OR-1-INV

Status of global supply and demand of helium and outlook for the future

*Yoshiki Koizumi[1]

K.K. Gas Review, Japan[1]

Helium is indispensable as coolant in cryogenic technology research and development. The gas is tight in supply and demand globally, making it difficult to obtain. Gas Review has been reporting the latest situation of helium for almost 40 years as the magazine specialized in industrial gas industry. In the lecture we will describe the current tight situation of helium and estimate how long this would continue.

Helium has been expanding in use in the USA, Japan, and Europe as an indispensable gas for cryogenic technology, MRI, and semiconductor as well as optical fiber manufacturing since around 1980, due to its physical property such as inert, high thermal conductivity, and low boiling point. The demand has rapidly been increasing in the East Asia including China, and India in these years.

Helium is also extremely rare natural resource, of which production area is very limited in the world. The gas is present in minute amounts in atmosphere, but the gas for industrial use is mostly produced as LNG by-product from natural gas field. Therefore, helium production depends on LNG plant operation and demand and supply balance of energy in the world. In addition, helium cannot be produced from any natural gas field. Only the USA, Qatar, Africa and Australia have natural gas field which can extract and purify helium at economically viable cost.

Tightness this time is the result of supply capacity not keeping up with globally growing demand. Regarding supply capacity, there has been no investment for new capacity in the world since Qatal II project in 2013. And the US helium operations will completely stop in 2020.

In spite of growth in demand, supply capacity has not been expanded. Limited supply capacity in the market leaded to limited supply to the users in the world.

This trend seems to continue over a coming few years. Sales price of helium will also hover at a high price. There is another point of view that the price might be down due to temporally mitigated demand and supply situation after 2021 when the new plant will start operation. But Gas Review expect that producers and suppliers will keep current price or move to additional price increase to maintain profitability in unstable helium business.

In the lecture, we would like to find out the future trend in helium supply and demand in the future.

Keywords: helium, natural resource, cryogenic

OR-2-INV

Development of High-Resolution HTS-SQUID Magnetometer for Observation of Magnetic Signals from Earthquake-Piezomagnetic Effects

*Kan Okubo[1], Yuto Oishi[1], Yuta Katori[1], Shinji Isogami[2], Tsunehiro Hato[3], Akira Tsukamoto[3], Keiichi Tanabe[3], Akira Tsukamoto[3], Nobuhito Ohnishi[4], Chikara Furukawa[4]

Tokyo Metropolitan University, Japan[1]
Research Center for Magnetic and Spintronic Materials, National Institute for Materials Science, Japan[2]
Superconducting Sensing Technology Research Association, Japan[3]
TIERRA TECNICA Ltd., Japan[4]

Electromagnetic changes associated with earthquakes have been investigated previously. For decades, researchers have studied the seismomagnetic effects[1,2]. From continuous observations, our research group reported a successful result which is “co-faulting” Earth’s magnetic field variation due to piezomagnetic effects caused by earthquake rupturing (i.e., earthquake(EQ)-piezomagnetic effects)[3]. This is an important finding: observation of EQ-piezomagnetic effect may lead us to a new system for super-early warning of earthquake detection.

However, additionally the observed result also suggested that the geomagnetic field accompanying fault movement are very small variations of some hundreds pT. Therefore, to develop an extremely high-resolution magnetometer system is so important, that our research group has developed a new geomagnetic observation system with low running cost and higher resolution at Iwaki observation site in Fukushima, Japan: we introduce high-temperature-superconductor based superconducting-quantum-interference-device (HTS-SQUID) as a magnetometer for a long-term geomagnetic observation.

The sampling-frequency of our magnetometer system is 50 Hz (0.02 s) which are higher sampling frequency than our conventional observation system using a flux-gate. Our system observed the orthogonal three-vectors of geomagnetic field vibration. The clock of this system is synchronized with a GPS signal. These observed data are uploaded to the web server through the mobile network.

Through our evaluation, it is clarified that the resolution of our HTS-SQUID magnetometer systems is about a few or several pico-tesla. We obtained the observation results of geomagnetic field changes associated with the earthquake generated near our observation point using our high-resolution magnetometer system.

[1] F. D. Stacey, Pure Appl. Geophys., vol. 58, no. 1,pp. 5–22, Jan. 1964.
[2] M. J. S. Johnston and R. J. Mueller, Science, vol. 237, no. 4819, pp. 1201–1203, 1987.
[3] K. Okubo, N. Takeuchi, M. Utsugi, K. Yumoto, and Y. Sasai, Earth Planet. Sci. Lett., vol. 305, no. 1–2, pp. 65–72, May 2011.

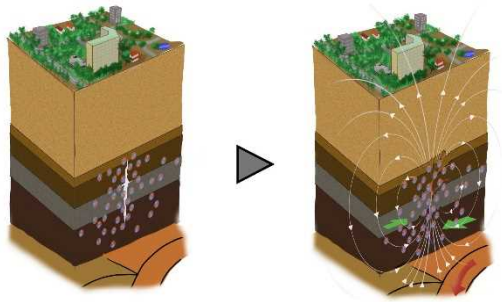

Fig. Aspect of Earthquake (EQ)-piezomagnetic effect: Earth’s magnetic field variation due to piezomagnetic effects caused by earthquake rupturing

Keywords: magnetometer, HTS-SQUID, earthquake-piezomagnetic effects, observation