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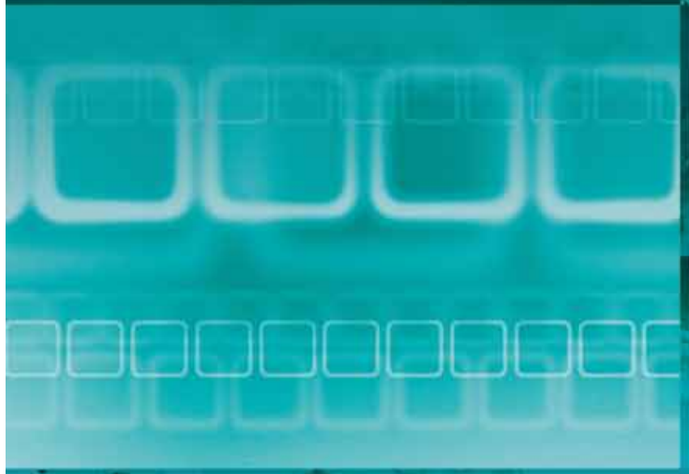
International slogan of KOBE STEEL Welding Group

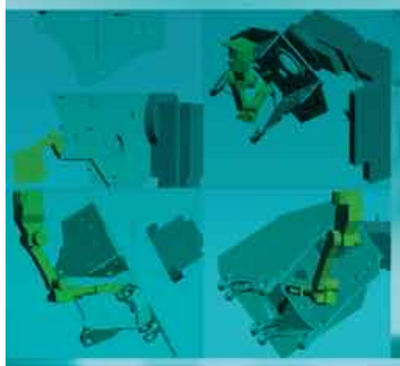
KOBELCO WELDING TODAY

Vol.15
2012 No.2

KOBELCO Puts the Customer First with All-in-One Product and Service







KOBELCO

REGARC™ *Process* offers low spatter and fumes even at high current in CO_2-shielded arc welding.

In conventional CO_2-shielded arc welding with a solid wire, excess spatter can generate in the following ways. (1) A molten droplet at the wire tip short-circuits in the weld pool and is then blown out at the moment of re-arcing. (2) A molten droplet at the wire tip becomes larger, and the arc's reactive force pushes it up to expel it around. In addition, an increase in welding current may cause the molten droplet at the wire tip to become larger and transfers irregularly, thereby causing much spatter. Because the behavior of such droplets is complicated and irregular, droplet transfer control is a particularly difficult aspect of CO_2-shielded arc welding.

However, the REGARC™ (Regulated Globular Arc) process has been developed to reduce spatter and fumes by pulse current waveform control. This process generates the optimum pulsed current at every moment of droplet formation and detachment to transfer regularly the droplets of a constant size. This process can also control the droplet short-circuiting and the arc's reactive force to prevent droplets from being pushed up. With such outstanding controls, the REGARC™ process allows for innovative CO_2-shielded arc welding. Figure 1 shows one cycle of droplet transfer taken by high speed video camera in REGARC™ welding.

As shown in Figure 2, the REGARC™ process enables a reduction in the amount of spatter with CO_2-shielding that matches conventional Ar-CO_2 shielded (MAG) pulse arc welding. Figure 3 compares spatter generation and bead appearance in conventional CO_2-shielded arc welding with that in REGARC™. Clearly, REGARC™ greatly reduces spatter during welding and the amount of spatter that adheres to the weld surface.

Furthermore, as shown in Figure 4, REGARC™ can significantly decrease the fume emission rate to realize environment-friendly welding.

Figure 2: Comparison of spatter generation rates in flat fillet welding. (Welding speed: 30 cm/min; Weaving: 3 mm, 2 Hz)

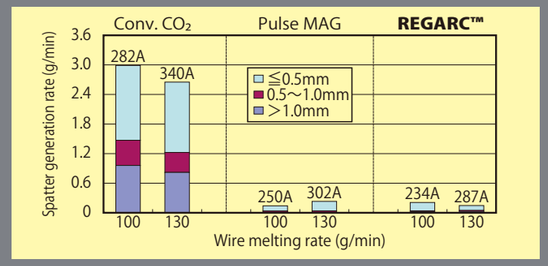


Figure 3: Comparison of spatter during and after welding between Conventional CO_2 welding (left) and REGARC™ (right).

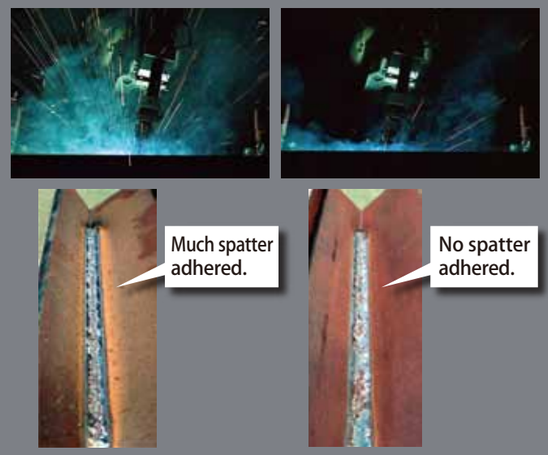


Figure 4: Comparison of fume emission rates. (Welding current: 280-290 A; Welding speed: 30 cm/min)

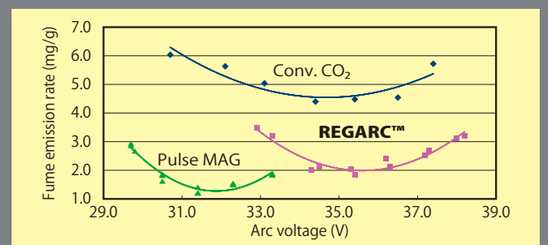


Figure 1: One cycle of droplet transfer taken by high speed video camera in REGARC™ welding —

(1) droplet produced (2) droplet squeezed (3) current decreased (4) droplet detached (5) droplet produced.

Kobelco aims to become most dependable in worldwide welding markets

Dear all the readers of Kobelco Welding Today: thank you very much for your regular reading of the Kobelco's periodical publication. My thanks as well for your patronage for the welding-related products supplied from the Kobelco Group Companies around the world.

Since last July, as the Vice Head of the Welding Business of Kobe Steel, I have focused on the entire business in China and the Southeast Asian countries. To execute my duties more effectively, I often fly around these countries from a base in Shanghai and Singapore.

In this column, I would like to announce our midterm business vision that encompasses the worldwide markets and the current major objectives we wish to accomplish in China and Southeast Asia this year.

For the midterm/long-term business visions, we in the Welding Business of Kobe Steel aim to become "the most reliable integrated welding enterprise to customers around the world." In order to attain "the world's most dependable position," I believe it is essential first to help users in individual countries and districts improve their product quality and reduce fabrication costs. To provide such users with useful proposals, we are making efforts to develop innovative, valuable products and technologies.

In addition, we strive to provide users with "excellent welding," "Kobelco products and services at anytime and anywhere" as well as "competitive pricing" and to help users notice "better welding" and "the importance of welding."

Particularly in China, our business focuses on four major lines: solid wires, flux-cored wires, welding robot systems and high value added welding consumables. It is this year's objective to expand and strengthen the marketing for individual product lines and to restructure and integrate the Kobelco Group's marketing framework. Through these activities, we hope to become intimately associated with customers and markets in China. To respond to our customer's desire for highly efficient and quality welding, we are determined to make all the efforts to become a more dependable company to customers and markets.

In Southeast Asia, Kobelco Group Companies are engaged in a wide scope of business centered on covered electrodes and solid wires. For the purposes of strengthening the business planning and production capability and setting up a new business base, Kobe Steel established Kobelco Welding Asia Pacific Pte. Ltd. (KWAP) as an overall management company in this region in April this year. We have also fortified the activities that will allow customers to notice "better welding" and "the importance of welding" and have been exerting more effort to develop and propose welding consumables and processes that are most suitable for local individual applications.

We in the Welding Business are determined to increase our efforts, aiming to become "the most reliable integrated company in the worldwide welding field" through international operations. Therefore, when it comes to welding, please contact the Kobelco Group Companies at anytime for anything.

Mitsuo Takamura
Senior Officer
Welding Business
Kobe Steel, Ltd.
at the 10th ASEAN SHINYOKAI Meeting
2012 held in Chiang Mai, Thailand

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CONTENTS Vol.15

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KOBELCO WELDING TODAY
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Typical Applications of ARCMAN™ Robot Welding Systems for Construction Machinery

Introduction

An article in the preceding issue briefly introduced Kobelco's welding system business and described the ARCMAN™ series arc welding robots and the SENSARC™ series arc welding power sources, which configure the welding robot system, focusing on the latest models and their features. The popular ARCMAN™ series robots are used mainly by customers in the medium/thick plate welding fields such as construction machinery, steel frame buildings, bridges, and railroad cars. The present issue will focus on how the ARCMAN™ series have typically been employed by the construction machinery fabricators.

The need for welding robots in the fabrication of construction machinery

In the field of medium/thick plate welding, the use of welding robots has progressed farthest in construction machinery fabrication. The main reason for this can be attributed to the low-mix, high-volume production in the fabrication of construction machinery compared to other fields. Additionally, the consumption ratio of the welding consumables needed for the fabrication of construction machinery is as high as about 1% by weight. That is, a 20-MT class hydraulic excavator (Figure 1), which is produced at the highest volume, requires about 200kg of welding consumables per one unit. Because of the large consumption of welding consumables as well as the need for consistent weld quality, welding robots, which have two to three times the capability of human welders, have steadily gained favor in the construction machinery field.

Requirements for the welding of construction machinery

The workpieces for construction machinery have a number of particular characteristics; hence, the welding robot must be able to work within a particular set of constraints, as follows:

(1) The complex shapes of the workpieces require groove welding and multi-layer welding.

(2) Flat welding is often used to obtain high welding efficiency, better penetration, and smoother bead appearance. Therefore the workpiece must be fixed on a positioner to place it at the most suitable position for flat welding.

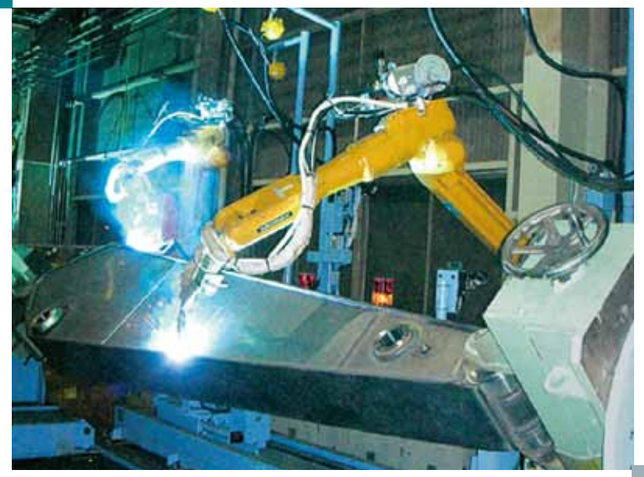
(3) Large workpieces require many hours of production to complete, and welding accounts for significant amounts of the production time. To reduce time spent on welding, processes offering high deposition rates, such as tandem arc welding, are favored.

Figure 1: A20-MT class hydraulic excavator needs about 200kg of welding consumables to fabricate.

Employing robotic welding for the "arm" component of a hydraulic excavator

The welding of hydraulic excavator arms provides a good example of how the ARCMAN™-MP, Kobelco's best-selling model, is applied in construction machinery fabrication. By employing this welding system, the welding cycle time can be shortened, and the weld quality can be improved. Following are the characteristics of this system.

Figure 2: The twin-robot system reduces production time due to simultaneous operations.



Twin robots

With this system, two robots weld one workpiece at the same time as shown in Figure 2, thereby shortening the production hours. In order to maximize the effect of twin-robot welding, each robot is responsible for welding the predetermined portions of the workpiece so that they will finish in roughly equal amounts of time.

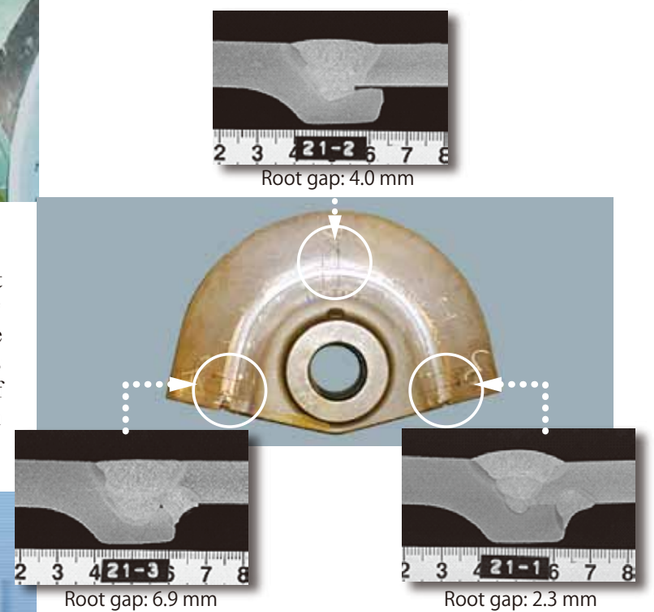
Groove-width tracking function

Using an arc sensor to measure the groove width during welding, this function sequentially corrects welding speed and weaving conditions according to the measured groove width. With this function, welds can be produced with uniform bead height and sufficient penetration, even on workpieces with varied groove widths.

Figure 3 shows the test results of welds produced with the groove-width tracking and multi-layer welding functions. The groove shape was 50°V. The groove width was varied by changing the root gap before welding along the weld axis: 2.3 mm at the start, 4 mm at the middle, and 6.9 mm at the end. Welding was completed with three layers. The final layer welding was carried out according to the sequential mode set by the original teaching, regardless of the subsequent groove width measurements.

Consequently, the tests show that, on workpieces with varied groove widths, multiple layer welds can be obtained with sufficient penetration and virtually uniform height of reinforcement. It is noteworthy that the final layer of the welds exhibited regular bead width regardless of fluctuation in groove width.

Figure 3: Part of an arm component exhibits uniform weld appearance (middle) and three cross-sectional macrostructures (top & bottom) show sufficient penetration.



Switching function for the welding and tool parameters

Most welding lines of a workpiece can be welded with the standard wire extension and gas shielding. However, for a deep single-bevel groove joint around a boss part, the wire extension must be switched to become longer in order to avoid torch-to-workpiece interference, thereby expanding the application range for the robot welding of the workpiece.

KOBELCO WELDING TODAY
Vol.15 No.2 2012

Using a tandem welding system for hydraulic excavator "booms"

A tandem welding system can reduce welding cycle time and minimize the number of systems to be installed; such benefits lead many fabricators in the construction machinery field to employ such systems.

Introduced here is an example of Kobelco's tandem welding system that is combined with ARCMAN™ -SR, a compact welding robot that can easily be set up overhead to maximize the capabilities of robot welding. In this system, the slider and positioner are integrated, reducing the system's footprint, and the positioner is equipped with an up-down axis, which improves operability when setting a workpiece. Figure 4 shows this system in operation.

Figure 4: ARCMAN™-SR (suspended overhead) in operation on the boom in the tilted position.

Higher efficiency by tandem welding

Using the rotating/tilting positioner, the tandem system allows all joints to be welded in the flat position, which maximizes efficiency and provides good penetration and bead appearance. Tandem arc welding can reduce the welding time of conventional single arc welding by 30-50%. This tandem arc welding system is able to obtain both increased welding speeds and sound weld beads due to its two-electrode, one-pool welding technique. Figure 5 shows bead appearance and cross-sectional macrostructure by single and tandem arc welding in the typical welding conditions for flat fillet welds with a leg length of 9 mm. As shown in the figure, tandem arc welding speed can be nearly 2 times (1.75 times) faster than conventional single arc welding.

Ultra-low spatter in tandem welding

To improve arc stability and reduce spatter generation, pulsed welding is applied, in which the peak and base currents are synchronized between the leading and trailing wires by the special welding output control. With this output control, the new system can reduce spatter generation by an impressive 70% and even produces smaller spatter particles than conventional systems.

Wider applications with compact integrated tandem torch

As shown in Figure 6, this system uses a compact integrated tandem torch, which can easily access the welding lines in the confined area of a workpiece and prevents the torch cables from getting tangled around the wrist of the robot. This integrated tandem torch therefore allows the robot to tackle a wide range of applications than robots equipped with a conventional tandem torch.

Figure 5: Bead appearance and cross-sectional macrostructure by single arc welding and tandem arc welding.

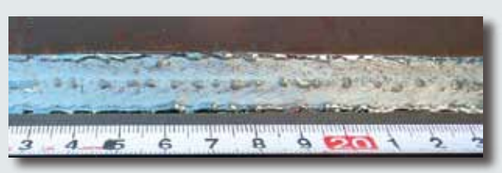
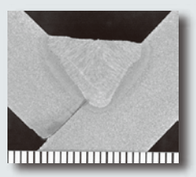
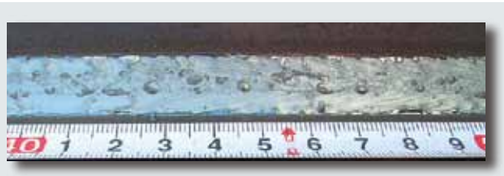
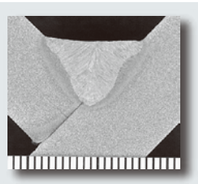
	Welding conditions	Bead appearance	Cross-sectional macrostructure
Single welding	▪ Amperage: 380A ▪ Carriage speed: 40 cm/min		
Tandem welding	▪ Amperage: Leading: 340A Trailing: 320A ▪ Carriage speed: 70 cm/min		

Figure 6: Compact integrated tandem torch offers easier access in a confined space and prevents the welding cable from getting tangled around the wrist of the robot.

Improved weld quality with the Dual-arc sensing function (trailing-wire tracking)

In order to obtain high quality welds in tandem arc welding, the leading and trailing wires must accurately track the welding line. If one of the two wires deviates from the welding line, the weld may contain such defects as undercut and insufficient penetration.

Even when the teaching is conducted accurately on a medium/thick plate workpiece, the welding wires may deviate from the welding line due to workpiece processing errors, thermal distortion, or the curvature of the welding wire.

Arc sensing is one way to overcome this problem. However, conventional arc sensors are effective only when the amounts of deviation of both the leading and trailing wires from the welding line are almost the same. In production, however, the failure to input accurately the tracking line of the trailing wire in the memory during the teaching operation or a curvature in the trailing wire may cause the leading wire and the trailing wire to deviate to different degrees. Such deviations of the trailing wire can cause weld imperfections because conventional arc sensors cannot sense the deviation of the trailing wire.

To solve this problem, Kobe Steel has developed a unique "Dual arc sensor" that can sense the trailing wire, too. Test results of the Dual-arc sensor demonstrate its excellent performance in tandem welding with the trailing wire deviating by 5 mm from the welding line. The main welding conditions were as follows:

- Horizontal fillet welding with 8-mm leg length
- Welding current: 320A for the leading wire; 270A for the trailing wire
- Welding speed: 72 cm/min.

Figure 7 shows the test result obtained in tandem welding with a conventional arc sensor (without sensing the trailing arc). As shown in the figure, the deviation of the trailing wire caused a large undercut on the web plate. Also, large spatter particles can be observed on the flange plate, further undermining the weld quality.

Figure 7: Weld bead appearance in tandem arc welding with a conventional arc sensor.

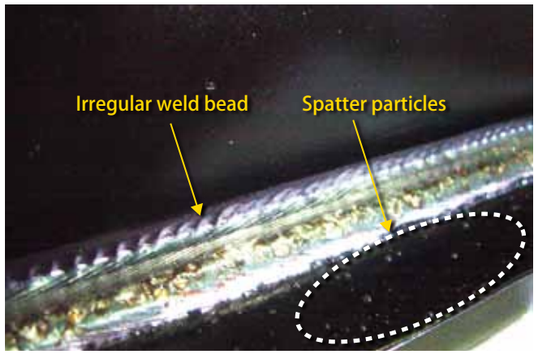


Figure 8: Weld bead appearance in tandem arc welding with a Dual-arc sensor.

In contrast, Figure 8 shows the result of a test carried out under the same conditions as above but with a Dual-arc sensor that could sense the deviation of the trailing wire and send the data to the controller to correct immediately the track of wire, thereby resulting in good weld bead appearance without defect.

The Dual-arc sensor was also tested in a case where both the leading and trailing wires deviate from the welding line (as shown in Figure 9). The results show that both the leading and trailing wires correctly tracked the welding line to produce the acceptable quality weld as shown in Table 1.

Figure 9: Deviation from actual welding line for testing the performance of the Dual-arc sensor.

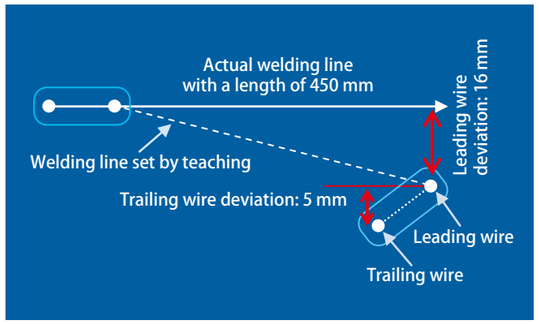


Table 1: Test results of weld tracking with the Dual-arc sensor

Type of welding	Leg length	Welding current	Welding speed	Weld results
Flat fillet	8 mm	Leading: 400A Trailing: 350A	80cm/min	Good
Horizontal fillet	8 mm	Leading: 350A Trailing: 300A	75cm/min	Good
Horizontal fillet	6 mm	Leading: 350A Trailing: 300A	90cm/min	Good

Postscript

As described in this article, the welding of excavator arms and booms are two common applications of robot welding systems employed in the construction machinery field. As a supplier of robot welding systems to construction machinery fabricators (among other fields), Kobe Steel's goal is to shorten the welding cycle time and to improve weld quality by continuing to develop robots with ever-better performance and proposing the best solutions for customers.

In the next issue, we plan to introduce robotic systems used for welding medium/thick plates in other fields, such as the railroad car industry.

Kobe Steel remains engaged in helping customers improve overall manufacturing performance through the operation of Kobelco welding systems installed in their fabrication sites. Our engagement and close working relationships should lead to excellent customer satisfaction. Therefore, when robots experience repetitive short-time stoppage during operation or cause weld imperfections, which degrade the consistency of production, the causes must adequately be analyzed and the teaching operation must be improved. In the next issue we will discuss the measures taken by Kobe Steel so that we may live up to your expectations.

KOBELCO WELDING TODAY
Vol.15 No.2 2012

Kobe Welding Singapore (KWS) renamed as Kobelco Welding Asia Pacific (KWAP) as it expands to become our Headquarters in the ASEAN Market

As of April 1, 2012, Kobe Welding (Singapore) Pte. Ltd. (KWS) was renamed Kobelco Welding Asia Pacific Pte. Ltd. (KWAP) in recognition of its wider scope as the new headquarters of the Kobelco welding group companies in the ASEAN region.

Readers of Kobelco Welding Today may not be aware that the Welding Business engaged in Kobe Steel Group's first foray abroad when it established overseas production and supply bases such as Thai-Kobe Welding (Thailand) in 1968 and Kobe Welding (Singapore) in 1979. Since then the Welding Business has persistently expanded its overseas production and supply bases, particularly in the ASEAN region, where we now operate in five locations including Malaysia and Indonesia (Technical Collaboration).

Economic growth in the ASEAN countries has been remarkable, and the demand for welding consumables is anticipated to increase further in the coming years. A boom is expected in Indonesia, Vietnam, Myanmar, Cambodia, and Laos, which suggests that market competition in these countries is going to become tougher.

To date, each of the Kobelco welding group companies in the ASEAN region has been managed independently. However, in following the goal of the Welding Business to become the leading comprehensive welding company in this region, we decided to establish the ASEAN Operations Division (AOD) within the Singapore unit as our regional headquarters, which will support business operations in the area and further enhance the ability of the units in each country to run on its own activities at the same time.

In the ASEAN region, KWAP will be responsible for business planning, marketing, and technical support at the regional level. It will also advise and strengthen the manufacturing capabilities of individual companies by improving worker's skills, establishing training programs and developing the new production methods that are most suitable in the region. Based on these new functions, KWAP will also focus on developing other potential growth markets such as Indonesia, Vietnam, and Myanmar.

Our ultimate goal is to contribute to social and economic development of the countries in the region by engaging in business, collaborating with local industries, providing Kobelco's high quality products and evangelizing for the importance of quality welds. We believe that by carrying out our activities based upon our values, we can be the most dependable welding manufacturer in the region.

We are looking forward to serving all of our Kobelco customers in the region.

Reported by **Kimihiko Nakamura** Managing Director, KWAP

Raffles Place

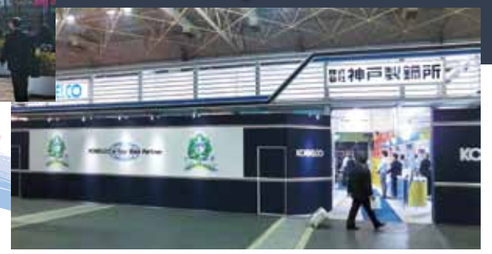
KWAP's Nakamura Managing Director (top) and staff members, posing at the office in Singapore.

Merlion statue, Merlion Park, Singapore

KOBELCO WELDING TODAY
Vol.15 No.2 2012

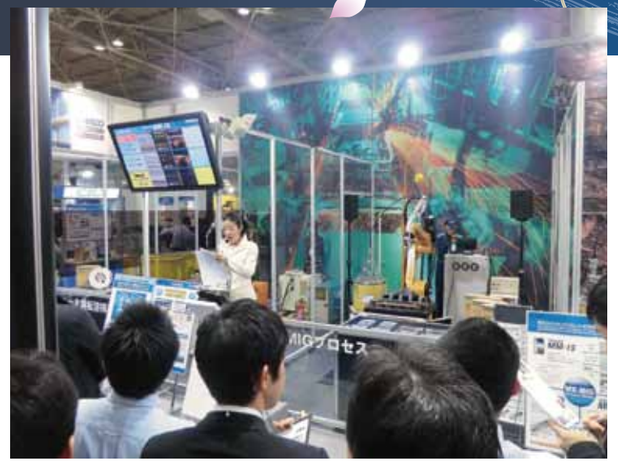
KOBELCO Shone as Your Best Partner at the Japan Int'l Welding Show 2012 in Osaka

Reported by **Naoto Terachi**
Editorial staff member for KWT magazine and web site
Marketing Planning Section
Marketing Department



High-current MAG robotic welding with low spatter.

Appealing bead samples with large mass and exquisite appearanc.



Many visitors listen to the guide demonstrating MX-MIG for sheet metal welding.

The Japan International Welding Show 2012, one of the world's three major welding shows, was held at the international exhibition center, Intex Osaka, from April 11 to 14. According to the show's organizer, as many as 66,697 visitors, including 2,291 from overseas, attended the four-day event that coincided with the blooming of the cherry blossoms in Osaka and elsewhere in Japan.

As one of the leading exhibitors, Kobe Steel participated on the theme, "KOBELCO is Your Best Partner," and attracted many visitors to our displays of cutting-edge welding consumables, robot systems and welding processes along with technical welding demonstrations. The Kobelco booth was designed to welcome visitors to four particular spaces: one for demonstrations, one for industry-wise displays, one for the Shinyokai pro-Kobelco sales network, and a lounge for business talk or chatting.

At the demonstration corner, four different welding processes were showcased by four individual robots. First, at a showcasing of the high-current MAG (Ar-CO_2) welding process with our advanced flux-cored wire (FCW), FAMILIARC™ MX-A100D, visitors saw a spray arc with low spatter but at currents so high that a conventional FCW would have generated much spatter. In this process, two SENSARC™ AB500 welding power sources were connected in parallel to generate a high current of 600A or higher for obtaining a high deposition rate of nearly 20 kg per one hour.

The audience was also interested in the REGARC™ process, which features extremely low spatter with solid wire and CO_2 shielding gas by means of the unique current waveform control mechanism equipped in the SENSARC™ AB500 power source. This process was first introduced at the previous welding show held two years ago; since then its applications have been expanding in Japan. In the present show, we emphasized the high level of workpiece accessibility this process achieves in combination with ARCMAN™-GS, a robot with a torch-integrated wrist.

The third eye-catcher was the MX-MIG process for thin plate welding, which uses a dedicated FCW with a pure Ar shielding gas to create exquisite bead appearance and ultra-low spatter. In lap welding, this process can produce a regular weld bead with smooth weld toes, thereby improving the fatigue strength of the weld joint.

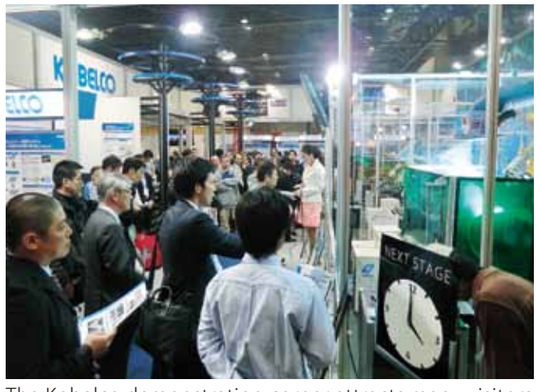
The last highlight was the galvanized thin steel welding process, an advanced welding technology that was developed collaboratively with Daihen Corp. and was announced via a press release just last March. This process uses a newly developed power source and a dedicated wire to reduce significantly the occurrence of porosity (pit) in the weld. Kobe Steel stressed the unsurpassed applicability of this process to galvanized thin steel sheets.

At the industry-wise corner for such industrial fields as energy, automobiles, shipbuilding, steel frame buildings and bridges, and construction machinery, visitors could learn about suitable welding consumables and processes in displays of welding consumables, welding equipment, and weld bead samples, in addition to the panel displays.

The elaborate displays and background panels allowed visitors to visualize how welding would be carried out at individual fabrication sites. On display at the shipbuilding corner, for example, were such mature welding devices as the horizontal fillet welding device, Super Animo I, and the vertical butt welding device, SEGARC™-2Z.

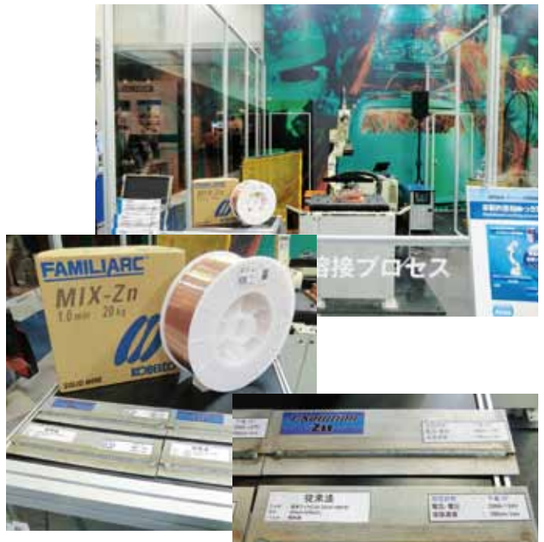
SEGARC™-2Z, an electrogas arc welding device, attached along the vertical butt joint of the simulated hull.

Space limits our ability to describe the many wonderful products and processes we displayed at the welding show; however, a visit to Kobe Steel's web site will allow you to see our booth, panel displays, and exhibited products in detail.



The Kobelco demonstration corner attracts many visitors with cutting-edge technologies.

ARCMAN™-GS robot with the torch-integrated wrist demonstrates the REGARC™ process installed in SENSARC™ AB500 power source.



The galvanized steel welding process in a demonstration with the ARCMAN™ robot (top), the dedicated flux-cored wire FAMILIARC™ MIX-Zn (middle), and the uniform bead appearance superior to conventional one (bottom).

Our lounge corner served as an oasis, where visitors could enjoy business discussions with beverages.