Experimental Investigation on the Performance Influencing Factors of a Transcritical CO\textsubscript{2} System

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1 INTRODUCTION

Ozone Depletion!!!
1 INTRODUCTION

Water ? . . .
Flood ? . . .
Every where!
1 INTRODUCTION

- **synthetic refrigerants**
- **natural refrigerants**

**Alternative Refrigerants**

- **CO₂**

**Unique advantages**

**Great disadvantages:**

- high pressure
- low COP
2 RESEARCH PURPOSE

How to improve the performance of the system?

cycle modifications:
- internal heat exchanger, expansion turbine, multi-staging,
- two-phase ejector, vortex tube, parallel compression economization

operating conditions:
- high pressure side and low pressure side
• Improve the performance of the system:
  Water-water transcritical CO\textsubscript{2} refrigeration system
  operating conditions:
  low pressure side: water temperatures and flow rates
  high pressure side: water temperatures and flow rates

To seek the reasonable operating conditions: temperature? flow rate?
3 TEST RIG
## 3 TEST RIG

### Table 1: Main Components

<table>
<thead>
<tr>
<th>Name of components</th>
<th>Main characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressor</td>
<td>Semi-hermetic reciprocating; Swept volume: 8.3 m³/h.</td>
</tr>
<tr>
<td>Gas-cooler</td>
<td>Plate heat exchanger; Heat transfer area: 2.09 m³</td>
</tr>
<tr>
<td>Evaporator</td>
<td>Plate heat exchanger; Heat transfer area: 1.81 m³</td>
</tr>
<tr>
<td>Expansion valve</td>
<td>Electrically expansion valve.</td>
</tr>
<tr>
<td>Receiver</td>
<td>Inner volume: 4.9×10⁻³ m³.</td>
</tr>
<tr>
<td>Oil separator</td>
<td>Inner volume: 11.7×10⁻³ m³.</td>
</tr>
</tbody>
</table>
• 4 RESULTS AND DISCUSSION

• 4.1 The effects of flow rates of the gas-cooler water

- **Pressure**: increase slightly, not much
- **Temperature**: increase slightly, not much
• 4 RESULTS AND DISCUSSION

• 4.1 The effects of flow rates of the gas-cooler water

Cooling capacity: decrease, not much

COP: decrease, not much
• 4 RESULTS AND DISCUSSION

• 4.2 The effects of inlet temperature of the gas-cooler water

- **Pressure**:
  - High pressure side: increase greatly
  - Low pressure side: increase a little

- **Temperature**:
  - High pressure side: increase greatly
  - Low pressure side: increase a little
4 RESULTS AND DISCUSSION

4.2 The effects of inlet temperature of the gas-cooler water

- Cooling capacity: decrease dramatically
- COP: decrease dramatically
• 4 RESULTS AND DISCUSSION

• 4.3 The effects of flow rates of the evaporator water

**Pressure:**
- High pressure side: decrease slightly
- Low pressure side: decrease slightly

**Temperature:**
- High pressure side: decrease
- Low pressure side: decrease
• 4 RESULTS AND DISCUSSION

• 4.3 The effects of flow rates of the evaporator water

Cooling capacity:

decrease, not much

COP:

decrease, not much
4 RESULTS AND DISCUSSION

4.4 The effects of inlet temperature of the evaporator water

**Pressure:**
- High pressure side: increase greatly
- Low pressure side: increase

**Temperature:**
- High pressure side: increase greatly
- Low pressure side: increase greatly
4.4 The effects of inlet temperature of the evaporator water

- Cooling capacity: increase dramatically
- COP: increase dramatically
5 CONCLUSIONS

(1) EEV inlet temperature strongly depends on heat transfer condition of gas-cooler.

(2) Compressor discharge pressure and temperature relate to both heat transfer condition of gas-cooler and evaporator.

(3) Effects inlet temperature and flow rates of heat exchangers on the system characteristics are the same as the conventional refrigerants.
THANKS!