EXPERIMENT OF LIQUEFY AND STORAGE OF HELIUM IN PHASE SEPARATOR

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ABSTRACT

In the study, the helium re-condensing phase separator with the storage vessel volume of 100 litres using a 4K Gifford-McManhon cryocooler is built at National Synchrotron Radiation Research Center (NSRRC). The separator has successfully liquefied helium gas that is supplied from gaseous helium bundle at 300K, and storage liquid helium at up to 65 litres continuously when no supply helium gas is added. The experimental results show that the total cooling capacity is 0.73 W at 1.67 bara, and which the total heat loss of thermal conduction and thermal radiation is about 1.2 W. The paper presents the experiment of liquefaction process and storage liquid helium process of 100 litres separator with fin-type condenser.

LIQUEFY OF GHE WITH PRE-COOLING

FIGURE 1. Configuration of the helium re-condensing phase separator.

FIGURE 2. Liquefaction process of the helium phase separator system.

FIGURE 3. Helium liquefaction process at 1.67 bara.

TABLE 1. Energy in the liquefaction process at 1.67 bara

<table>
<thead>
<tr>
<th>m (g/s)</th>
<th>T_s (K)</th>
<th>h_s (J/kg)</th>
<th>T_1 (K)</th>
<th>h_1 (J/kg)</th>
<th>Q_1 (W)</th>
<th>h_2 (J/kg)</th>
<th>Q_2 (W)</th>
<th>Q_L (W)</th>
<th>Q_{2nd} (W)</th>
<th>Q_{2nd} (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0026</td>
<td>295</td>
<td>1532</td>
<td>54</td>
<td>281</td>
<td>3.25</td>
<td>14.06</td>
<td>1.34</td>
<td>0.69</td>
<td>0.04</td>
<td>0.73</td>
</tr>
</tbody>
</table>

STORAGE OF LHE IN PHASE SEPARATOR

FIGURE 4. Temperature of storage vessel, condenser and 1st stage of cryocooler during the helium liquefaction process.

FIGURE 5. Variation of liquid helium level during the liquefaction process.

FIGURE 6. Test results of liquid helium storage in phase separator.

CONCLUSION

A helium phase separator with volume of 100 litres has been developed at NSRRC, and can liquefy helium gas and store liquid helium when under operation by 4K Gifford-McManhon cryocooler successfully. The total cooling capacity of the 2nd stage of cryocooler is 0.73W. The storage of liquid helium level is up to 65% of the inner vessel, and total heat load is about 1.2W. This experiment is our preliminary trial in NSRRC. We have gained major confident in developing the separator system. The results can be used to study the enhancement of cooling efficiency of condenser and precooler system in the future.