Impurity concentration in recovered helium gas of liquid-helium supply and recovery system

M. Nakamura,[*1] T. Dantsuka,[*1] H. Okuno,[*1] S. Turuma,[*1] M. Kuroiwa,[*1] M. Ohshima,[*2] H. Hirai,[*2] H. Shiraki,[*2] H. Shiba,[*2] K. Kimura,[*2] S. Okada,[*2] A. Mikami,[*2] H. Hazama,[*2] M. Nagano,[*2] and M. Nakayama[*2]

We use recovered helium gas for a liquid-helium supply system. However 1–2 ppm hydrogen gas, for example, was intermixed with the recovered helium gas, and we had to stop the operation of our system for a few month in 2004.[1] To cope with such serious troubles, we introduced gas chromatography equipment and have been analyzing the recovered helium gas. Then, we could observe the concentration of impurity gas and the condition of the recovered helium gas for effective operation. In this paper, we report the change in concentration of impurity gases in 2021.

The recovered helium was analyzed using SHIMADZ 2014 every day except Saturdays and holidays. The results from January 4 to December 28 in 2021 are shown in Fig. 1. The left axis shows the concentration of N_2 and O_2, and the right axis shows that of H_2, CO_2, and CO. The results for CO_2 and CO are presented in a bar chart because we could rarely observe these gases and the results are difficult to plot using polygonal lines. The black, gray, and red lines show the N_2, O_2, and H_2 concentration, respectively. The blue and green bars show the CO_2 and CO concentration, respectively.

The concentration changes of N_2 and O_2 were almost in exact correspondence. The N_2 and O_2 concentrations changed from 1300 to 2000 ppm and from 900 to 1300 ppm, respectively. From April to September, the N_2 and O_2 concentrations reduced to approximately 1300 and 900 ppm, respectively. We presume that N_2 and O_2 from air intermixed into the helium gas when helium was recovered. However, the ratio of N_2 and O_2 of our result is approximately 0.7 and not the same as that of the air (0.25). The cause of this difference cannot be explicated at present.

The fluctuation of the H_2 concentration was fairly radical. Ordinarily, the H_2 concentration settled around 0.1 ppm. However, the concentration suddenly increased to 0.3–0.7 ppm at several instances. The correlation of H_2 concentration change with that of N_2 and O_2 is not so clear. We presume that the H_2 impurity intermixed into the recovered helium gas through a mechanism different from that of N_2 and O_2.

We cannot estimate the CO_2 and CO impurity concentrations because these gases were observed only a few times in this year.

In January, some parts included in the helium liquefier were blocked, and we could not operate the helium liquefier. In the term of this trouble, we could observe CO_2 and CO several times, and H_2 concentration increased to 0.7 ppm. The N_2 and O_2 concentrations also increased. Hence, we can presume that this serious trouble was caused by impurity gases. However, the cause of this trouble could not be clarified.

To keep the purity of liquid helium, we have to analyze the impurity gases in the recovered helium gas.

Reference

1) K. Ikegami *et al.*, RIKEN Accel. Prog. Rep. **38**, 286 (2005).

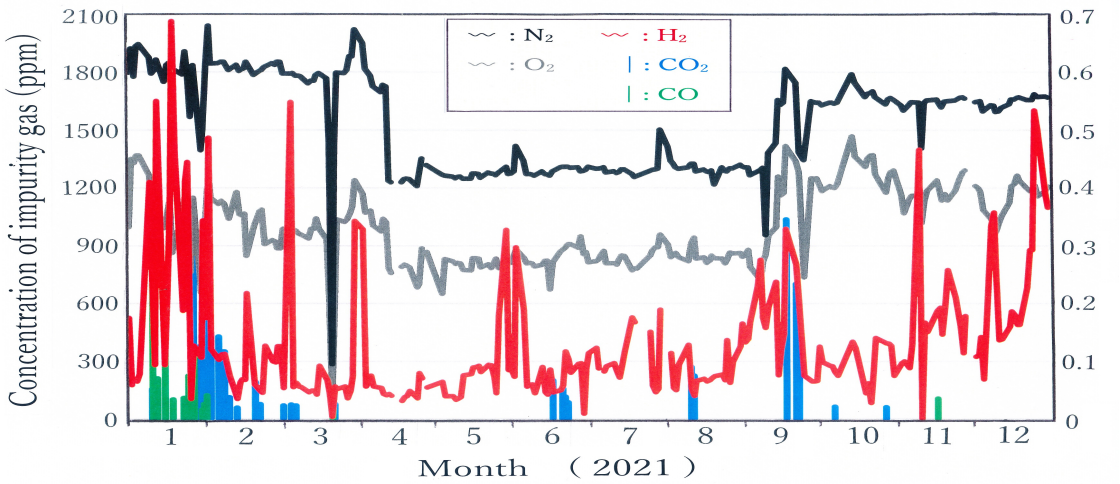

Fig. 1. Impurity concentration in the recovered helium gas in 2021.

*1 RIKEN Nishina Center
*2 Nippon Air Conditioning Service Co., Ltd.