Improvement of the operational settings of a helium purifier leading to a higher purity of the recovered gas

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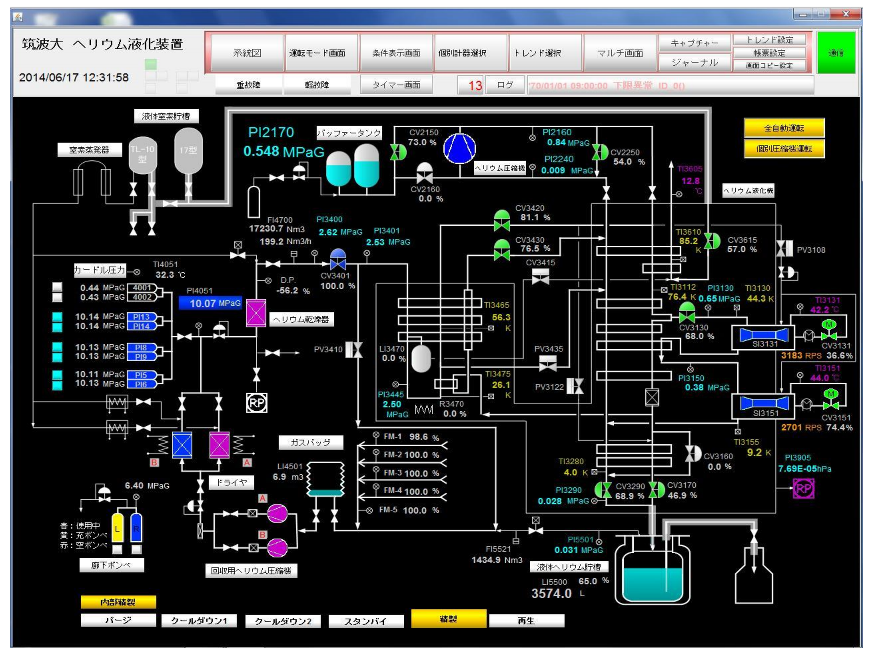
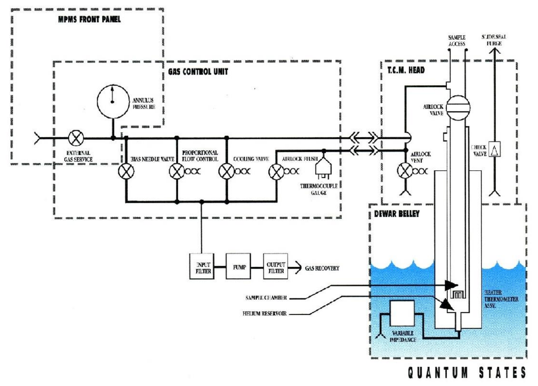
Introduction

In recent years, several universities that renewed their helium liquefier system have reported that solid hydrogen was mixed within the liquid helium produced by a helium liquefier [1-3]. The University of Tsukuba has also installed a Linde L280 helium liquefier system in October 2010. Similar to other universities, cases where the helium flow of cryogenic equipment with flow impedance (equipment to control temperature while limiting the flow of helium by a filter and capillary) was blocked began to be reported around March 2012. In this paper we focused on the internal purifier of the helium liquefier for the problem where solid hydrogen is mixed in the liquid helium produced by a helium liquefier. We adopted a new method to monitor the purity of the gas recovered from the internal purifier with a simple helium gas purity meter. This enabled us to improve the purity of the recovered gas from 33% to 99% by changing the cold end temperature of the purifier from 32.5K to 22K. From this, we have found that it is possible to reliably determine the internal purifier operating conditions, which are the solution to the problem where solid hydrogen is mixed, and this is reported below.



Lined L280 system in Tsukuba University

Quantum Design MPMS



Flow impedance blocked by solid hydrogen

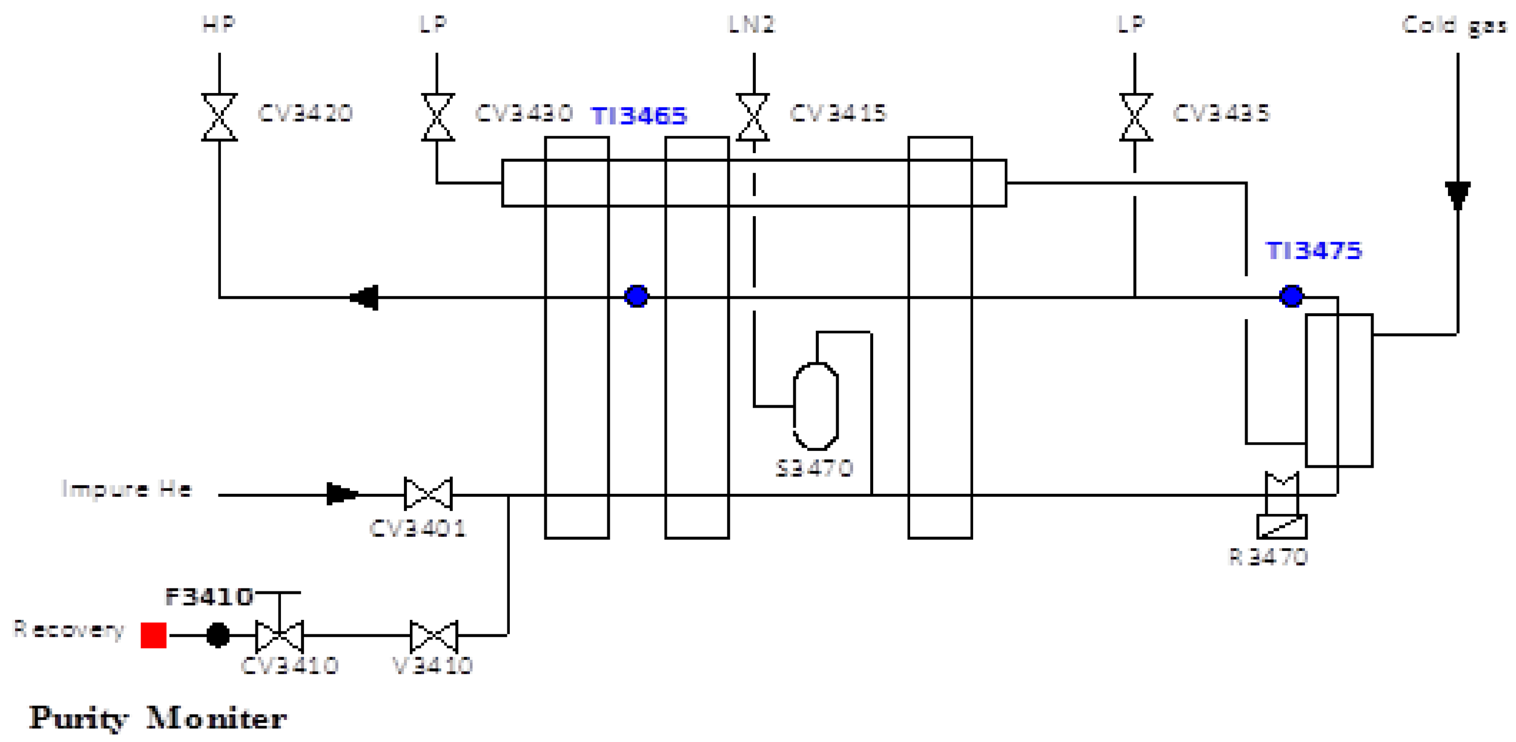


Fig. 1. Internal purifier flow for Linde L280 system

New Method！

Fig. 2. Monitor the purity recovered helium gas by attaching a simple purity of the Pirani gauge type.

Improvement 33% to 99%

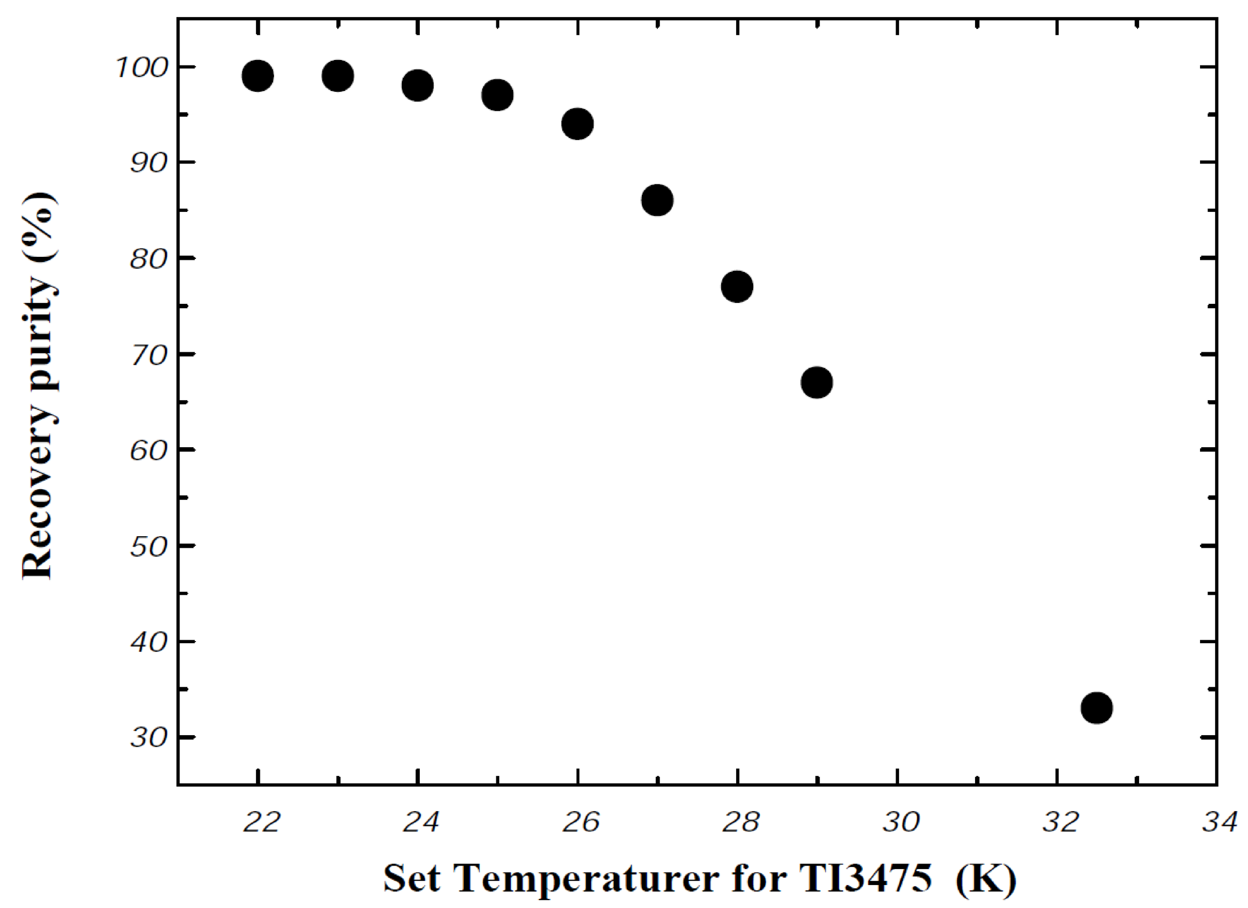


Fig. 3. Monitored the recovered gas purity during regeneration by fixing the cold flow F3410 to 180 ℓ/min and changing the cold end temperature TI3475.

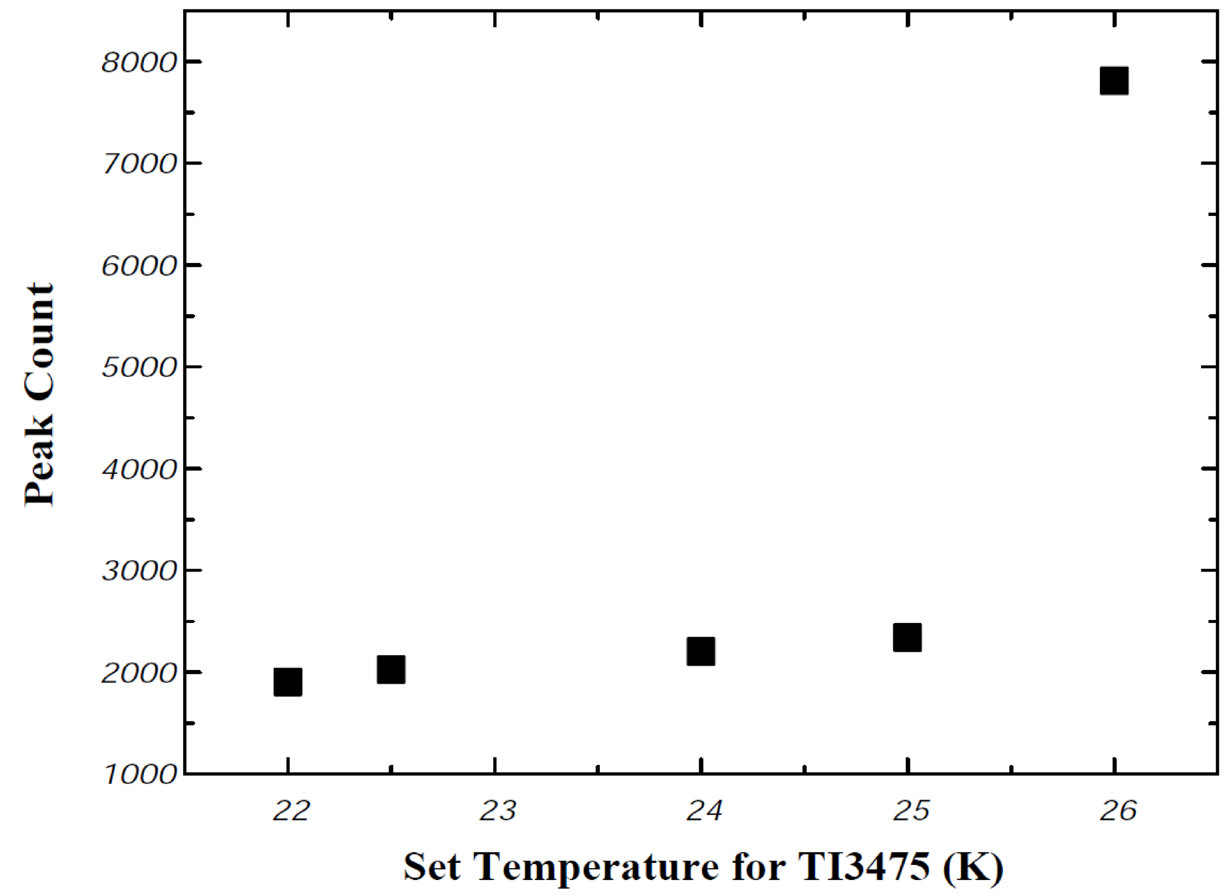
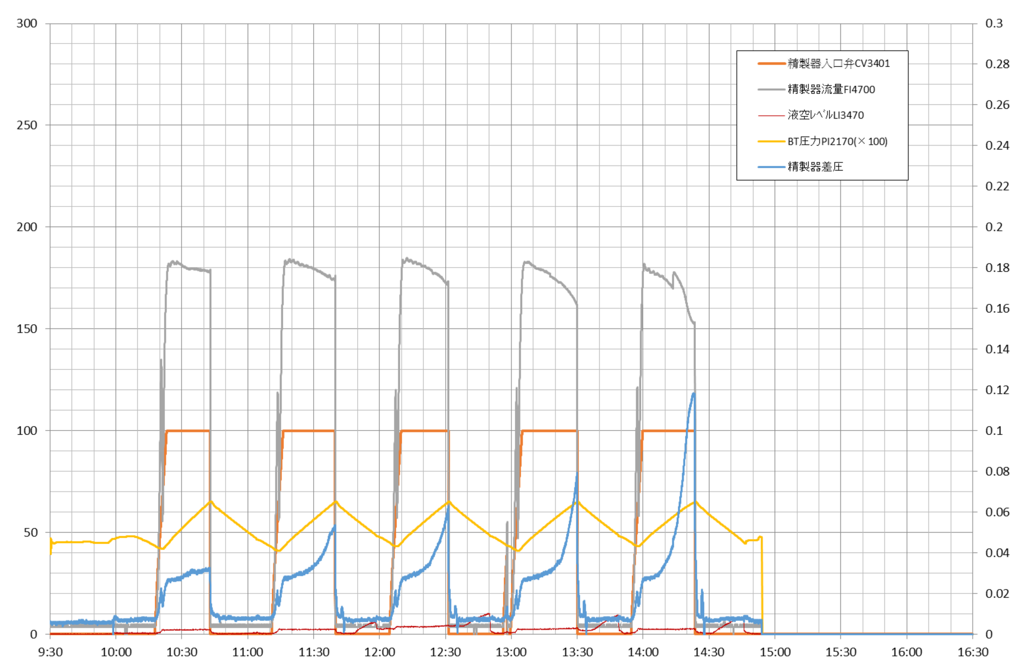


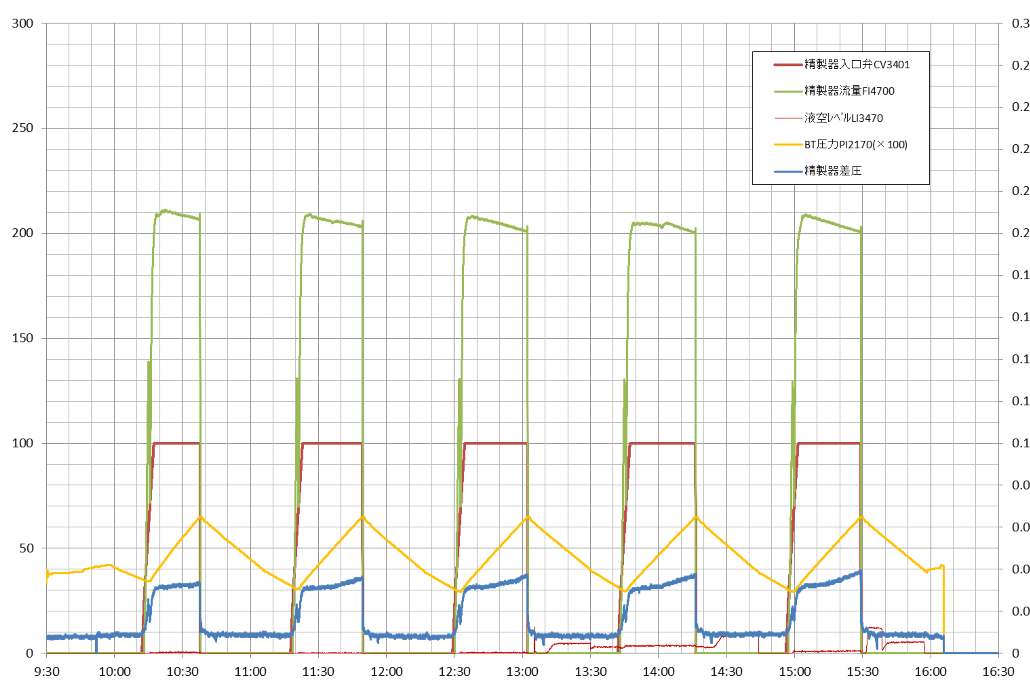
Fig. 4. Gas chromatograph mass spectrometer impurity analysis of helium liquefaction machine.

Cold end temperature TI3475=32.5K, cold flow F3410=120 ℓ/min, regeneration completion temperature TI3465=140K, and heater control output R3470=18%



Before improvement of the operational setting of helium purifier

Cold end temperature TI3475=26K, cold flow F3410=180 ℓ/min, regeneration completion temperature TI3465=145K, and heater control output R3470=22%



After improvement of the operational setting of helium purifier

Conclusion

The purifier operating conditions of commercially available helium liquefiers are determined by adjusting the cold end temperature, the cold flow, the regeneration completion temperature and the heater temperature. As a new method to determine the purifier operating conditions, we monitored the purity of the gas recovered from the purifier and succeeded in improving the recovered gas purity during purifier regeneration operation from 33% to 99%. This enabled us to reliably determine the internal purifier operating conditions.

References
1. Nojima, T., Center for Low Temperature Science University of Tohoku report, (2013) 14.
2. Nishizaki, S., Integrated Technical Institute of Ehime University, (2012) 07-02.
3. Toda,R., Kamo,Y., Abe,M., Technical Institute of National Institute for Fusion Science, (2013) 4-07.
4. http://www.linde-engineering.com/en/process_plants/cryogenic_plants/helium_liquefiers/index.html L280 Manual