

IMPLEMENTING ATOMIC TECHNOLOGY IN THE DEVELOPMENT OF HIGH-SENSITIVITY GAS ANALYSIS SYSTEMS

The Contribution of Swagelok's Quality and Supporting System

As quality control is becoming increasingly important in many areas these days, consumers have started showing more interest in the foods they purchase. People are more and more sensitive now with respect to selecting safe foods, and have started demanding information about the agricultural and livestock commodities in their foods, such as ingredient lists and expiration dates. Because there is also the idea that disclosure of such detailed information helps to add value to the products, many analytical systems have been introduced. However, up until now, the major analytical methods were mostly conducted in ways which partially destroyed the tested objects, such as electrifying or by dissecting parts. Recently, nondestructive testing (methods which do not harm the objects) is being focused on.

The Japan Atomic Energy Agency (JAEA, an independent administrative agency, in Tokaimura, Ibaraki Prefecture, Japan, President, Atsuyuki Suzuki) is dedicated to comprehensive research and development (R&D) in the field of nuclear energy. There are almost 2,000 intellectual properties (some of them pending patent applications) which are the offspring of their R&D. The Industrial Collaboration Promotion Department in JAEA is now conducting collaborative research with private sector companies in view of developing new products.

The achievements from the collaborative research mentioned above include the 'Gravi-Mass®' (Combined System of Electromagnetic Force Vacuum Balance and Quadrupole Mass Spectrometer) and 'Breath-Mass®' (High Sensitivity Gas Analysis System using Quadrupole Mass Spectrometer), both of which are nondestructive testing devices, jointly developed with Nikkin Flux Inc. These devices are based on the intellectual properties derived from the results of atomic fusion research, implementing the technologies of applied vacuum engineering. They can gather, measure, and analyze gas components emitted from human breath or from the surface of vegetables, without harming the tested material. It also shows a practical performance level in the time required to conduct the analysis, which is approximately 10 seconds, a remarkable speed for a device with such highly sensitive analytical performance.

In the case of Breath-Mass, only 0.2ml of human breath is needed to instantly analyze and produce detailed information into identifiable data. They can produce data such as what the test subjects have been eating for several days prior, or whether they had smoking habits in the past, and so forth. The same principle is used for a standard doping inspection device or an alcohol detector, but according to Hajime Hiratsuka, an assistant principal engineer at JAEA, "acquired data from Breath-Mass is constantly maintained under 0.1% in its reproducibility variation rate. The reproducibility itself is 10 times better when compared to gas analyzing devices with the same vacuum system structure.

This high reproducibility is made possible owing to the special vacuum evacuation system for which JAEA possesses intellectual property, and also to Swagelok vacuum components, such as bellows valves, which can keep the emitted gas amount to a minimal volume."



"We are relying on Swagelok quality products where leakage is strictly prohibited under high temperature where vacuum technologies are applied," explains Tetsuya Abe (Coordinator of the Industrial Collaboration Promotion Department, an independent administrative institution, the Japan Atomic Energy Agency).



Breath-Mass: High Sensitivity Gas Analysis System using Quadrupole Mass Spectrometer (provided by an independent administrative institution, the Japan Atomic Energy Agency [JAEA]).

An advanced technique is implemented in this device to make it possible to produce sophisticated analysis data. When analyzing an object, Breath-Mass uses a special system to create an ultrahigh vacuum with a pressure almost the same as the surface of the moon. In order to maintain this vacuum condition, device is required to be heated up to a high temperature of approximately 200°C, which means that each component of the device is also required to show high durability and quality.

“While leakage is not tolerated at all in vacuum conditions, valves and other components, in general, are susceptible to melting and causing thermal deformation when heated at high temperature. Besides, if a component is contaminated with impure materials, they may emit toxic gas. In this regards, Swagelok uses high quality materials which are already gas vented, and valves do not deform under high temperature,” says Tetsuya Abe, a coordinator of Industrial Collaboration Promotion.

In the Industrial Collaboration Promotion Department, Swagelok is highly recognized not only for the high quality and stability of its products, but also for its supporting services. Hiratsuka explains that, in the research and development field, quick responsiveness is also a key factor in the service that is expected from the supplier. For example, if there were an emergency case during development experiments using Breath-Mass, immediate replacement of the malfunctioning components would be critical. If the system failed to maintain a vacuum state, the experiment would have fatal damage.

Nippon Swagelok FST, Inc., the authorized sales and service center for Japan, has established a quick, responsive service system to deal with an emergency state like this, at any time. This flexible delivery system and the resulting reliability have led to a high reputation within the department. “The same thing may apply to the semiconductor industry, where the system is operating 24 hours a day. It is not practical to use a supplier who doesn’t have a service system to respond quickly,” commented Abe.

For more than 20 years, JAEA has been using Swagelok products for their reliability. Approximately 20 products, including Swagelok® bellows sealed valves, are used for each Breath-Mass, and for Gravi-Mass, about 40 Swagelok products are used.

Currently, Gravi-Mass is mainly used in automobile related factories, for evaluating the quality of the recycled automotive parts. Breath-Mass is already commercially utilized in various fields. Analyzing the freshness of foods and alcohol aromas are two examples. It is also expected to be utilized in medical practices, since it is much easier and accurate for a diagnosis compared to a normal blood examination. Since the technologies of applied vacuum engineering, which is the offspring of the atomic research, have developed into totally different fields, it is important to look for improvements in each of those applied fields.

Swagelok has also discussed ways to assist JAEA improve the fluid system components, such as developing Engineered to Order Products (ETOP).

“We are also planning to begin commercial production of Gravi-Mass and Breath-Mass, and would like to promote its utilization further in the future as a solution for varieties of challenges,” says Kuniaki Shoji, director at JAEA. It seems a bright future is much to be expected for Gravi-Mass and Breath-Mass.