

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**

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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 Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.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

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## Acknowledgement

I express my deepest appreciation to Dr J P Kesari, Associate Professor DTU and principal advisor for this dissertation. Prof. Kesari not only provided essential guidance through my graduate study, but also shared me with his vision for solar energy industry development. His passion, enthusiasm, inspiration and wisdom will always encourage and lead me for my future career.

Let me express my sincere gratitude to Er S K Singh ,Director and Scientist 'F', my advisor at National Institute of Solar Energy, Ministry of New and Renewable Energy, Government of India, who provided the technical guidance to the success of this thesis. Er S K Singh dedicated himself in helping me form the hypotheses, establish the methodology and solve the technical issues. His rigorous research methods of thinking and effective ways of communication have substantially improved the research outputs.

The same profound appreciations extend to my professors and colleagues at Department of Mechanical Engineering, Delhi Technological University, who worked closely with me and established the foundation work.

My special thanks go to Mrs Anju Singh, Senior research scientist at NISE, for providing the valuable suggestions and technical help. Her thoughts and knowledge in vapour absorption chiller operation inspired me a lot.

A big thank is due for my good friend Yadvinder Singh, Research Scholar, Simon Fraser University, Canada for providing valuable inputs and suggestions throughout my research.

It is my pleasure to thank my colleagues from National Institute of Solar Energy for exciting group discussions on solar energy and constant motivation in cruncher time. Special mention to Mr Promod, technical assistant, Solar Air Conditioning Laboratory for providing everything I needed during this work.

Finally, the deepest love and appreciation goes to my parents, Abbas Khan and Gulshan, for their encouragements, care and patience and my lovely wife, shahnaz, who gave me unconditional support and took the responsibility of caring our cute little son, Ayaan, who fills us with joy every day. I would also like to thank my sisters, Musarrat who is my source of inspiration, Nazma and her husband Zahid who kept motivating me throughout the work and also helped me out in arranging references.

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
$\psi$	=	flow exergy in kJ/kg
$\theta$	=	incidence angle in degree
$\eta_{\text{exergy}}$	=	exergetic efficiency
$\eta_{\text{thermal}}$	=	thermal efficiency
$\dot{w}$	=	rate of work done
$h$	=	specific enthalpy in kJ/kg
$s$	=	specific entropy in kJ/kg-k
$Q_{\text{eva}}$	=	heat energy transferred by evaporator
$Q_{\text{g}}$	=	heat energy supplied by HTG
$x$	=	concentration of LiBr in solution by weight
$K(\theta)$	=	Incident angle modifier factor
$\eta_{\text{o}}$	=	Optical efficiency
$\eta_{\text{o,peak}}$	=	peak optical efficiency
$T_{\text{m}}$	=	mean temperature
$A_{\text{c}}$	=	aperture area in m <sup>2</sup>
$T_{\text{eva}}$	=	temperature of evaporator
$T_{\text{g}}$	=	temperature of HTG
$T_{\text{o}}$	=	ambient temperature
$h_{\text{o}}$	=	enthalpy at environment condition
$s_{\text{o}}$	=	entropy at environment condition
$\cos\theta$	=	cosine loss factor