Feature-Ⅰ: Welding and Joining Technologies

Kobe Steel's Research and Development in Welding Consumables, Robotic Welding System and Welding Process

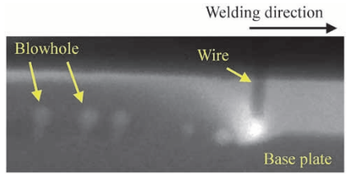

Fig. 1 Blowhole formation phenomenon observed using high-intensity X-ray imaging apparatus

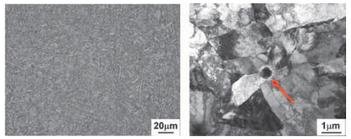

Fig. 2 Microstructure of weld metal with LB-67LJ

Welding and joining using an arc as the heat source is a technique absolutely necessary for constructing ships, bridges, construction machines, building structures, offshore structures, transport, boilers, and reactors. Kobe Steel is developing arc welding and joining technology for ferrous and non-ferrous materials. This issue introduces the latest technologies in the field.

A high-intensity X-ray imaging apparatus was used to observe the blowhole formation phenomenon in the GMAW (Gas Metal Arc Welding) of galvanized steel sheet. Fig.1 is an example of a still image. The moving images clearly show the growth behavior of blowholes caused by zinc vapor from the root of the overlapped plate. The effects of wire and shielding gas composition and the current waveform on the blowhole formation phenomenon were understood by using this apparatus. As a result, a new GMAW process "J-Solution™" has been developed for the welding of galvanized steel sheet. (JWRI Osaka university coresearch)

Fig.2 shows the microstructure of weld metal made with the covered electrode "TRUSTARC™ LB-67LJ," which was developed for steel having a 0.2% yield strength of over 500MPa. By adjusting the basicity of flux and Si content, the oxygen content of the weld metal is suppressed to as low as approx. 160ppm, and a very fine microstructure can be obtained (left). It has been found from a TEM observation (right) that acicular ferrite is formed, originating at an oxide (indicated by an arrow in the figure). The refinement of the microstructure by controlling oxides has achieved good CTOD (Crack Tip Opening Displacement) properties down to −40℃, despite its high strength.

Feature-Ⅱ: Energy Machinery and Equipment

Kobe Steel's Research and Development in Technologies for Energy Equipment

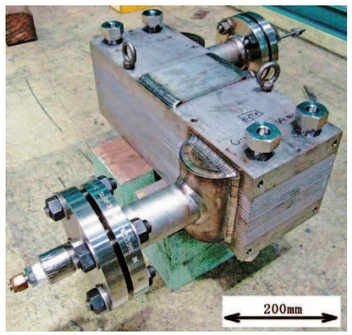

Fig. 3 Diffusion-bonded compact heat exchanger (DCHE)

Kobe Steel has been using advanced technology to develop energy-related products. These fall into two categories. One is a heat exchanger as typified by the LNG vaporizer type, and the other is a rotating machines for, for example, refrigerators. This issue introduces energy machinery and equipment, including a binary-cycle power generation system which is gathering attention.

Fig.3 shows a compact heat exchanger, the Diffusion-bonded Compact Heat Exchanger (DCHE). Its demand is expected to increase in the area where lightness and compactness are required. A DCHE has a stacked structure of plates made of stainless steel or some other materials with small channels. The plates are diffusion bonded to realize the same level of strength as the base materials, making the DCHE excellently resistant against high pressure and temperature. With its large heat transfer area per unit volume, the DCHE size can be made very small.

<Cover photos>
The photos on the left side of the cover shows welding robots that contributes to welding automation and improves the efficiency. Our aim is to develop advanced welding consumables, while making full use of our state-of-the-art equipment, to develop welding solutions combining a variety of technologies – welding robots, power sources and equipment – to meet the needs of customers.
The upper right photo is a radial turbine power generation system.
The photo in the lower right is the small-scale unit for a binary-cycle-power-generation system. These units can utilize the thermal energy of hot springs and the unused steam in factories.

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