SCIENTIFIC INSTRUMENT NEWS

INTERVIEW

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The RoHS Directive* was released in July 2006, and since 2007 many nations and regions around the world have adopted regulatory frameworks based on it. More recently, 2019 witnessed the addition of four types of phthalate to the list of regulated substances. In response, Hitachi High-Tech Science collaborated with Takeo Kitahara to develop the HM1000 dedicated phthalate screening system. Since then, increasingly stringent regulations have placed growing emphasis on the important role played by ExTOPE, which facilitates sharing of test data and increases administrative efficiency. To learn more about the backstory behind the development of the HM1000—and about expectations for the new ExTOPE system—we spoke to Takeo Kitahara of the Environment & Climate Change Strategy Department at Brother Industries, Ltd.

Introducing ExTOPE for Sharing of Test Data on Regulated Substances. A Promising Future with International Ties.

Takeo Kitahara

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*See also Kitahara's article on the RoHS Directive and the development of the HM1000:
https://www.hitachi-hightech.com/global/en/sinews/si_report/110204/
•For more on the HM1000A, a phthalate screening system based on a thermal-desorption mass spectrometer, see here:
https://www.hitachi-hightech.com/global/en/products/analytical-systems/ms/td-ms/hm1000a/
•For an overview of instrument data-collection systems based on ExTOPE (an IoT service portal), see here:
https://www.hitachi-hightech.com/jp/ja/products/analytical-systems/xrf/device-data-acquisition-system/data-collection.html
(in Japanese)

1. Collaborating with Takeo Kitahara to Develop a New Test System in Response to the RoHS Directive

Behind Takeo Kitahara's decision to introduce ExTOPE lies his previous experience collaborating with Hitachi High-Tech Science to develop the HM1000. The origins of that collaboration date back to 2013.

At that time, Kitahara had predicted that phthalates were highly likely to be targeted by new regulations, and had begun investigating techniques for reducing use of phthalates and testing for their presence. Because phthalates were widely used as plasticizers—softening agents for resins and rubbers in products such as insulating coatings for electric wiring, electrically insulating tapes, and packaging films—this was a matter of considerable urgency for many manufacturers, particularly manufacturers of electronic devices and electrical appliances. Kitahara realized that the occasion called for a new analytical instrument, and he turned to Hitachi High-Tech Science for solutions.

"Around 2 years before the new regulations went into effect, I had the privilege of witnessing a demonstration of a testing system," he recalls. "My impression at the time was that, although measuring times were somewhat long, the use of an electronic cooling technique—without the need for liquid nitrogen—was very attractive. The reason was that, in our plants, we don't have on-site experts in cryogenic procedures like handling liquid nitrogen, so it was very important to have instruments that could be used safely by anybody."

A number of problems that became apparent during the demonstration needed to be solved, and performance had to be improved to satisfy the RoHS Directive. The fact that these advances were completed in a relatively short time—around 1 year—was surely due to Kitahara's assistance.

2. Enabling On-site Phthalate Screening at Production Plants

Before regulations were revised, all regulated substances covered by the Directive could be detected with high sensitivity using fluorescent X-ray analyzers. However, detecting macromolecular compounds like phthalates requires gas-chromatograph mass analyzers. This was problematic for several reasons: the required measurement instruments were expensive and complicated to operate, and they required around 30 minutes to yield results—all factors that posed difficulties for daily testing protocols at production plants. It was right around that time that Hitachi High-Tech's analytical division merged with SII Nanotechnology to form Hitachi High-Tech Science; the two firms combined their expertise in mass-analysis and thermal-analysis techniques to create the HM1000.

"The background and concept of the HM1000 was this goal of daily on-site testing at production sites so that we could ship products, and I think the decision to focus on performance optimized for testing at the product-shipping stage was a key point," explains Kitahara. "We were grateful to Hitachi for producing a product that met those needs."

3. Using Test Instruments at Production Sites Helps Increase Measurement Accuracy

As noted above, the HM1000 was developed over a brief period of time, allowing only a few sample measurements to be made during the development process. Increasing the accuracy of the instrument required actually using it at production sites and improving its performance on the fly—and here, again, Kitahara's assistance proved invaluable in this PDCA cycle.

"We were convinced that if we shared the problems and worked on them together, we'd be sure to make progress," says Kitahara. "To that end, we were also grateful to receive early delivery of the testers."

Because these instruments were in demand from the community, we prioritized delivering them to production sites first. For Hitachi High-Tech Science, that was a momentous business decision. The processes of delivering a measurement system before it had been fully vetted, getting it used on-site, and working together to complete the instrument were only made possible by the trusting relationship we had built. This type of partnership is enormously powerful for tackling challenges like advancing technologies and solving social problems—and that enterprising spirit is surely the basis for Brother Industries' decision to introduce ExTOPE at some of their Japanese sites where Hitachi High-Tech Science instruments are used, thus allowing the system to be cultivated as it is used.

Innovative product development depends essentially on partnerships that break down barriers. Takeo Kitahara insists it was his trusting relationship with Hitachi High-Tech's "5 brave men" that enabled the HM1000 to be developed so rapidly.

4. Introducing ExTOPE in Japan: Exploiting the Cloud to Increase Administrative Efficiency

What sorts of considerations led up to the introduction of ExTOPE today? Takeo Kitahara explains the situation as follows.

"In the past, whenever we wanted to exchange data with a production plant we had to call them on the phone and double-check which dataset in which folder we were talking about," Kitahara recalls. "Even after multiple emails sent back and forth, we frequently had trouble getting through to each other. We quickly realized that ExTOPE was the ideal solution for eliminating all of that lost time. Plus, when necessary, the system even makes it easy to look at results that the HM1000 measured automatically on evenings or holidays. We decided that ExTOPE had multiple advantages like this."

Brother Industries began using ExTOPE in 2019. At present, the system is operating only at plants in Japan, but Kitahara is looking forward to establishing connections with overseas plants as well. In particular, for plants in the U.S. and U.K.—where the time difference vs. Japan is significant—conversations by email often straddle multiple working days. But even in such cases, Kitahara notes, "with ExTOPE we can continue working right through the data—a huge advantage!"

When asked how ExTOPE is being utilized, Kitahara starts by explaining how the system has improved administrative efficiency. "More and more instruments these days can make automated measurements, but the data can only be viewed on a PC screen. That means that all the advantage of the automatic measurement can be wasted—if you're out of the office traveling the following day, you wind up having to wait until the next working day to see test data. But ExTOPE allows you to look at the data from your travel destination—and issue instructions for what to do next. I personally oversee many test instruments, and the ability to check their operating status is also a major advantage."

Kitahara also notes ExTOPE's virtues from the perspective of security controls. Because the PCs that control measurement instruments operate in standalone configurations, the traditional approach was to save data on USB drives after every measurement, then transfer the data to other PCs in the office for evaluation. The introduction of ExTOPE eliminates the need for that step, helping to improve security. Moreover, in the rush to adjust to the new world of COVID-19, ExTOPE smooths the transition to working at home or hybrid-work arrangements, offering another key secondary benefit.

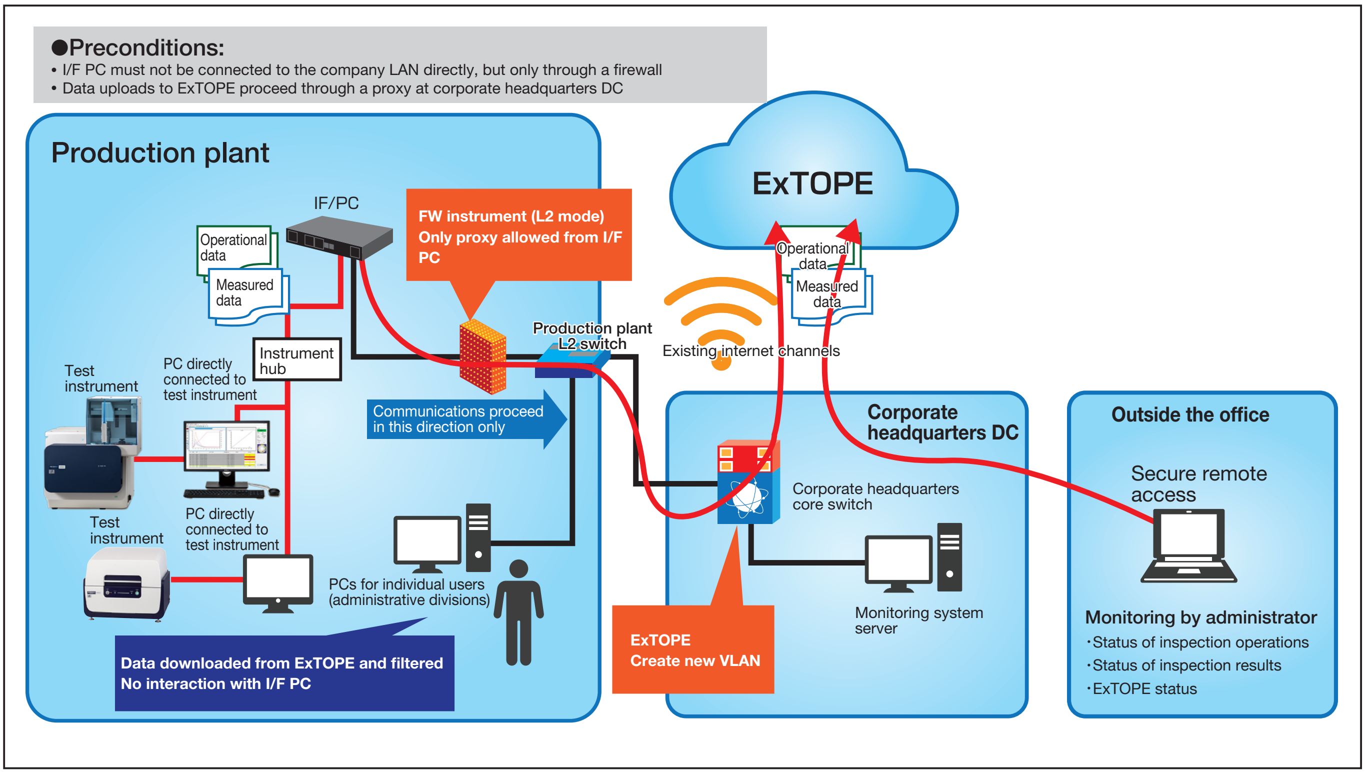

Fig 1. Conceptual flowchart of ExTOPE operations.

Fig 2. ExTOPE on-screen display

5. Future Trajectories—and Hopes for New Capabilities

The final report regarding the RoHS Directive, released on April 21, 2020, noted the high likelihood that medium-chain chlorinated paraffins (MCCPs) and tetrabromobisphenol A (TBBPA) would soon be subject to regulatory limits. We asked Takeo Kitahara to describe his plans and expectations for responding to new substance regulations and the role to be played by ExTOPE.

“When new regulated substances are added, we’re looking forward to being able to make measurements in negative-ion mode via the HM1000’s atmospheric-pressure chemical ionization (APCI) feature,” Kitahara explains. “When we can do this, we’ll be able to measure TBBPA and MCCP, a chlorine compound, in negative-ion mode—and then switch right over to measuring phthalates in positive-ion mode, just as we do now. We’ll be able to do all of our analyses at once, and we’re eagerly anticipating that capability. Also, switching measurement modes may have the consequence of subdividing data, but within ExTOPE we may be able to combine test results into compound datasets and make comprehensive judgments—which will be even better.”

Another key advantage noted by Kitahara is the ability to use ExTOPE not only with analytical instruments from the Hitachi Group, but also with systems from other manufacturers.

“For measuring new substances,” Kitahara explains, “the ability to combine analytical data from multiple separate instruments—and analyze everything in a unified way to make pass-fail decisions via ExTOPE in the cloud—will reduce the likelihood of incorrect judgments due to human error, which will be very powerful. Also, if we can use AI to make decisions about spectrum files for measured data in the cloud, that will free up our experts to devote their time to other tasks. Ultimately, we envision a world in which everyday decision-making is handled by AI, while the challenges of addressing new material and rules are handled by humans.”

6. The Conviction That New Metrologies Will Support Manufacturing Industries

So how did Takeo Kitahara get started down the road of metrology in his career? “During my college years, I worked during the day and took courses at night,” he recalls. “In the measurement-certification office where I worked, there was a supervisor who could have been called the god of analysis, and I think my good fortune in meeting somebody I wanted to emulate was a big factor.”

Kitahara also attributes his understanding of the importance of accurate metrology for industrial purposes to things he learned during those years. Later, he went to graduate school, then joined Brother Industries and was assigned to the Environmental Division, where he conducted experiments on water quality and similar subjects. As environmental regulations began to restrict the quantities of chemical substances in products, there was growing demand for compliance techniques, and Kitahara found purpose in helping the industrial world fulfill its mission of delivering safe, worry-free products to consumers.

“When I was choosing where to work, that inspirational supervisor told me to go out and see the wider world,” Kitahara remembers. “That really stuck with me, and to this day I’m driven by the goal of doing work that he would be proud of.”

Within a tradition of making things that dates back more than a century, household appliances familiar from everyday life stand out—and none more so than the full wall displaying the history of sewing machines (top). Also prominent is the *garment printer* designed to print on fabric (bottom), which is said to have produced output of such high quality that it was installed in dress shops throughout Japan. The HM1000 plays a role in manufacturing processes for products like this as well.

Photos (with permission) from the Brother Museum in Nagoya, Japan.

Takeo Kitahara told us his dream for the future is to achieve non-destructive testing of every item.

“When you manufacture products on a daily basis, controlling those products efficiently requires more than just measurement technology—it also requires careful consideration of sample selection, including narrowing the focus of measurements and studying the frequency with which products are chosen for testing,” says Kitahara. “At present, it’s not possible to analyze every component and material, but what would be very desirable is a manufacturing line on which every product could be tested non-destructively for online auditing. I think that’s our ultimate goal in this line of work.”

Hitachi High-Tech Science will continue exploring the future of analytical instruments to bring Takeo Kitahara’s vision closer to reality. We are grateful to Takeo Kitahara for taking the time to join us for this interview.

Interviewer: Toshinari Yamaguchi

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https://www.hitachi-hightech.com/jp/ja/sinews/special/011b/

“The RoHS Directive and other restrictions on the chemical content of products and analytical methods for handling controlled substances” (in Japanese)
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