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TITLE OF THE THESIS: THERMODYNAMIC PERFORMANCE ASSESSMENT FOR A NOVEL COMBINED POWER & EJECTOR-ABSORPTION REFRIGERATION CYCLE

ABSTRACT

Food conservation and the air conditioning of living spaces are indispensable for human beings in the modern life. The mechanical vapor compression systems used conventionally for this purpose, which consumes large amounts of electrical power. This electrical power is produced in great proportion by fossil fuel combustion, which is a cause of the global warming. Global warming makes imperative the need to develop alternative technologies. The alternative energy sources like solar, geothermal, industrial waste heat and wind energy are low grade energy. The use of low grade energy sources such as residual energy from industrial processes or solar thermal energy has been proposed, not only in its ecological context but for its economical repercussion. Absorption, adsorption and ejector refrigeration cycles are some technologies that can use low grade thermal energy.

This thesis is to describe and present the result of a theoretical study of the ejector refrigeration system, combined power and ejector refrigeration cycle, combined power and ejector-absorption refrigeration cycle, and triple effect refrigeration cycle. The performance improvements brought about by the innovations cycle modification, the application of environmentally friendly refrigerant R-141b. The new cogeneration becomes a combined power and ejector absorption refrigeration cycle, which utilizes the industrial waste heat more effectively and elevates the performance to some extent. Energy and exergy methods are applied to investigate the thermodynamic performance of the proposed cycle. Exergy analysis is conducted to identify and quantify the sources of irreversibilities and the contribution of each source towards the effective exploitation of waste heat.

Exergy analysis of ejector refrigeration system was performed and its different configurations were presented. The result of thermodynamic analysis demonstrated that the first law efficiency (thermal efficiency) of ejector refrigeration system was 22.7% at mean operating conditions. Further, the first law efficiency of combined power and ejector refrigeration cycle, combined power and ejector-absorption refrigeration cycle, and triple effect refrigeration cycle were evaluated as 12.16%, 19.7 % and 19.1% respectively. Second law efficiency (exergy efficiency)
for ejector refrigeration system, combined power and ejector refrigeration cycle, combined power and ejector-absorption refrigeration cycle, and triple effect refrigeration cycle were evaluated as 5.3%, 33%, 31% and 7.63% respectively at mean operating conditions.

It is observed that both the first and second law efficiency of proposed combined power and ejector absorption refrigeration cycle was very high as compared to the other cycle, except the second law efficiency of combined power and ejector refrigeration cycle.

The main objective of this work is to evaluate the feasibility of employing LiBr-H_2O absorption refrigeration cycle to obtain further improvements in the efficiency of combined power and ejector refrigeration cycle.

Using the first and second law of thermodynamics the performance of the proposed cycle is evaluated under diverse working conditions. The effect of evaporator temperature, condenser temperature, turbine back pressure and turbine inlet pressure on the turbine power, refrigeration capacity and exergy efficiency has been evaluated. The effect of change of main parameters has been observed on energetic and exergetic performance of proposed cycle. The thermal efficiency, exergy efficiency of the cycle and irreversibilities associated with various components has been evaluated for various operating parameters in order to determine where improvements could be made to enhance the performance of the cycle. Based on the result obtained an efficient and sustainable cogeneration cycle configuration can be identified and recommended for future clean power generation.