A.M. Papadopoulos, S. Oxizidis, N. Kyriakis "Perspectives of solar cooling in view of the developments in the airconditioning sector "Renewable & Sustainable Energy Reviews, Vol.7 (2003),pp 419-438

[23] Jose Fernandez- Seara, Francisco J. Uhia, Jaime Sieres "Analysis of an aircooled NH_3-H_2O vertical tubular absorber" International Journal of Thermal Sciences, Vol.46 (2007),pp 93-103

[24] V. Muthu, R. Saravanan, S. Renganarayanan "Experimental studies on R134a-DMAC hot water based vapour absorption refrigeration systems" International Journal of Thermal Sciences , Vol.47(2008), pp 175-181

[25] Ben Richard Hughes, Hassam Nasarulah Chaudhry and Saud Abdul Ghani "A review of sustainable cooling technologies in buildings " Renewable and Sustainable Cooling Technologies in Buildings, Vol.15(2011),pp 3112-3120

[26] G.A. Florides, S.A. Tassou, S.A. Kalogirou and L.C. Wrobel "Review of solar and low energy cooling technologies for buildings "Renewable and Sustainable Energy Reviews, Vol. 6 (2002),pp 557-572

[27] M. Venegas, M.C. Rodriguez-Hidalgo, R. Salgado, A. Lecuona , P. Rodriguez, G. Guttierrez "Experimental diagnosis of the influence of operational variables on the performance of a solar absorption cooling system" Applied Energy , Vol.88 (2011), pp 1447-1454

[28] R.Z. Wang, T.S. Ge, C.J. Chen, Q. Ma, Z.Q. Xxiong "Solar absorption cooling systems for residential applications: options & guidelines" International Journal of Refrigeration, Vol.32 (2009),pp 638-660

[29] M. Ortiz, H. Barsun, H. He, P. Vorobieff, A. Mammoli "Modelling of a solar assisted HVAC system with thermal storage" Energy and Buildings, Vol.42(2010), pp 500-509

[30] Hongxia Xi, Lingai Luo, Gilles Fraisse "Development and applications of solar-based thermoelectric technologies" Renewable and Sustainable Energy Reviews, Vol. 11 (2007), pp 923-936