Experimental Performance Evaluation of Vapor Compression Refrigeration System for R134a and R152a

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Abstract: An experimental performance evaluation of a vapor compression refrigeration system with refrigerants R134a and R152a were done and there results were compared. According to the results refrigerant R152a have slightly higher coefficient of performance (COP) than R134a for evaporating temperatures ranging between -5°C and 10°C and condensation temperature of 44°C. Refrigerant R152a was found superior to Refrigerant R134a. Various parameters of performance such as Pressure ratio, Compressor work, Refrigeration effect, power per ton refrigeration, volumetric refrigeration capacity, compressor power, discharge temperature, mass flow rate were also investigated for various evaporating temperatures.

Index Terms— Refrigeration, Alternative Refrigerants, R134a, R152a

1. INTRODUCTION

Now a day’s ozone depleting potential and global worming potential of the refrigerants has become most important criteria for selecting and producing the refrigerants. Refrigerant R134a has high global warming potential which can cause serious impacts on refrigeration industry [1]. Refrigerant R152a has global warming potential of 120, which is approximately 10 times less than R134a [2]. The performance of the refrigerant R152a is superior to R134a [3]. R152a has higher exergetic efficiency, efficiency defect in condenser and evaporator than R134a [4]. R152a shows less efficiency defect for 40°C condenser temperature [5]. Refrigerant R134a shows better performance over commonly used refrigerant R22 but less than R152a [6]. Mixture of refrigerants R134a and R152a also works safely in a vapor compression refrigeration system. For R152a and R134a in proportion 70:30 the highest value of coefficient of performance can be obtained[7]. R134a is primarily used as high temperature refrigerant for domestic purpose. Hot R134a has hazardous effects on human body and also on environment [8]. Hence there is urgent requirement of alternative refrigerant to replace R134a.

2. EXPERIMENTAL PROCEDURE

Experimental procedure is as follows
(a) Firstly a performance test was conducted for refrigerant R134a for the evaporating temperature ranging from -5°C to 10°C. The super heating up to 10°C and sub cooling up to 7°C was provided.
(b) Secondly a performance test was conducted for refrigerant R152a for the evaporating temperature ranging from -5°C to 10°C. The super heating up to 10°C and sub cooling up to 7°C was provided.

3. RESULTS AND DISCUSSION

The fig. 1 and 2 shows the changes in evaporating pressure and pressure ratio with respect to evaporating temperature. It was found that the evaporating pressure of both refrigerants increased with increase in evaporating temperature and the pressure ratio for both refrigerants decreased with increase in evaporating temperature, while the refrigerant R134a had higher evaporating pressure and pressure ratio than the refrigerant R152a. Refrigerating effect verses evaporating temperature is shown in fig. 3. The refrigerant R152a had higher refrigerating effect than the refrigerant R134a. In fig.4 the change in compression work with change in evaporating temperature has been plotted. The refrigerant R152a had higher compression work than the refrigerant R134a. The change in coefficient of performance with change in evaporating temperature is shown in fig.5. The refrigerant R152a had higher coefficient of performance than the refrigerant R134a. The compressor power and power per ton of refrigeration with change in evaporating temperature
is shown in fig.6 and fig.7 respectively. The change volumetric refrigeration capacity, discharge temperature and mass flow rate with change in evaporating temperature ranging from -5°C to 10°C is shown in fig.8,9 and 10 respectively.
4. CONCLUSIONS

In this experimental performance evaluation of vapor compression system the performance tests are conducted for refrigerants R134a and R152a. Both the refrigerants are eco-friendly as both of them do not cause ozone layer depletion. While refrigerant R152a has lower global warming potential than refrigerant R134a. Considering the performance parameters like coefficient of performance the refrigerant R152a was found superior to R134a. Hence the refrigerant R152a can be used as an alternative for refrigerant R134a.

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6. REFERENCES

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