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Thermo Economic Analysis for Optimize Air Conditioning System

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Abstract

Thermal system cannot always be optimized by means of mathematical or numerical techniques, because a complete model of the plant is not always available; and in case mathematical difficulties are often great, even for particularly complex system and the help of computerized algorithms is needed.

The purpose of thermo economic optimizations is to achieve, within a given system structure, a balance between expenditure on capital cost and energy costs, which will give the minimum cost of the plant product.

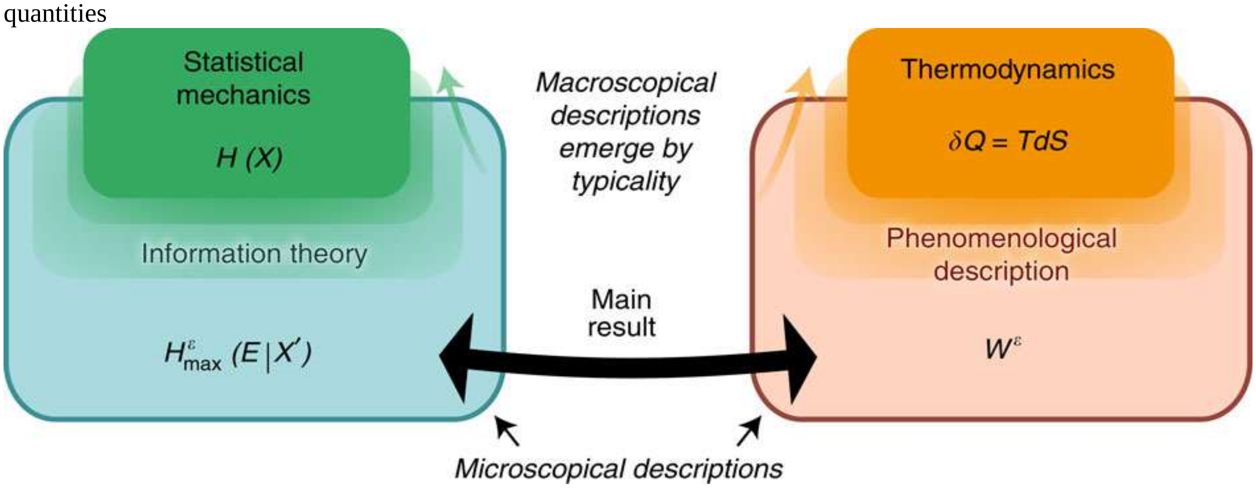
In this paper, an attempt has been made to optimize an Air conditioning system (vapor compression refrigeration cycle) with the help of thermo economic analysis.

Keywords: Air Conditioning system, Exergy, Refrigeration Cycle

INTRODUCTION

Refrigeration and Air Conditioning can be achieved by processes such as vapor compression, Vapor absorption, water/air refrigeration, thermoelectric refrigeration, steam jet refrigeration etc., but the most widely used process is the vapor compression. No one system will economically fulfill the requirements of all applications.

The system is described in relation to the physical and economic environment. These two environments are interrelated by cost relations for physical quantities



LITERATURE REVIEW

Some of the important paper related to analysis of optimize an air conditioning system with the help of thermo economic have been reviewed and discuss here.

Author of [1] includes cost of equipment, source, quantity and cost of power (steam, gas, Oil, electricity), source purity, quantity and temperature of water or air available for condensing purposes, Space available for system components, safety requirement, service and maintenance problems and usage of load factor.

In paper [2] maximum cost is set for each part of the system and the market prices determine to what extent an efficient component and the afforded. Such system always cost at least, as much as and after more than they would if thermodynamic optimization were used.

Satsaronis et al. [3] energy economic (thermodynamics) a relatively new field of thermal science, combines a details

exergy (II Law) analysis with appropriate cost balance to study and optimize the performance of energy system from the cost point of view. The analysis and balance are usually formulated for single component of the system.
EI sayed et al. [4] developed the concept of thermodynamics, in which the objective functions optimized, subject to given economic and technical constraints. The purpose of thermodynamic is improve analysis of the system by introducing ways of concurrently suggestion improvements.
Tribes, evens [5] and their co- workers proposed the autofocus thermo economic optimization of system components by using unit cost of exergy flues entering and leaving the components, under consideration.
In the paper [6] the structure method of thermodynamic optimization method of thermo economic optimization, basis on the concept introduced by buyer is applied on an air conditioning system, in order to minimize its total annual cost for plant operation.
Author from [7] focused on extensive work has been done on the optimization related to refrigeration and air Conditioning systems.
According to Author [8] various work the optimization of a refrigeration plant is based on the criteria for minimum losses of exergy.
Paper [9] analyze the most reasonable criterion for optimization is economical and it may be expressed as a minimum of the so called total.

Assumption made in the analysis

For the purpose of analysis of the system the following assumption are made,

- The system is in steady state.
- Refrigerant at the condenser exit and the evaporate exit are in saturated states.
- The reference environmental state for the system is
- $T_0 = 35^\circ$
  $P_0 = 1bar$
- Exergy input to the plant should be of invariable quality.
- Pressure losses in the pipelines are negligible.

RESULT AND DISCUSSION

In this paper structural method of thermo economic optimization technique is used to optimize a vapor compression air conditioning plant of 40 ton capacity using R22 as the refrigerant. Our objective is to minimize overall annual cost for plant operation (capital and running) with respect to the no. of design parameters. They are the electromechanical efficiency of electric motor, the isentropic efficiency of the compressor, the thermal effectiveness of the condenser, the thermal effectiveness of the evaporator. The purpose of this optimization is to determine, for a selected component (system element) the capital cost corresponding to the minimum annual operating cost of the plant for a given plant output.

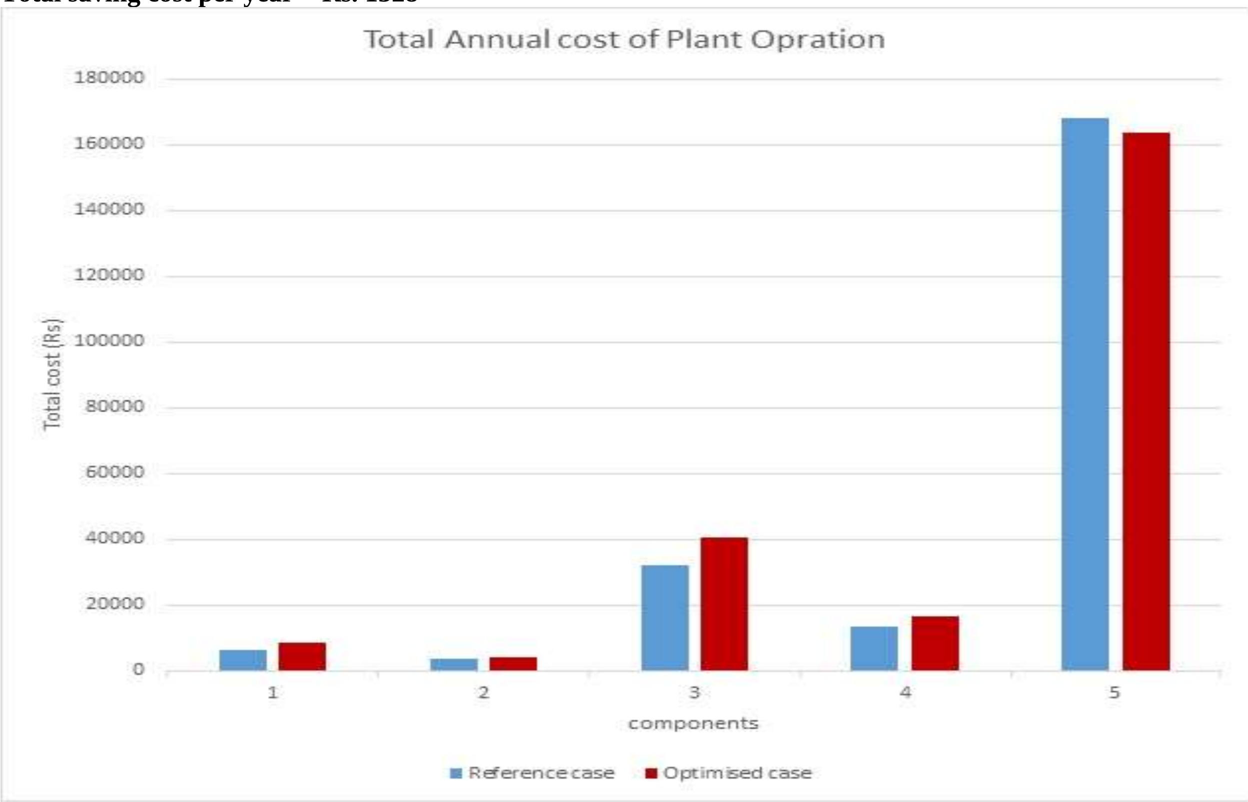
Total capital cost of various components of air conditioning plants reference and optimizing case

Component	**Capital cost for reference case(Rs.)**	**Capital cost for optimized case(Rs.)**
Electric motor	**6418**	**8486**
Compressor	**3774**	**4273**
Condenser	**32210**	**40566**
Evaporator	**13376**	**16593**

Total annual cost of plant operation both for reference and optimize case

Case	Electric cost (Rs. Per Year)	Total capital costs of all components (Rs. Per Year)	Total operational cost of the system (Rs. Per Year)
Reference case	168041	10954	178996
Optimised case	163942	13733	177669

Total saving cost per year = Rs. 1328



1.Electric motor 2. compressor 3.condenser 4.Evaporator 5. Electricity cost per year

CONCLUSIONS

The structural method of thermo economic optimization is a very powerful tool for the optimization in process plants. The methodology is a simple, with no great loss of accuracy in comparison with conventional and most sophisticated procedures.

Allowing the analyst to achieve a better knowledge of the cost formation process through the units which make up the plant. Even then one must pay attention to the following factors to use this method of optimization:

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