azbil

2017 Vol.3
azbil Group PR magazine

azbil FIELD
Tokyo Rinkai Heat Supply Corporation

azbil MIND
Ensuring Safe and Consistent Operations of Plants and Factories Across Japan By Reinforcing Valve Maintenance Systems and Providing IoT-Based Services

Special Feature

Japanese zippers that fasten the world together

Japanese zippers that fasten the world together

Japanese manufacturer YKK's fastening products are used not only for daily fashion items such as clothing, but also for use in automobiles and in outer space. Zippers may look like simple devices, but they are actually packed with a wide range of technologies to meet the expectations of various industries.

Masahiro Kusayama
Executive Chief Engineer
Product Development Division,
Fastening Products Group,
YKK Corporation

Birth of one of the world's leading zipper makers

YKK factories all over the world, including those in Japan, produce about 2 million km of zippers per year, which is the equivalent of 50 times the circumference of the Earth. Manufactured to an accuracy of 0.01 to 0.1 mm, some of YKK's fastening products can withstand opening and closing 10,000 times. These Japanese zippers are truly the world's leading fastening product in terms of both quality and quantity.

Founded by Tadao Yoshida in 1934 in the Nihonbashi area of Tokyo, YKK Corporation was originally called San-es Shokai and sold handmade fastening products. Just after World War II, Yoshida approached U.S. buyers to export his fastening products. Mr. Masahiro Kusayama, YKK Fastening Products Group, explains the history of the company.

"Although the company took pride in its products, I've heard that YKK's products at that time were not competitive with the zippers manufactured with automated high-performance machines in the U.S. in terms of either quality or price. So, in 1950, the company decided to purchase four of the latest chain machines from the U.S. to automate its zipper production. The price per machine was comparable to the company's annual sales at the time. But productivity improved to four times that of manual output."

After that, YKK requested a precision machine manufacturer to develop a machine that could be competitive with the U.S.-made chain machine and immediately introduced 100 units, dramatically improving the quality of their fastening products.

Yoshida believed that an integrated production system, including the production of materials, was necessary to stabilize and improve the quality of his fastening products. Therefore, after establishing an automated mass production system, he built an aluminium alloy manufacturing factory and a spinning factory in order to have an integrated zipper production system that included the production of metal parts and yarn. In the 1950s, YKK started manufacturing chain machines in-house.

It was also the integrated production system that assisted YKK's overseas expansion, which began in 1959. Since apparel requiring zippers is produced in a wide variety of types in small quantities with short production cycles, fastening products must be produced locally in order to promptly respond to customer needs.

"We not only brought manufacturing machinery developed in-house to our factories around the world, but also delegated authority to the local subsidiaries to facilitate quick decision making. It is our 'localism' that enables a quick response to each country's market demands while maintaining the quality of products."

In 1978, YKK, already a global market leader, entered the U.S. jeans market with its in-house sewing machines that attach zippers to jeans automatically. These machines were of such high quality that a leading U.S. brand decided to use them in its 17 factories. Today, YKK conducts business in 71 countries and regions around the world, based on a six-region global business management structure.

Components of a zipper

A zipper consists of three parts: a slider with a pull tab to open or close the zipper; two rows of small elements called teeth; and tapes where the elements are attached.

From underwater to the ground, and even to space

In the 1970s, as the accuracy and durability of zippers improved thanks to advances in technology and materials, fastening products were used in fields other than apparel. For example, flame-retardant zippers, which are processed to make the zipper tape fire-resistant, can withstand temperatures as high as 1,000 ℃ and are used for firefighting suits and fire shutters. Rust-resistant, lightweight, and strong zippers for fishing nets are also used in cage nets for fish farming. Recently, in another example, nets fastened with zippers were installed instead of tetrapods to prevent the erosion of coastlines by the sea. For spacesuits, chemical protective clothing, diving suits, etc., YKK's watertight and airtight PROSEAL® zippers are used.

Currently, YKK produces about 100,000 different types of fastening products. All of these products are the fruit of the development team's flexible thinking and close relationships with their clients.

"It is important for us, as professionals who understand the fundamental principles of zippers, to listen to the needs of our customers to develop and manufacture new products. It is also necessary for us to make proposals to customers, suggesting that we can produce such and such type of product. By making these continuous efforts, we were able to earn customer trust and expand our business," says Mr. Kusayama.

Spacesuits

Pressure suits are worn by astronauts during space shuttle launch and re-entry. YKK's watertight and airtight zippers were used from front to back on the suits.

Accumulation of technology and free thinking for the future

How will zippers evolve in the future?

"For the past decade or two, we have been developing zipper technology focusing on the development of value-added products and the pursuit of quality, low cost, and quick delivery. However, the basic concept of zippers, including the manufacturing method, has not changed significantly. It is difficult to create a revolutionary new product in this industry."

In the household appliances sector, for example, technological innovations have replaced CRT TVs, which were standard televisions twenty years ago, with LCD and OLED TVs. Of course, YKK has been conducting studies to improve quality, including research on new combinations of raw materials, and YKK engineers are constantly exploring ways to create something new.

"Our zippers are used for connecting artificial turf mats and attaching car seat covers. These are examples of zipper usage born from changing the idea that a zipper is to be opened and closed repeatedly. It's a new idea that once zippers are closed they will not be opened again. I think we should be able to create something more interesting using imagination and flexible thinking. We will continue our efforts to develop excellent products that will surprise our customers."

YKK's wisdom, accumulated over 80 years since the company's foundation, and its willingness to take on new challenges are rock-solid. The company's fastening products, made with the spirit of *monozukuri*,*1 will continue to contribute to our daily lives.

*1 The art, science, and craft of making things.

Tokyo Rinkai Heat Supply Corporation

The Tokyo waterfront area where Tokyo Rinkai Heat Supply Corporation is providing heat

Tokyo Rinkai Heat Supply Corporation, a district heating and cooling business serving Tokyo's Rinkai Fukutoshin area, upgraded the central monitoring systems at its plants and integrated their distributed control systems.*1 On this occasion, the company extensively revised and reconstructed its system for optimizing operation, making operation highly efficient by selecting which heat source equipment, etc., to operate based on data such as current energy demand trends, weather conditions like temperature and humidity, and past operation data.

Making use of a new operation support system to achieve optimal operation of heat source equipment

Established in 1990 to provide heating and cooling services across Tokyo's Rinkai Fukutoshin area, Tokyo Rinkai Heat Supply Corporation produces 7 °C chilled water and 80 °C heated water at its three district heating and cooling plants in Daiba, Aomi Minami, and Ariake Minami (all in Tokyo), and provides heat in these districts for office buildings, hotels, hospitals, recreational facilities, TV stations, etc. At the Ariake Minami and Daiba plants, the company helps to reduce CO_2 emissions and save energy by using waste hot steam emitted from the Ariake Incineration Plant.

"Since we began providing heat in 1995, we have continued to improve operational efficiency while putting our efforts into providing a reliable energy supply. In the process, we have successfully lowered energy rates a total of five times, because our focus is always on lowering costs for our customers," says the company's president, Masaru Hosoi.

In around 2006, ten years after the plants began operation, the company started to discuss an upgrade of the plants' central monitoring systems, which had begun to age. Uppermost in mind during the discussions was the integration of the monitoring systems at the three plants.

"Until then, the three plants had independent systems. We thought that the upgrade was the right moment to put these plants' systems together and construct a shared system so that we could improve operability by standardizing procedures for operators working at the different plants. We also wanted a heat supply that could meet customer demand just by furthering the development in the Rinkai Fukutoshin area, so we needed to establish a system that enabled these plants to cooperate with each other to achieve various aims, such as cost reduction," explains Takayuki Hatabe, director of the Engineering Department.

"Operators working at the plants decide the appropriate number and combination of heat source devices to operate according to the current energy demand and weather conditions like temperature and humidity. The old operation support systems were only capable of predicting customers' energy consumption, so our operators had to make decisions based on their experience. As a matter of course, the decisions varied depending on the operator, and human judgment is limited. So we wanted to install a new operation support system that could help operators by providing guidance for operating the heat source equipment so that we could make our heat production more efficient," says Takashi Yamaguchi, director of the Ariake-Minami Management Office.

Left: The central monitoring room at the Ariake Minami plant. Operators at the three plants can now share the same view through their screens in their central monitoring rooms, which enables them to reference information about problems that occurred at other plants and how they were handled. The current operation support system has implemented a unique function that shows the approximate price in yen of the electricity and/or gas being used to produce one gigajoule of energy.
Right: The same operation support system monitors can also be accessed and viewed from offices at the headquarters, allowing relevant departments and management personnel to check the status of operations.

DSTJ™3000 Ace+ differential pressure transmitters measure the pressure of the main pipes for heat and chilled water.

Left: A MagneW™3000 FLEX+ electromagnetic flowmeter measures flow rate while a DSTJ3000 Ace+ transmitter measures pressure.
Right: A turbo chiller uses electricity to produce chilled water.

Upgrade process examined closely to guarantee a reliable heat supply

Tokyo Rinkai Heat Supply Corporation asked several companies, two of which were suppliers of the existing systems, to submit estimates and upgrade plans. After a comprehensive assessment of the plans in terms of the technological skill and past performance of the company, cost, maintenance system, etc., Azbil Corporation, the supplier of the former system at the Ariake Minami plant, was selected as the partner for the new project.

"We were favorably impressed by Azbil's past performance, such as its cordial handling of maintenance work at our plant, and when thinking about future operations, we felt comfortable with Azbil's plan, which stated their intent to hear operators' requests at any time and continually incorporate them into the system," says Mr. Yamaguchi.

At the start of the project, Azbil conducted a survey to gain insight into the opinions and requests of all operators working at the three plants. Incorporating as many of the requests as possible, Azbil constructed a system which was ideal for the sites, based on a highly dependable open automation system called Industrial-DEO™, and including a utility optimization software package for power plants with heat source equipment in order to ensure optimal operation. One of the important challenges for Azbil was to find a way to make efficient progress in the system integration work while maintaining the reliability of the heat supply.

"There are hospitals in the area we serve, so we can never interrupt the heat supply. Upgrading a system while it is running a plant is difficult and requires caution. We spent one year in discussions over the selection of the measurement and control system and the construction methods necessary to integrate the systems, repeatedly checking and adjusting fundamental matters before we finally settled on the details of the upgrade. The construction period was planned to be one year per plant. We made a detailed plan for five-year construction starting from the Aomi Minami plant, and then continuing to Daiba, Ariake Minami, and finally the headquarters in that order," says Mr. Hatabe.

Electricity and gas contracts factored in to achieve minimum-cost operation

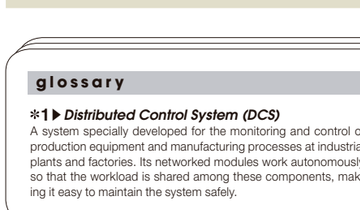
Thanks to careful preparation, the upgrade work, which began in 2010, made smooth progress and was completed for all locations by the end of 2014. The same project team, composed of the same members, carried out the work for all three district plants, so the knowledge they gained from preceding upgrade work was effectively leveraged in subsequent work.

"Plant operational data that has been accumulated since the start of operation is one of the very important sources of information we can use to achieve optimal operation. We handled that data very carefully in order not to lose any of it during the upgrade work, and after considering the best way to import it into the new system, we successfully did so at each plant," comments Mr. Hatabe.

After the upgrades, the new system can predict the demand one hour or 24 hours in the future by referencing the operation data for the same time in the previous year. It also imports weather data, such as the outdoor temperature and humidity, which can greatly affect plant operation. It then presents operators with the best number and combination of devices to achieve optimal operation in terms of cost, CO_2 emissions, and operating efficiency. "There are two types of heat source equipment, electricity-driven and gas-driven. The new system uses the best combination of both to achieve energy efficiency," says Mr. Yamaguchi.

Tokyo Rinkai Heat Supply Corporation is determined to continue its pursuit of efficiency. "The series of deregulation measures advanced by the Japanese government will force us energy service companies to compete more intensely. So increasing the reliability of our heat supply and becoming more cost-competitive are important challenges for us. The key to addressing these challenges is to make the best use of our new system. We are looking forward to Azbil's help on this point also," says Mr. Hosoi.

Tokyo Rinkai Heat Supply Corporation



Location
3-6-11 Ariake, Koto-ku, Tokyo
Established
August, 1990
Business
Supplies heat in the Tokyo waterfront area for heated or chilled water

Masaru Hosoi
President-Director

Takayuki Hatabe
Director of the Engineering Department
(at the time of the interview)

Takashi Yamaguchi
Director of Ariake-Minami Management Office
Engineering Department

glossary

1 ▶ Distributed Control System (DCS)
A system specially developed for the monitoring and control of production equipment and manufacturing processes at industrial plants and factories. Its networked modules work autonomously so that the workload is shared among these components, making it easy to maintain the system safely.

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Ensuring Safe and Consistent Operations of Plants and Factories Across Japan By Reinforcing Valve Maintenance Systems and Providing IoT-Based Services

With the aim of helping plants and factories to reinforce their valve maintenance systems, Azbil Corporation has installed five valve maintenance centers in Japan and established a system that enables the centers to help each other by dispatching maintenance staff and sending equipment. Thanks to this system, the centers can provide cross-regional valve maintenance services, and by also providing IoT-based valve diagnosis services, they help to ensure the safe and consistent operation of customers' plants and factories.

Providing high-quality maintenance services, backed by a history of achievement in valve manufacture and maintenance

Guided by its corporate philosophy of "human-centered automation," the azbil Group develops products and services using its control and measurement technologies. One of its core areas of business is advanced automation, which ensures the safe and consistent operation of customers' plants and factories and plays a role in improving the quality of customers' products and the efficiency of manufacturing. Azbil equipment is used in various facilities for the production of oil, industrial chemicals, etc. Included in this equipment are valves. Since they control the flow rate and pressure of liquids and gases that are important for manufacturing, valves are essential devices for maintaining the quality of products and for consistent production.

Valves are put on rails while being inspected, repaired, and maintained, in order to keep them upright. The new maintenance facility has added two more rail tracks, doubling the previous amount, and has improved its workflow to make overall maintenance performance highly efficient.

Generally, industrial plants regularly halt all production lines every two or four years in order to maintain equipment functions and ensure consistent operation. During this periodic shutdown maintenance, large facilities and equipment are repaired and maintained. At this time, valves also undergo overhaul inspection. They are removed, disassembled, and cleaned. If necessary, old parts are replaced. With its expertise and specialized technology cultivated over many years of valve manufacture and maintenance services, Azbil can provide high-quality maintenance services not only for its own products, but also for valves made by other companies. This results in increased convenience for customers, as it eliminates the complication of requesting inspections from multiple manufacturers.

With five maintenance centers, a flexible system covers all of Japan

Azbil has bases in each region where many industrial complexes are located, so it can provide services to nearby customer sites by maintaining Azbil valves and other devices that are used. Since customers often wish to have their facilities undergo maintenance at the same time as the nearby ethylene plant,* or they wish to shorten the maintenance period, valve inspection and maintenance orders tend to be concentrated in the same periods of time. To address these busy periods, Azbil established a valve maintenance center in each of its locations in the five relatively large industrial zones of Kashima, Chiba, Yokkaichi, Mizushima, and Kawara, and constructed a system for sharing staff, work space, and equipment in cases where one of the regions becomes busy with maintenance work, so any engineer can help with technical support to that region. Each center has an operational director who provides technical guidance and adjusts the workload among the centers when some are busy with maintenance work. In this way, by providing cross-regional solution-based services, the centers provide reliable maintenance across Japan.

Disassembled valves from customers' plants. The inside is cleaned and, depending on the amount of wear and deterioration, valves are repaired, parts are replaced, and coating is applied. Valves are restored to like-new condition and returned to customers.

To ensure quality, engineers use specialized test equipment to check a variety of characteristics of repaired valves, including tests of pressure, airtightness, leakage, and operation.

The maintenance center at the Mizushima office in the city of Kurashiki (Okayama Prefecture) is the largest of the five and serves as the hub for the others. Receiving orders from the surrounding large industrial complexes, the center services a great variety of valves and has accumulated a corresponding amount of know-how.

When it relocated in February 2014, the Mizushima office expanded the size of its maintenance center, revised its workflow, and made its procedures more efficient. As a result, the office has successfully shortened the time necessary for maintenance and improved maintenance quality.

Furthermore, the location serves as a training site for engineers who are involved in valve maintenance work across the azbil Group. Many engineers visit from around the world and around Japan in order to learn management methods for finishing a large number of valves in a short time, or for hands-on practice of parts replacement skills that are difficult to learn from manuals. On top of that, the center has created a system for evaluating and visualizing engineers' maintenance techniques to help them improve their skills. Azbil plans to establish an internal qualification system to recognize valve engineers who have reached a certain level as "highly skilled engineers."

Valve diagnosis services provided by fusing maintenance and IoT technologies

It is impossible to tell if a valve is worn out or degraded inside only by checking its appearance. Therefore, time-based maintenance (TBM), meaning that valves are inspected on a regular basis after a certain interval, is usually used. However, in recent years, a more efficient method called condition-based maintenance (CBM) has been attracting attention. In CBM, the condition of valves is checked without disassembling them, and maintenance is provided only to those valves that need it.

CBM is made possible by Azbil's smart valve positioners, which not only control the opening and closing of valves but also measure their condition as they operate, and by a control valve maintenance support system called PLUG-IN Valstaff™, which can analyze data from the positioner and provide diagnosis. This IoT-based system can grasp the condition of every valve in real time and identify valves whose movement is abnormal.

Recently, many industrial plants face the problem of aging facilities and fewer experienced maintenance personnel, so it is important for them to find a way to take over or supplement veterans' technical skills in order to ensure safe and consistent operations while improving productivity. From that standpoint also, Azbil's smart valve positioners and Valstaff are useful, since they can supplement veterans' techniques and reduce the workload of maintenance staff. From now on, Azbil will provide valve diagnosis services that make use of these smart valve positioners at overseas valve maintenance centers also.

Azbil Corporation intends to continue to provide speedy and high-quality maintenance services and high-value-added valve diagnosis services using advanced technology in order to help its customers to operate their plants smoothly.

*** Ethylene plant**
A facility that generates ethylene, which is a raw material for petrochemical products, and provides it to petrochemical plants. Companies increasingly opt for joint operation by integrating their facilities.

Keywords A to Z Vol.13

Keyword Risk Assessment

Overall process comprising a risk analysis and a risk evaluation. This method involves identifying injuries that could possibly be caused by the product, analyzing the probability and severity of these injuries, and assessing the risk level (probability combined with severity).

Ensuring product safety is essential in manufacturing

Today, the importance of product safety is emphasized more than ever before.

Products with safety concerns can lead to serious problems, such as user injury or even a fatal accident. Product-related injuries and damage do not affect the user only. The manufacturer may lose the public's trust and be damaged by reduced effectiveness of the brand, lower sales, and a large loss of money due to product recalls, etc.

Therefore, when making products, not only the pursuit of quality but also the effort to ensure safety by risk assessment is effective.

The word "risk" is used in various contexts, but in the area of product safety, it is used in sentences like "Because the risk of injury from using this product is significant, it is not acceptable." There is no perfect measure for safety, but by implementing the process of risk assessment and risk reduction, we can reduce the risk of severe injuries and lower it to an acceptable level.

Implementing truly effective risk countermeasures by identifying and analyzing risks based on knowledge

So how is risk assessment done on a product? Generally we use the following procedure.

First, to identify risks, we imagine the users of the product and when, where, and how they use it. For example, we normally expect that adults will use the washing machine according to the manual, but a child may sit on the lid. This is the wrong way to use a washing machine, but we include such cases and list as many situations that could occur as possible. Although there is a possibility of using a washing machine upside down, that is too unrealistic to actually happen. So it should not be included with the possible situations. To identify risks thoroughly, it is essential to ask for opinions from departments other than the product design department, such as the marketing and sales departments, as well as from veteran workers with plenty of experience and knowledge.

Next, we think up hazards (sources of risk) and danger scenarios related to the situations identified at the previous stage. If a hose from the washing machine is not connected properly to the tap, water can leak and someone can slip on the wet floor, or if that water drips into an outlet, someone may get an electric shock. In this way we think up hazard scenarios based on the sources of risk, like water and electricity.

Third, we analyze risks for each scenario and then assess them. One often-used method of risk analysis and assessment is risk mapping.

Risks in each scenario are assessed using a risk map (R-map), that is a matrix of risks having frequency (or probability) of occurrence as the vertical axis and severity (degree of harm) as the horizontal axis.

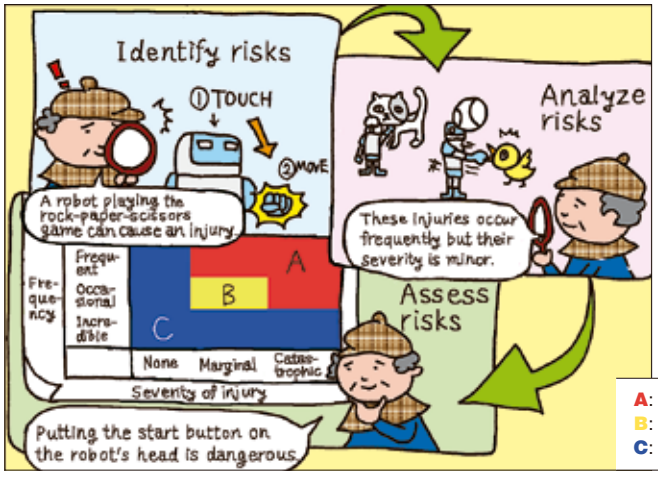
The area of the matrix is divided into sections, such as "A" sections for the risk of severe injury that is intolerable, "B" sections for the risk of injury whose severity is as low as reasonably practicable (ALARP) and "C" sections for the risk of injury whose severity is broadly acceptable. If a risk appears in the A or B areas, its severity level should be lowered by applying countermeasures, or its frequency should be reduced, so that it can be moved to the C area.

In the case of a washing machine, the frequency of water leaks can be reduced if the type of hose connection or its material is changed. As in these examples, risks should be lowered into the C area by repeating the process of risk assessment and incorporating countermeasures into the design.

For risks caused by the wrong use of the product, etc., if the risk level cannot be lowered by changing or improving the design, it can be lowered by placing a warning, such as "Risk of Electric Shock," on the product to guide users to use the product properly.

Many of the products we use daily have had their risk reduced to an acceptable level through these kinds of risk assessment.

Safety standards change with the times and technologies for safety is advancing every day. There is no end to the effort to pursue product safety.



A: Intolerable region
B: ALARP region
C: Broadly acceptable region

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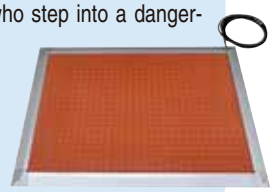
Azbil Trading Co., Ltd., makes a product called a pressure-sensitive mat switch that can immediately stop robots or deactivate the start switches of machine tools in order to protect people who step into a dangerous area in industrial plants and factories. This switch is an additional safety measure.



Cover photo by Koji Mizutani, MERRY PROJECT Representative

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http://www.azbil.com/
Yamatake Corporation changed its name to Azbil Corporation on April 1, 2012.

azbil Group PR magazine, azbil 2017 Vol. 3, No. 7
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PRINTED WITH SOY INK
MIX Paper from responsible sources FSC® C002215

PR-3001E-1707 (1707-4K-D)

Company/Branch office