CHAPTER I

INTRODUCTION

Rationale for the Study

After the resolution of the energy crisis, energy demand will continue to rise, between 2001 and 2025 that was expected to 54% at Asia. The governments across the world had been investigating the use of alternative energy sources to promote energy independence. In Thailand, nearly 50% of the electricity demand is for air conditioning systems, 50,000 GW-hrs per year. It showed that, she would have a new 600 MW power plant to meet the peak demands. In addition, air conditioning had been considering high electric energy consumption. Using renewable energies to power new cooling systems would help Thailand decrease her energies that depended on oil and natural gas and had greatest renewable energy source in solar power, 5 kW-hr.m $^{-2}$ per day (Shiao, 2005, unpaged).

The absorption cooling was based on the principle that some refrigerant combine chemically with an absorbent to release heat during absorption. Solar energy operated absorption air condition consists of four major components: generator, condenser, evaporator and absorber. In absorption cycle two working fluids: a refrigerant and an absorbent were used. The most popular absorption cooling system was the lithium bromide-water air conditioner, water acts as a refrigerant and lithium bromide in water acts as an absorbent (Garp and Prakash, 1990, unpaged).

At School of Renewable Energy and Technology, SERT, Energy Park, Thailand, there was the use of solar absorption cooling system in testing building for cooling and reducing electric energy consumption. This system used YAZAKI chiller; 35kW-Standard Cooling Capacity, to operate the comfort zone in the building by the water evaporation inside the AIRCON fan coil units. Along with being stable, the auxiliary heat, LPG and water storage tank could also be component to this system. The cooling system's performance was depend on the chiller's performance that known as COP. The Coefficient of Performance (COP) was the ratio of energy demand and energy supply and it was used to indicate the efficiency of chiller in solar cooling system. The COP not only indicated the performance of chiller in the cooling system, but also indicated the ability of energy balancing, which was the equilibrium of cooling supply and cooling demand.

Unfortunately, COP used by this system was not as good as expected, because of the manufacturer shows a COP at nominal equal to 0.7, but the measurement shown an average daily actual COP was 0.3. Due to the limitation of water flow rate via the four main flow circuits would have significantly affect the thermal energy that was balancing the COP, whereas measurements taken by other works (Yongprayun, Ketjoy, and Rakwichian, 2006, unpaged). And it indicated that the supplying water temperature effected on the actual COP by varying the flow rate, as measurements taken by other author (Mittal, Kasana, and Thakur, 2005, unpaged), (Asdrubali, and Grignaffini, 2005, pp. 489-497) and (Kaynaki and Kilie, 2007, pp. 599-607). Therefore, the variations of water flow rate via the main components were purpose for this work by mean of increasing the efficiency of COP during operating condition.

Purpose of the Study

To optimize both technically and economically of LiBr – H_2O solar absorption cooling system in Thailand.

Significance of the Study

The optimal equations seek to improve the coefficient of performance (COP) and evaluate the internal rate of return (IRR), net present value (NPV), benefit-cost ratio (B/C), payback period (PB) and the specific life cycle costs (SLCCA) of LiBr – H_2O solar absorption cooling system in Thailand.

Scopes of Work

1. The optimal technical equations was constructed by the relationship between the variation of water flow rate via the main component, differential temperature and the tilt solar irradiation.
2. The optimal technical optimization model would be written by SIMULINK, MATLAB.
3. The optimal economic equation was purpose to study of how the variation

both of the coefficient of performance (COP) was 0.35 - 0.65 and the solar fraction ($SOLF_{the}$) was 0.5 – 1.

Basic Assumption

1. The optimal water flow rate could generate the maximum energy demand and supply.
2. The technical equations were validated by the relative error obtained being less than 15% (in the worst case).
3. The temperature of heat medium inlet was 75 – 95 °C for producing the chilled water while the differential temperature (ΔT) inside the collector was in the range of 1 – 10 °C or K and tilt solar irradiation (G_β) in the range of 200 –1000 $W.m^{-2}$.
4. The heat losses could be avoided and kept at a minimum by insulation at all parts of system's junctions and pipe with no water flow rate drop because the pump working.
5. The optimal COP in the range of 0.35 – 0.65 when the cooling system was operated during 09:00 – 17:00.
6. The optimal rate of IRR should be more than the loan rate, 6 – 7 %.
7. The optimal PB should be less than 15 years.
8. The optimal NPV should be more than 0.
9. The optimal B/C should be more than 1.
10. The SLCCA should be the lowest cost per cooling unit ($Baht.kWh^{-1}$).
11. The life time of this system was 20 years.

Hypothesis

1. The optimal water flow rate via the main components could generate the maximum actual COP.
2. The optimal condition was generate the lowest of SLCCA , the shorten time for pay back period (PB), and the highest rate of return (IRR), net present value (NPV), computation of B/C for a single investment throughout its life time was appearing when the maximum actual COP was produced.
3. This simulation should be a powerful tool for solar cooling both development and testing of control strategies.