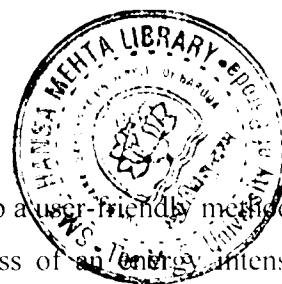


## ABSTRACT



The objective of the present research work is to develop a user-friendly method of exergoeconomic optimization to predict the cost effectiveness of an energy intensive thermal system such as Aqua Ammonia Vapour Absorption Refrigeration (AAVAR) system and suggest ways of improving the cost effectiveness from both thermodynamic and economic points of view.

In recent years, the exergy analysis (Second law analysis) is getting more popularity in analyzing thermal systems, as it provides information about the losses qualitatively as well as quantitatively along with their location. Exergetic optimization improves the performance of thermal system through increasing the exergetic efficiency. This improvement, however, is accompanied by an increase in capital investment of the system. Hence, thermal systems should be optimized from both thermodynamic and economic points of view. In this regard, exergoeconomic optimization is a better tool as it combines the thermodynamic analysis with the economic principles. Here, appropriate costs are assigned to the thermodynamic inefficiencies of the system components through meaningful Fuel-Product-Loss definition and also estimates the parameters like the exergy destruction and the exergy loss which add to the hidden cost. For maximum exergoeconomic efficiencies, these costs are to be minimized. Therefore, it is necessary to correlate the exergy with cost value. It can be carried out through exergoeconomic analysis.

The exergoeconomic analysis improves the performance of the thermal system which is associated with the increase in investment and operation & maintenance cost. Thus the cost optimization problem involves the maximization of thermodynamic performance and minimization of investment cost. These are the contradictory disciplines. The exergoeconomic concept combines them together and develops effective tool for design the thermal system with higher efficiency and lower cost.

The literature survey has also identified a number of exergoeconomic optimization models. However, most of them are either complex to translate or incomplete in their availability in open literature. Thermoeconomic Evaluation and Optimization (TEO) method suggested by Tsatsaronis and his associates is a user friendly

method which needed some alterations to suite to the optimization of a given thermal system.

The exhaustive literature survey on exergoeconomic optimization of various thermal systems reveals that the researchers have shown little interest towards AAVAR system. The probable reason behind this may be the less popularity of AAVAR system compared to vapour compression refrigeration system. Moreover, they are less capital intensive compared to other thermal intensive systems like power plants. However, AAVAR system used in huge chemical industries needs greater attention as slight modification in the system parameters brings substantial savings in energy and production cost. Considering this important observation, the present research work on the optimization of an industrial brine chilling unit using AAVAR system is undertaken.

The system considered in the present research work is a single effect AAVAR system with a cooling capacity of 800 TR located at a large fertilizer industry at Bharuch, Gujarat. The existing system uses steam as heat source generated in the independent boiler. This AAVAR system is exergoeconomically optimized to reduce the product cost through Exergoeconomic Evaluation and Optimization method. The method follows iterative procedure based on the local optimization of the sub systems. Being iterative in nature, the method requires engineering judgments and critical evaluations in each iterative step to take decisions on the change of decision variables.

The fertilizer industry is having gas turbine power plant with a capacity of 8 MW. The waste heat of exhaust gas is utilized in HRSG to generate steam thus forming a GT-HRSG plant. The steam thus generated is subsequently utilized in chemical process. The AAVAR system is simulated in combination with gas turbine power plant considering steam generated at HRSG as heat source for AAVAR system instead of the steam from independent boiler. This first option of the combining the steam generated at HRSG of GT-HRSG plant system with AAVAR is optimized exergoeconomically. Considerable reduction in the cooling cost of AAVAR system is observed with this option.

The major electricity demand of the Fertilizer plant is met by the captive steam turbine power plant of 50 MW capacity located in the plant premises. The thermodynamic cycle of the steam turbine power plant is Regenerative Rankine Cycle. The tapped steam from the steam turbine is considered as a heat source option for

AAVAR system. This second option of combining steam generated from the captive steam power plant with AAVAR is optimized exergoeconomically. It is found that the cooling cost of AAVAR system is further reduced by about 50%.