Experimental Performance Determination of COP and TR for R12 Vapour Compression Refrigeration System

Amruta Panda, N. K. Kund

Abstract: Experiments stand performed for investigating influence of R12 refrigerant on system performance evaluation in terms of COP and TR. Temperature and pressure got measured by different temperature and pressure gauges mounted at several predetermined locations. Additionally, power consumption by refrigeration system also got measured from the installed energy meter readings. Altogether, it summarizes the tabular inscriptions of the variations of COP\(_{\text{th}}\), COP\(_{\text{act}}\) and COP\(_{\text{rel}}\) with TR for R12 refrigerant. Besides, it also demonstrates the graphical representation of the corresponding variations of COP\(_{\text{th}}\), COP\(_{\text{act}}\) and COP\(_{\text{rel}}\) with TR for R12 refrigerant. As expected, it stands observed (from both the stated table and figure) that both COP\(_{\text{th}}\) and COP\(_{\text{act}}\) increase with TR, however, the COP\(_{\text{rel}}\) decreases with the same for said R12 refrigerant. Furthermore, the stated variations of COP\(_{\text{th}}\), COP\(_{\text{act}}\) and COP\(_{\text{rel}}\) with TR remain observed as approximately linear, independently. That’s why, both COP\(_{\text{th}}\) and COP\(_{\text{act}}\) stay directly proportional to TR, however, the COP\(_{\text{rel}}\) stays inversely proportional to the same because of approximately linear relationship between the COP\(_{\text{th}}\), COP\(_{\text{act}}\) and COP\(_{\text{rel}}\) with TR, independently.

Index Terms: R12 Refrigerant, COP, TR, Experiment, Performance, Refrigeration System.

I. INTRODUCTION

Vapour compression refrigeration remains as the supreme significant practice for removal of heat in chilling of any kind of items/goods. It is a cooling practice where coefficient of performance (COP) and tons of refrigeration (TR) of preferred pressure and temperature gets produced through removal of heat using refrigerants. Refrigeration practices remain influenced through external power supply to the unit. Here, chilling happens because of collective/net heat removal from the refrigeration system.

Key objective of refrigeration practices stand to keep items/goods for getting cold of desired COP and TR using R12 refrigerant throughout its epoch. In refrigeration practices, the major concern of customer requirements is coldness. COP and TR remain primarily outcomes of process parameters (refrigerating conditions) pressure and temperature. Numerical or experimental evaluations on COP with TR remain extant in collected works [1-7]. Computational and experimental researches stand also described [8-44].

Current research remains as examining the effect of R12 refrigerant on COP and TR for the stated refrigeration system.

II. EXPERIMENTAL ARRANGEMENT

Arrangement explicates enthusiastically about the basics of modern refrigeration system block diagram along with experimental setup components.

A. Illustration of Refrigeration System Block Diagram

Figure 1 illustrates the colorful block diagram of refrigeration system. It involves compressor, condenser, expansion device and evaporator, sequentially.

Figure 1. Schematic of refrigeration system block diagram

B. Demonstration of Experimental Setup Components

It involves descriptions of the colorful components of the experimental setup. The exploded colorful photos of compressor, condenser, dryer and capillary tube are illustrated in figures 2 to 5, respectively. These components are fabricated and assembled to produce the desired experimental setup relating to the refrigeration system.
III. EXPERIMENTAL PROCEDURES

It ensnares the apparatus readings of under declared variables.

A. Pressure Measurement

Pressure got measured by both high pressure (0 to 35 kg/cm²) and low pressure (-2 to -10 kg/cm²) gauges (mounted at different predetermined locations) as depicted in figures 6 and 7, respectively.
said R12 refrigerant. Furthermore, the stated variations remain observed as approximately linear. In other words the COPth stays directly proportional to TR because of approximately linear relationship between the COPth and TR.

Table 1. The COPth of R12 refrigerant at different TR

<table>
<thead>
<tr>
<th>COPth</th>
<th>6.21</th>
<th>5.9</th>
<th>5.62</th>
<th>4.83</th>
<th>4.72</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR</td>
<td>0.156</td>
<td>0.148</td>
<td>0.141</td>
<td>0.121</td>
<td>0.118</td>
</tr>
</tbody>
</table>

Figure 8. COPth vs. TR with R12 refrigerant

B. Variations of COPact with TR for R12 Refrigerant

Table 2 summarizes the tabular inscriptions of the variations of COPact with TR for R12 refrigerant. Figure 9 also demonstrates the graphical representation of the corresponding variations of COPact with TR for R12 refrigerant. As expected, it stands observed (from both the stated table and figure) that the COPact increases with TR for said R12 refrigerant. Furthermore, the stated variations remain observed as approximately linear. In other words the COPact stays directly proportional to TR because of approximately linear relationship between the COPact and TR.

Table 2. The COPact of R12 refrigerant at different TR

<table>
<thead>
<tr>
<th>COPact</th>
<th>1.8</th>
<th>1.77</th>
<th>1.74</th>
<th>1.66</th>
<th>1.64</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR</td>
<td>0.156</td>
<td>0.148</td>
<td>0.141</td>
<td>0.121</td>
<td>0.118</td>
</tr>
</tbody>
</table>

Figure 9. COPact vs. TR with R12 refrigerant

C. Variations of COPact with TR for R12 Refrigerant

Table 3 summarizes the tabular inscriptions of the variations of COPact with TR for R12 refrigerant.
Figure 10 also demonstrates the graphical representation of the corresponding variations of COP$_{rel}$ with TR for R12 refrigerant. As expected, it stands observed (from both the stated table and figure) that the COP$_{rel}$ decreases with the increase of TR for said R12 refrigerant. Furthermore, the stated variations remain observed as approximately linear. In other words the COP$_{rel}$ stays inversely proportional to TR because of approximately linear relationship between the COP$_{rel}$ and TR.

Table 3. The COP$_{rel}$ of R12 refrigerant at different TR

<table>
<thead>
<tr>
<th>COP$_{rel}$</th>
<th>0.29</th>
<th>0.30</th>
<th>0.31</th>
<th>0.34</th>
<th>0.35</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR</td>
<td>0.156</td>
<td>0.148</td>
<td>0.141</td>
<td>0.121</td>
<td>0.118</td>
</tr>
</tbody>
</table>

Figure 10. COP$_{rel}$ vs. TR with R12 refrigerant

V. CONCLUSION

Experiments got accomplished for examining effect of R12 refrigerant on system performance evaluation in terms of COP and TR. Temperature and pressure got measured by different temperature and pressure gauges mounted at several predetermined locations. Additionally, power consumption by refrigeration system also got measured from the installed energy meter readings. Altogether, it summarizes the tabular inscriptions of the variations of COP$_{th}$, COP$_{act}$ and COP$_{rel}$ with TR for R12 refrigerant. Besides, it also demonstrates the graphical representation of the corresponding variations of COP$_{th}$, COP$_{act}$ and COP$_{rel}$ with TR for R12 refrigerant. As expected, it stands observed (from both the stated table and figure) that both COP$_{th}$ and COP$_{act}$ increase with TR, however, the COP$_{rel}$ decreases with the same for said R12 refrigerant. Furthermore, the stated variations of COP$_{th}$, COP$_{act}$ and COP$_{rel}$ with TR remain observed as approximately linear, individually. That’s why, both COP$_{th}$ and COP$_{act}$ stay directly proportional to TR, however, the COP$_{rel}$ stays inversely proportional to the same because of approximately linear relationship between the COP$_{th}$, COP$_{act}$ and COP$_{rel}$ with TR, individually.

ACKNOWLEDGMENT

The authors gratefully acknowledge the vital supports and means from VSSUT Burla for performing this research work. The authors also wish to thank the reviewers and journal editors for their constructive and critical comments for improving the text.

REFERENCES


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