

A DISSERTATION ON
EXERGY ANALYSIS OF COMBINED CYCLE POWER PLANT

Submitted in partial fulfilment of the requirement
For the award of the degree of

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In
Thermal Engineering

Submitted By

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CERTIFICATE

It is certified that Mahendra Kumar Pandey, Roll No. 2K12/THR/13, student of M.Tech. Mechanical Engineering, Delhi Technological University, has submitted the dissertation titled “**Exergy Analysis of combined cycle power plant**” under our guidance towards the partial fulfillment of the requirements for the award of the degree of Master of Technology.

He has developed a mathematical computational model for performing the energy and exergy analysis of the combined cycle using EES software. His work is found to be satisfactory and his discipline impeccable during the course of the project. His enthusiasm, attitude, towards the project is appreciated.

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CANDIDATE'S DECLARATION

I hereby declare that the work which is being presented in this project report entitled “**EXERGY ANALYSIS OF COMBINED CYCLE POWER PLANT**” submitted as major project towards the fulfilment of the requirements for the award of the degree of Master of Technology with specialization in Thermal Engineering, D.T.U. Delhi, is an authentic record of my own work carried out under the supervision of *Prof. R. S. Mishra and Dr. Rajesh Kumar* Mechanical Engineering Department, at Delhi technological university, Delhi.

The matter embodied in this dissertation report has not been submitted by me for the award of any other degree.

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Generally, individuals set aims but more often than not, their conquest are by the efforts of not just one but many determined people. This complete project could be accomplished because of contribution of a number of people. I take it as a privilege to appreciate and acknowledge the efforts of all those who have, directly or indirectly, helped me achieving my aim.

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ABSTRACT

The performance of Thermal power plant is evaluated by the exergetic performance criteria, which is basically based on the second law of thermodynamics including thermal Efficiency. The real useful energy loss cannot be determined by the first law of thermodynamic, because it does not differentiate between the quality and quantity of energy. In this analysis major losses occurs in combustor and exergy destruction is also shown in various parts of the power plant. There are two important criteria in the exergy analysis: Exergetic efficiency and exergy destruction. An important application of exergetic efficiency is the assessment of thermodynamic performance of component or system relative to the performance of a similar one. The results show that the greatest exergy loss in the gas turbine occurs in the combustion chamber due to its high irreversibility. As the second major exergy loss is in HRSG, the optimization of HRSG has an important role in reducing the exergy loss of total combined cycle. The results show that the combustion chamber, gas turbine and heat recovery steam generator (HRSG) are the main sources of irreversibility. The results show that the greatest exergy loss in the gas turbine occurs in the combustion chamber due to its high irreversibility. The exergy losses in different vital components of power plants have been observed and a relative possible improvement in the components has been observed. The improvement in these components provides a wide space of improvement for researchers and academicians in the power plant.

TABLE OF CONTENTS

CONTENTS	PAGE NO
TITLE PAGE	I
CERTIFICATE	II
DECLARATION	III
ACKNOWLEDGEMENT	IV
ABSTRACT	V
TABLE OF CONTENTS	VI
LIST OF TABLES	VIII
LIST OF FIGURES	IX
LIST OF SYMBOLS	X
CHAPTER 1. INTRODUCTION	1-7
1.1 Overview	
1.2 Power Plant	
1.3 Classification of Power Plants	
1.4 Current Scenario of Power Plants in India	
1.5 Future, Power Generation in India	
1.6 Basics of Exergy Analysis	
1.7 Exergy Analysis	
CHAPTER 2. LITERATURE REVIEW	7-13
2.1 Research Gap	
2.2 Objective of Present Work	

CHAPTER 3.METHODOLOGY	14-18
3.1 Combined cycle systems	
3.2 T-S Diagram for Combined Power Plant Cycle	
3.3 Exergy analysis	
CHAPTER 4.RESULT AND DISCUSSION	19-40
CHAPTER 5.CONCLUSSION	41-42
5.1 Validation	
5.2 Further Scope of Research	
REFERENCES	43-44

LIST OF FIGURES

Figure Number	Figure Title	Page Number
1.1	Classification of Power Plants.	3
3.1	Combined cycle process.	14
3.2	T-S diagram of combined cycle.	15
4.1	Exergy destruction in various component	21
4.2	Exergy loss (combustor and compressor) v/s ambient temp	28
4.3	Exergy loss (exhaust and HRSG) v/s ambient temp	29
4.4	Exergy loss (steam turbine and gas turbine) v/s ambient temp	29
4.5	Exergetic efficiency v/s ambient temp	30
4.6	Exergetic efficiency v/s pressure ratio	30
4.7	Efficiency(gas plant) v/s Pressure ratio	31
4.8	Exergy loss in Gas turbine and power output (GT) v/s pressure ratio	32
4.9	Exergetic loss in combustor and compressor v/s pressure ratio	32
4.10	Exergy loss(exhaust gases) v/s pressure ratio	33
4.11	Exergy loss(combustor) v/s pressure drop	34
4.12	Exergy loss(GT) v/s pressure drop	34
4.13	Exergetic efficiency and gas plant efficiency v/s pressure drop	35
4.14	Exergetic efficiency v/s Condenser pressure	36
4.15	Exergetic efficiency(SP) v/s condenser pressure	36
4.16	Overall efficiency(plant) v/s condenser pressure	37
4.17	Exergetic efficiency v/s boiler pressure	38
4.18	Overall efficiency v/s boiler pressure	38

4.19	Energy dissipation in combustor and compressor v/s condenser pressure	39
4.20	Energy dissipation in combustor and compressor v/s boiler pressure	39
4.21	Energy dissipation in GT and ST v/s boiler pressure	40

LIST OF SYMBOLS

C_p	Specific heat
ST	Steam turbine
GT	Gas turbine
i	Rate of exergy loss
\dot{Q}	Rate of heat transfer (kW)
\dot{W}	Work rate (kW)
$\dot{E}D$	Exergy destruction rate (kW)
\dot{X}	Exergy rate (kW)
\dot{X}^Q	Rate of thermal exergy flow rate (kW)
\dot{m}_r	Mass flow rate of refrigerant (kg/s)
T	Temperature (K)
s	Specific entropy (kJ/kg-K)
h	Specific enthalpy (kJ/kg)
comp	Compressor
comb	Combustor
HRSG	Heat recovery steam generator
Exh	Exhaust