Advances in Gas Pressure Welding Technology for Rails

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Gas pressure welding is accomplished by butting work pieces together, applying a suitable amount of axial pressure, and heating the joining area with an oxygen/acetylene flame to about 1,200° C, until the upsetting amount reaches a predetermined value (see Fig. 1). This welding method does not use heavy equipment, and produces highly reliable joints that are about as strong as the work pieces being jointed together. For these reasons, it is often used for welding rails and steel reinforcing bars. Fig. 2 shows usage ratios for gas pressure welding and other methods employed by the JR Group for rail welding.

The gas pressure welding method was developed in Japan and the United States around the same time in the 1940s, and the technology was later studied in the former Soviet Union and Germany, with a view to using it for rail welding. However, since the 1960s in the West, rail welding has steadily shifted to flash welding and aluminothermic welding methods, and today gas pressure welding is used very rarely there for rails.

Japan has taken a different route. Rail gas pressure welding equipment was developed here in 1953, and since then both the equipment and the method itself have been improved on numerous occasions. Gas pressure welding used to be done almost exclusively in welding plants, but since the 1970s welding equipment weight was reduced, making it feasible to perform it on-site. As a result, since then use of the gas pressure welding method has spread in Japan.

Bulges formed during the pressure welding process were traditionally removed through gas scarfing, but a hot shearing method was developed to improve workability. The hot shearing method, which removes the bulge immediately after welding, not only improves workability

but also permits simple, highly precise inspections. This has greatly boosted the reliability of gas pressure welded joints. Fig. 3 shows the hot shearing method being used to remove a bulge. The combination of the advantages mentioned above makes gas pressure welding an extremely effective method for welding rails. However, welders need considerable expertise when grinding end surfaces and when using the heating burner. A shortage of welders with such expertise is predicted, so in the future companies could possibly find it difficult to ensure quality joints. Another problem is that today's gas pressure systems use acetylene as their combustion gas — the combustion reaction involving oxygen produces carbon gases, creating concern over environmental consequences.

For the above reasons, our research group is presently working on a new gas pressure welding system for rails that is environmentally friendly, easy to use and requires a lower level of expertise. Fig. 4 shows a gas pressure welding test being performed using a mixture of oxygen and hydrogen for rail welding. This new method is attracting attention as a more environmentally friendly gas pressure welding system for rails.

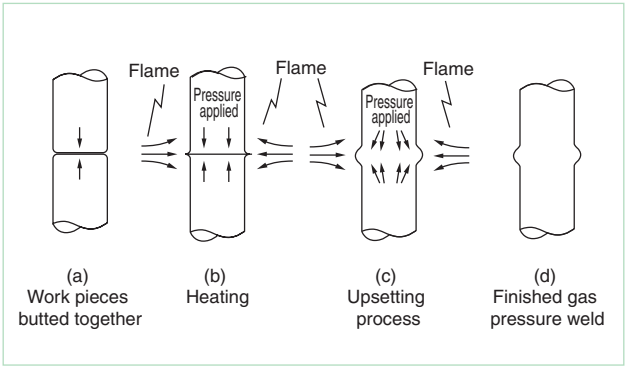

Fig. 1 Gas pressure welding process

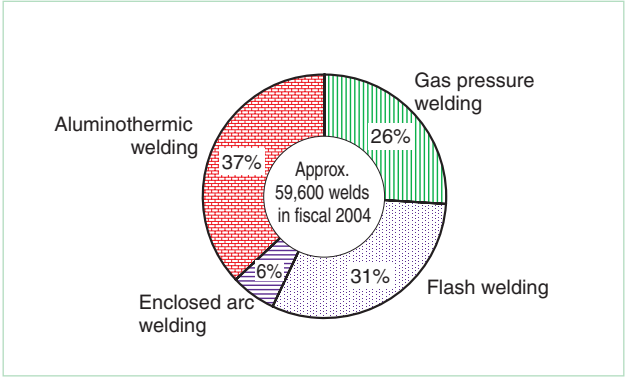

Fig. 2 Gas pressure welding, as a percentage of four welding methods used by the JR Group to weld rails

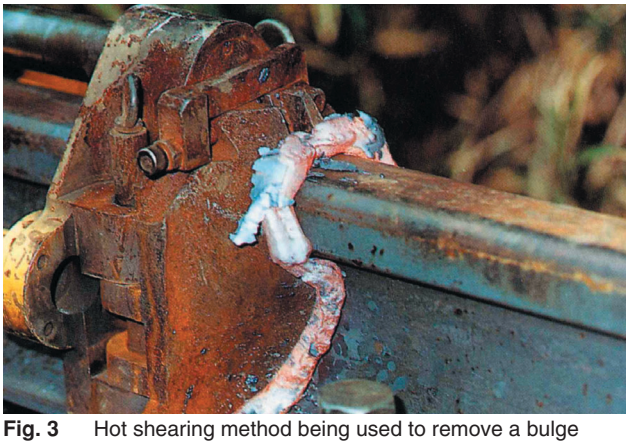

Fig. 3 Hot shearing method being used to remove a bulge

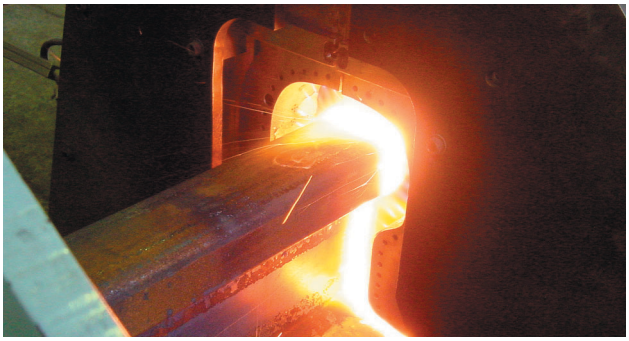

Fig. 4 Gas pressure welding test using an oxygen/hydrogen flame for rail welding