The Power of Heat: Behind-the-Scenes Stars Supporting the Comforts of Everyday Life

Kawasaki Thermal Engineering Co., Ltd. (KTE) is a pioneer in the manufacturing of boilers and absorption chiller-heaters which support the comforts of our daily lives. This issue of Special Feature focuses on how the “power of heat” is demonstrated in thermal products manufactured by KTE—a heat technology specialist celebrating its 120th anniversary in the boiler business in 2019.

Boilers and Absorption Chiller-Heaters at the Frontline of Life-Saving Work

Osaka Medical College Hospital is located adjacent to Takatsuki-shi Station on the Hankyu Railway Kyoto Line, and is a five-minute walk from Takatsuki Station on the Japan Railway Line. With 29 clinical departments and 14 specialized centers (such as pathology, laboratories, surgery, radiology, etc.), the 1,800-staff hospital serves about 2,000 outpatients per day and has 882 beds. It is positioned as a core community medical institution in the Hokusetsu district (in the northern part of Osaka Prefecture).

In March 2016, a six-story Central Surgery Building was completed at the hospital. One of the largest surgery buildings in western Japan, it has 20 operating rooms, including a robotic surgery room and one for “hybrid” surgeries (a combination of catheter intervention under X-ray guidance and conventional surgical procedures), equipped with coronary and cerebral angiography. KTE boilers and absorption chiller-heaters are working behind the scenes to support healthcare. Steam generated by the boilers is used in a variety of ways, including sterilization of medical equipment, and the cooling/heating and humidification of the hospital using heat exchangers. Absorption chiller-heaters provide cold and hot water, which are also used for cooling and heating the entire hospital.

Katsuhiko Tsutsumi, head of the Facility Section of the General Administrative Department at Osaka Medical College, which manages all facilities of Osaka Medical College and its hospital, comments, “Boilers and absorption chiller-heaters are energy sources that drive all medical activities at the hospital and are a lifeline for its 24-hour operations. That is why high stability and reliability are expected of them.”

Three units of the KF-A multi-tube once-through boiler are in operation at the hospital. This compact boiler, measuring 110 cm wide, 210 cm high, and 170 cm deep, generates a ton of steam per hour. Also in operation are two Efficio absorption chiller-heater units, each capable of 180-ton refrigeration (equivalent to 265 units of
household air-conditioners capable of cooling/heating a room with a floor space of 10 m$^2$.

As for the reason why multi-tube, once-through boilers were originally adopted at the hospital, Tsutsumi says, decisively, “Because of KTE’s high standard of manufacturing and a maintenance system that allows expeditious servicing.” He adds, “Boilers can last longer than 20 years if maintained properly. I support KTE’s approach to product development, which is based on its conviction that products should serve the users for a long time and should never be designed as disposable equipment.”

The speed with which service personnel can respond to equipment malfunctions can affect and sometimes jeopardize the mission of a hospital. On KTE’s quickness, Tsutsumi comments, “Absorption chiller-heaters have been the main products we have had business with at KTE, and their responses to malfunctions have been extremely swift. The company also doesn’t change service personnel frequently, and the same staff are assigned each time, so that we can work as a team with the shared goal of protecting hospital operations. KTE has a sense of mission in supporting the front line of life-saving interventions. This is the biggest reason why our business relationship has lasted for half a century.”

A History Lasting 120 Years, and the Industry’s Longest Warranty Provided with Confidence

Kisha Seizo Co., Ltd., the predecessor of KTE, was the first private company to manufacture a locomotive in Japan. It then launched a smoke tube boiler in 1895, which means that KTE will be celebrating the 120th anniversary of its boiler business in 2019. Boilers evolved as a family of steam-driven types of equipment which led the Industrial Revolution. Presently, once-through boilers account for 90% of the boiler market in Japan.

A once-through boiler has a cylindrical body consisting of many heat-exchanger tubes connected together by steel plates called “fins” which are welded in between the tubes. A burner at the top of the cylindrical body burns the gas to heat the water in the tubes, supplied from the bottom section (water circulates continuously), and the heated water rises upward as steam. Because the volume of water in the tubes is small and therefore the energy stored in the water is also small, this type of boiler is less likely to explode due to pressure and therefore safer. This type is also characterized by a short steam-start-up time after the boiler is activated. In terms of its simple structure, technologies associated with once-through boilers are considered to be already mature. However, Takahide Yanagida, Senior Manager of KTE’s Boiler Engineering Department, says, “We are pursuing further advancement of these technologies in four areas: firing, heat-exchange, control, and welding.”

For example, by reusing exhaust gas and using fins with high-heat-transfer performance, boiler efficiency (the ratio of the energy absorbed by the water and steam in the boiler against total energy input) as high as 98% can be attained. Efficient boiler operations are also attributable to KTE’s control technology, which stabilizes fluctuations in the load and in steam pressure.

Another component that demonstrates the technological prowess of KTE is a steam-water separator. Once-through boilers manufactured by other companies are designed such that the feedwater is supplied directly to the heat-exchanger tubes. KTE’s model, however, heats the feedwater first, using waste heat from the boiler, and then guides the water through the steam-water separator before it is supplied to the tubes.

Yanagida comments, “If the feedwater is supplied directly to the heat-exchanger tubes, warm and cold waters are mixed abruptly inside the tube, causing thermal shock and releasing dissolved oxygen into the water which results in increased corrosion of the tubes. However, by having the feedwater pass through the steam-water separator in order to keep the water level at consistent level, thermal shock can be avoided, minimizing corrosion of the tubes and fluctuations in steam pressure. This may not appear to be an eye-opening design, but many such ingenuity’s are packed into the boilers to prolong their lives.”

KTE provides a 15-year warranty with its boilers — the longest in the Japanese market. (Certain conditions apply, such as establishing an annual maintenance contract with KTE.) Yanagida says, “Offering the longest warranty (in the market) reflects our confidence in our products.”

In recent years, more compact and highly efficient absorption chiller-heaters have been developed. An absorption chiller-heater is a piece of equipment used to cool or heat, using the principle of heat extraction through water evaporation — the same mechanism as the Japanese custom of sprinkling water in streets and gardens to cool the surrounding area. Water is used in this system instead of fluorocarbons with high global warming potential, or chloro-fluorocarbon substitutes, so as to achieve a large, centralized, eco-friendly heating and cooling system. KTE successfully commercialized the double-effect direct-fired absorption chiller-heater in 1968, and the triple-effect direct-fired absorption chiller-heater in 2009 — both of which were first in the world of their kind.

How a KTE Boiler Is Made

Developer of a Number of World’s Firsts; One of the Largest Market Share Holders for Absorption Chiller-Heaters in Japan

For the once-through boiler’s casing, tubes and fins, metal sheets are used. This compact boiler with a steam output of 2,000 kg/h requires 51 tubes.

Standing with Satoshi Tsuchino (center), who supervises the management of all facilities at Dukeki Medical College and its hospital, are officials of KTE’s Osaka Branch: Keigo Ikeda (left), boiler group leader, and Kanehisa Hayashida (right), administration group leader.

Finally, a cover casing is installed. The door’s front panel is equipped with a controller used for remote monitoring of the boiler via communication lines.
According to the options provided, the text discusses the features and improvements of boilers and absorption chillers. The text also mentions the launch of new products and the importance of maintaining efficiency and safety. It highlights the commitment to advancing technology and meeting customer needs. The text concludes with a focus on the future, emphasizing continued efforts to improve performance and meet environmental standards.