PERFORMANCE OPTIMIZATION OF REFRIGERATION SYSTEM

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ABSTRACT

Energy efficiency improvement is one of the most important objectives in today's engineering systems. Environmental concerns such as ozone depletion and global warming are forcing energy efficiency to be taken as new urgency to mitigate fossil fuel demands and associated greenhouse impacts. Since refrigeration systems are energy consuming, their optimization is very important. This paper presents a study on performance optimization of a refrigeration system using experimental method. The paper begins with the brief description of the definition of refrigeration and its historical background. Four basic types of refrigeration system (vapour compression, vapour absorption, gas cycle, and steam jet refrigeration systems) are studied and compared. VCRS is selected to be analyzed as it is the most widely used refrigeration system in domestic application. The characteristics of ideal and actual VCRS are explored. Five critical parameters are selected to be evaluated. They are saturated condenser and evaporator temperature, ambient temperature, subcooling and superheating, air flow effect, and insulation. Heat pump experiments with R-134a are designed based on the chosen parameters. Assumptions, simplifications and related formulas are justified. Changes in the operating parameters are simulated through experiments. The resulting system performances are compared to the established baseline system performance and software simulation. Results show that an increase of 5°C of subcool increases COP_{HP} by 62.43% and COP_R by 82.89%. Superheat should be maintained below 30°C and any superheat beyond that will decrease the COPs. A decrease of ambient temperature from 26 to 20°C increases the COP_R by 68.26%. The COP_R of heat pump increases up to 87.27% by increasing the stand fan speed to 3. Insulated condenser line increases COP_{HP} by 323.77% while insulated evaporator line increases COP_R by 94.55%. Increasing evaporator temperature and decreasing condenser temperature increase the COPs of the system. Eventually, the findings are concluded and recommendations for future work are suggested.

Keywords: air flow, ambient temperature, energy efficiency, global warming, heat pump, insulation, parameters, performance optimization, refrigeration system, saturated condenser and evaporator temperature, subcool and superheat.