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Vapour Absorption Machine Run By Solar Thermal Plant Solar Energy Project In India & Absorption Systems

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ABSTRACT– Solar thermal as source have two work system,the power generation cycle and refrigeration cycle.
System contain two generators with current dual effect VAR system & they work only power/only cooling/both power and cooling.
They contain absorber & have to streams two in no. i.e. one flows to the first generator and heats by solar thermal heat, then patch in turbine.
These inlet turbine the maximum vapour aqua ammonia as and changes with temperature and pressure and made the cooler effect at exit of turbine due to the maximum power
The other energy goes to the second generator for refrigeration.
So,basicall the system get two benefits a cooling and power.

I. INTRODUCTION

The vapour absorption system is a single stage absorption consisting of evaporator, absorber, generator and condenser. ... The heat applied to the generator replicated the solar thermal energy based on the climatic conditions . The exhaust steam from the turbine goes to the generator of the vapour absorption system. The water to be chilled to provide refrigeration goes in series through the evaporators of the two refrigeration systems. This concept is similar to the concept of co-generation or combined heat power system.

II. LITERATURE REVIEW

This study presents a techno-economic comparison of four alternatives (experimental prototype of concentrating solar power tower system, photovoltaic (PV) system, collapsible vertical axis wind turbine and diesel generator) to supply electrical energy for a small compound of buildings. Among the services needed in the compound are the provision of an adequate drinking water, health centre for immunization purposes, and learning centre. The result of this study shows that the amount of electrical energy needed to meet the basic power requirements is 7.3 kWh/day. Detailed analysis and design requirements of the four alternatives are presented. Dynamic indicators (life cycle cost, annualized life cycle cost and cost of energy production) were applied to evaluate the economic-effectiveness of these energy supply systems. The cost of energy was \$1.06/kWh, \$1.18/kWh, \$1.19/kWh and \$2.98/kWh for the PV system, solar power tower system, diesel generator system and wind turbine system, respectively. Providing electricity to the compound buildings using solar power tower and PV systems is very beneficial and competitive among the other types of energy sources.

III. OBJECTIVES

The overall objective of the present dissertation is to design solar VAPOUR ABSORPTION system for buildings in INDIA. The specific objectives include:

1. Techno-economic evaluation comparison of solar LiBr-water absorption air-conditioning systems, solar photovoltaic vapor compression VAPOUR ABSORPTION systems and conventional vapor compression VAPOUR ABSORPTION systems.
2. Design of a continuous operation (24-hour a day) solar LiBr-water absorption VAPOUR ABSORPTION system.
3. Design of hybrid storage for continuous operation (24-hour a day) solar LiBr-water absorption VAPOUR ABSORPTION system.
4. Thermodynamic analysis of the continuous operation (24-hour a day) system designed in 2.
5. Thermodynamic analysis of the hybrid storage system designed in 3.

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6. Unsteady analysis of a hybrid storage (cold storage and refrigerant storage) system under the climatic conditions of Dhahran, INDIA.

IV. METHODOLOGY

To achieve the above listed objectives, the following methodology was adopted:

A comprehensive literature review of solar VAPOUR ABSORPTION systems. This includes a thorough study of absorption systems and their utilization in airconditioning application.

Techno-economic investigation to evaluate the technical feasibility of several solar VAPOUR ABSORPTION systems to be used in buildings in INDIA. The study focuses on photovoltaic vapor compression systems, solar absorption systems and conventional (vapor compression) systems.

Development of different designs for continuously operated (24-hour a day) totally solar powered absorption VAPOUR ABSORPTION systems using lithium-bromide water as the working fluid. The designs include the arrangements required to facilitate the solar powered system.

Development of hybrid storage designs for continuously totally solar powered absorption lithium-bromide water VAPOUR ABSORPTION system. These designs allow uninterrupted operation and achieve maintenance process optimization. The designs include arrangements required to facilitate the solar powered system.

Thermodynamic analysis of continuous operation designs using EES Software. Thermodynamic analysis for these designs will be performed to provide a conceptual formulation of each design. The thermodynamic analysis assists in defining the controlling parameters that affect the performance of each design and finally determine the efficiency of each design.

Analysis of continuous operation designs based on system performance and storage tanks size using EES Software. The parametric thermodynamic analysis will enable the selection of the best suitable design.

Thermodynamic analysis of hybrid storage designs using EES Software. Thermodynamic analysis for these designs will be conducted to provide a theoretical formulation of each design. The thermodynamic analysis support

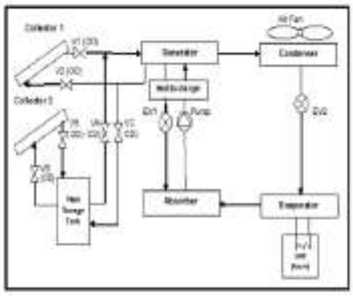
defining the controlling parameters that affect the performance of each design and finally determine the efficiency of each design.

Analysis of hybrid storage designs based on system performance and storage tanks size using EES Software. The parametric thermodynamic analysis will enable the selection of the best suitable design.

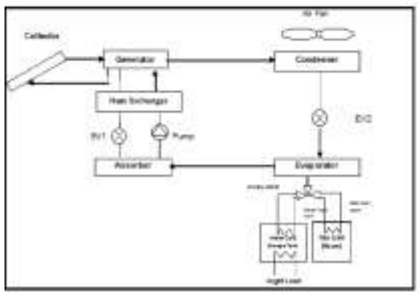
Unsteady analysis of hybrid storage (cold storage and refrigerant storage) system under Dhahran ambient conditions using EES Software.

DESIGNS FOR CONTINUOUS OPERATION (24-HOUR A DAY) SOLAR LIBR-WATER ABSORPTION AIR

Heat Storage System -The stored hot thermal energy is supplied to the generator when the incident solar radiation is insufficient to produce the required generator temperatures. This is the most common storage method in solar cooling systems. The main advantage of the heat storage system is the employment of heat storage unit for continuous (day and night) cooling requirements using a LiBr-H_2O vapor absorption VAPOUR ABSORPTION system.



COLD STORAGE SYSTEM-The cold storage tank is introduced after the evaporator, as shown in figure 5-2. Losses to the environment in this system can be expected to be lower than in hot thermal energy storage because of the lower temperature difference between working and ambient temperatures. Working with cold thermal energy storage, the cooling effect is produced during the day, and excess over the daytime load is stored for later use when the heat input is not sufficient to separate the refrigerant from the solution in the generator.



Refrigerant Storage System- The LiBr-water vapor absorption system with refrigerant storage is one of the primary designs under consideration. The storage for this system is

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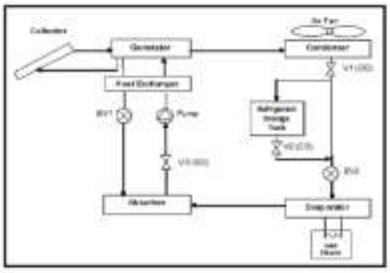
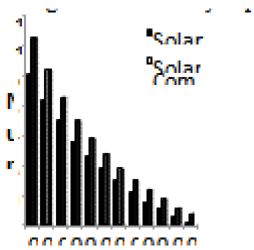
associated with the condenser where the storage tank accumulates the refrigerant during the hours of high solar insolation. Then, this stored liquid refrigerant can be regulated at other times (e.g., nighttime) to meet the required cooling loads [135]. Figure 5-3 shows a continuous operated solar powered lithium bromide-water absorption VAPOUR ABSORPTION system with refrigerant storage.



V. RESULTS

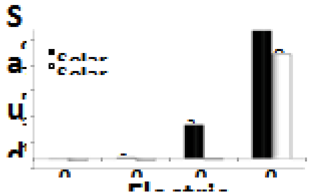
Payback Period (PBP) Results-The economical results show that the payback periods for solar absorption system is 18.5 years while it is 23.9 years for PV system which demonstrate that solar absorption is more feasible than solar PV system at the rate of electricity ($0.0693/kWh). Table 9-1 summarizes the components cost, total investment cost and annual operation cost for the three systems.

At the average international electricity rate of ($0.16/kWh [139]), the payback period for solar absorption system is 9 while it is 10 for PV system. This verifies that solar absorption system is more feasible when compared to PV system at the average international rate of electricity. Figure 9-2 shows that solar absorption system is still more feasible than solar PV system even for high electricity rate of $0.38/kWh, which is higher than the very expensive electricity rate, which is $0.373/kWh.



Electricty Rate ($/kWh)

Net Present Value (NPV) Results-The results of this type of analysis show that net present value for the solar absorption system is $701,512, indicating that solar absorption system is feasible at this rate of electricity. On the other hand, the PV system is not economic at the same rate of electricity as net present value is negative, -$13,327. The NPV detailed mathematical calculation at the electricity rate of $0.0693 is shown in APPENDIX 1 for solar absorption system and shown in APPENDIX 2 for PV-vapor compression system.



Economic Comparison Results -The economical results of the payback period PBP method has been compared with [14], HOTRES project which aimed the implementation for future massive applications of renewable energies. The comparison results showed that the feasibility of implementation of solar VAPOUR ABSORPTION applications in INDIA is better than Europe for both PV system and solar thermal systems. Table 9-5 shows that the payback period for solar thermal in INDIA is 18.5 years while itis 19 years in France. Furthermore, the payback period for the PV system is lower in INDIA, 23.5 years compared to Greece, 43 years as shown in Table 9-6. The main factors of such results

Technical Results -The pervious economical results were based on assumed COP and pump electrical consumption as the cost of the absorption chiller is based on such assumption. In this section, the results of the thermodynamic analysis are utilized to obtain the actual COP and pump electrical consumption in order to have more accurate economical results.

Applying the mass and energy equation, Table 9-7 shows the component thermodynamic results and the following are the main results:

- Q_G =1,962 kW
- Wp =0.0846 kW
- COP = 0.7644
- COP_{max} = 1.421
- η_{II} = 0.538

VI. CONCLUSIONS AND RECOMMENDATIONS

The development of a solar VAPOUR ABSORPTION system that will meet a 24-hour uninterrupted daily cooling load in buildings in INDIA is presented. The development includes an in-depth review of novel alternative solar-powered LiBr-water absorption designs of three storage

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systems and four hybrid storage systems. Also, the impact of unsteady analysis of hybrid storage (cold plus refrigerant) design system on the operation and performance parameters of absorption chiller of 5 kW cooling power with hybrid storage system is discussed. Moreover, the techno-economic analysis and feasibility for three systems: conventional vapor-compression system, solar absorption system and solar photovoltaic vapor-compression system is presented. Based on the analysis of the results; the following can be concluded:

The economical analysis using payback period (PBP) and net present value (NPV) methods revealed that solar LiBr-H_2O absorption system and solar photovoltaic vapor-compression systems can be economically feasible in the eastern province of INDIA for large commercial buildings that consume large amount of electrical energy (more than 8000 kWh per month). However, the results show that solar absorption systems are more feasible than solar photovoltaic vapor-compression systems. The results indicate that the increase in the COP reduces the payback period (PBP) and increases the net present value (NPV) of the system.

The results for the continuous operation designs analysis show that the cold storage system has the lowest mass requirement and has the highest collector area. Although the heat storage system has the highest COP during nighttime operation, its mass requirement is the highest. The analysis revealed that the best-suited alternative design is that with refrigerant storage for a solar LiBr-H_2O absorption system because the collector size is smaller than to the other alternates designs.

Additionally, the refrigerant storage system requires non-insulated storage tank. These two features confirm that the cost of the refrigerant storage system is lowest compared to the alternatives designs.

The results for the hybrid storage designs analysis show that heat, cold and refrigerant hybrid storage system require smaller collector area (22.37 m^2), however, has a high storage capacity especially for heat storage tank (473.9 kg). Although, the heat, cold and refrigerant hybrid storage system has high COP_s (0.765), the mass requirement for this system is very high. The analysis revealed that hybrid storage design with cold and refrigerant storage for solar LiBr-H_2O absorption systems is the best suitable design since the collector size is comparatively smaller (31.76 m^2) than to the heat and refrigerant hybrid storage and the heat and cold hybrid storage systems. The mass storage capacities of this system will be the lowest (cold storage tank: 50.32 kg and refrigerant storage tank: 54.27 kg). Also, this system is simple in design due less complexity in the control requirements compared to other systems. These three features do confirm that the cost of the cold-refrigerant hybrid storage system is lower than to the other systems. The improvement of the mass storage and collector area by increasing the solar availability time shall have positive effect on the design parameter, size and system selection.

The results for unsteady behavior of the hybrid refrigerant and cold storage tanks design show that the coefficient of performance (COP) in summer decreases at the start and the end of the effective sunlight due to the high generator heat energy at this time. COP reaches to its peak values (0.84) at noon time in summer and the daily average COP is (0.775).

Based on the results of the present dissertation analysis, it is recommended to consider the following in the future:

Study the implementation options (new buildings or existing buildings) of solar absorption VAPOUR ABSORPTION system for the implementation in commercial and residential buildings in INDIA.

1)Analyze the feasibility of concentrator photovoltaic (CPV) for VAPOUR ABSORPTION application in INDIA.

2)Study the performance of the continuous operation and hybrid storage designs when using the double-effect and triple-effect absorption systems.

3) Conduct techno-economic analysis for other sectors and small-scale systems.