Major project report

PERFORMANCE EVALUATION AND ANALYSIS OF ACTUAL SOLAR POWERED 100kW TRIPLE EFFECT VAPOUR ABSORPTION AIR CONDITIONING PLANT

Submitted on partial fulfilment for award of

Master of Technology

In

Thermal Engineering

By

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(2k13/THE/12)

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Certificate

This is to certify that the major project report entitled **"Performance evaluation and analysis of actual Solar powered 100kW triple effect vapor absorption Air Conditioning plant"** submitted by Imran Khan (Roll No. 2K13/THE/12) for the partial fulfillment for the award of the Degree of Masters of Technology in Thermal Engineering of Delhi Technological University. It is an authentic record of student's own work carried out by him under our guidance and supervision.

This is also certified that this dissertation has not been submitted to any other Institute/University for the award of any degree or diploma.

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Declaration

To the best of my knowledge I do hereby declare that this thesis is my own work. It has not been submitted in any form of another degree or diploma to any other university or other institution of education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Place: Delhi, India

Date: 25^{th} July, 2015

Name: Imran Khan

Signature:

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Dedicated to my father

Mr Abbas khan

Beloved teacher of physics

Who invested his whole life in educating his three children

This is for you papa

Abstract

Performance evaluation of an Air-Conditioning plant which is running for the last four and half year is presented in this thesis. This plant is actually a demonstration project installed by Thermax and Ministry of New and Renewable Energy at National Institute of Solar Energy for research purpose. Triple effect vapor absorption chiller is utilized to produce cooling and the input heat is provided by solar energy with the help of parabolic trough collector .Apart from understanding its complex design and working, energy and exergy analysis is done on vapor absorption chiller. Also optical and thermal analysis is carried out on parabolic trough collector. Both are being done separately. Mathematical modelling of vapor absorption chiller and parabolic trough collector is done for formulating the required relations for evaluation. Mass, concentration, energy and exergy balance equations of chiller are clearly presented. For parabolic trough collector, a general equation for obtaining efficiency is also proposed. The results of analysis of chiller shows that the two heat exchangers, (HX I) and (HX II) are the biggest source of exergy destruction, destroying 16.40 % and 8.60 % of exergy respectively. Deviating from the previous published results in literature, absorber is not the component where maximum exergy is destroyed. The components that need to be optimized are the three generators. The COP is also calculated from energy balance and it comes out to be 1.27. Exergetic efficiency of chiller obtained is 9.2 %.Optical study of parabolic trough collector reveals that the optical efficiency is 58 % but the incidence losses are not considered. Results from thermal analysis are presented in tabular form and various graphs have been drawn to discuss the results obtained and research findings. Future scope for further study on this plant or other is also discussed.

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List of Abbreviations

MoEF	Ministry of Environment & Forests
COP	Coefficient of performance
CFC	Chloroflouro carbons
DCC	Double condenser coupled
PTC	Parabolic trough collectors
NISE	National institute of solar energy
MNRE	Ministry of New and renewable Energy
SRRA	Solar radiation resource assessment
LFR	Linear Fresnel reflectors
CSP	Concentrated solar power
HTF	Heat transfer fluid
EES	Engineering equation solver
TRANSYS	Transient simulation
PLC	Programmable logic Controller
HTG	High temperature generator
MTG	Medium temperature generator
LTG	Low temperature generator
HX	Heat exchanger
VAM	Vapor absorption machine
CPU	Central processing unit
PR I,II,III	Pressure relieve valve 1,2,3
EV I,II,III	Expansion valve 1,2,3
DNI	Direct normal irradiance
IAM	Incident angle modifier

Symbols

$\dot{m}$	=	mass flow rate in kg/sec
ψ	=	flow exergy in kJ/kg
θ	=	incidence angle in degree
η_{exergy}	=	exergetic efficiency
$\eta_{thermal}$	=	thermal efficiency
$\dot{w}$	=	rate of work done
h	=	specific enthalpy in kJ/kg
s	=	specific entropy in kJ/kg-k
Q_{eva}	=	heat energy transferred by evaporator
Q_g	=	heat energy supplied by HTG
χ	=	concentration of LiBr in solution by weight
$K(\theta)$	=	Incident angle modifier factor
η_o	=	Optical efficiency
$\eta_{o,peak}$	=	peak optical efficiency
T_m	=	mean temperature
A_c	=	aperture area in m^2
T_{eva}	=	temperature of evaporator
T_g	=	temperature of HTG
T_o	=	ambient temperature
h_o	=	enthalpy at environment condition
s_o	=	entropy at environment condition
$\cos\theta$	=	cosine loss factor