Shielding Gas Purification Improves Weld Quality

Purification of argon shielding gas and backing gas improves impact toughness for two stainless steels

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Since the development of gas shielded arc welding processes, a variety of shielding gases and gas mixtures have been introduced, ranging from highly oxidizing to inert. The primary reason for using a shielding and backing gas is to protect 1) the melted portion of the welding wire, 2) the nonconsumable electrode (when used), 3) the weld pool, and 4) the weld bead (up to a point) from atmospheric contamination. Depending on the material being welded, gas contaminants can cause cracking, varying degrees of porosity, weld bead oxidation, arc instability, and degradation of mechanical and corrosion properties (Refs. 1–5). Other reasons to use a particular gas or mixture might be for 1) enhanced arc stability, 2) a particular mode of weld metal transfer, 3) enhanced penetration or bead profile, 4) availability or 5) easier arc ignition.

Certainly, there is no question that quality welds require quality shielding. This requires obtaining clean gas and maintaining gas quality at the point of use. From a practical point, some factors that have been identified as relating to "bad gas" and welding problems are:

- Contaminated gas cylinders (by moisture/air).
- Contaminated and/or leaking gas manifold systems.
- Damaged, defective or loose shielding/backing gas line fittings.
- Intrusion of contaminants when mixing gases.

Achieving gas quality at the point of use can be a challenge. Welding problems can show up with a single cylinder of gas or a series of cylinders. A manifold system can be particularly difficult to deal with because of the usual long length from the liquid tank or gas cylinder to the numerous welding stations served. As a result of poor gas quality, 1) defects are produced that require costly repair, 2) job completion can be delayed, and 3) job quality may be compromised.

"During welding, it was observed that when using the new resin purifier, the surface of the molten weld pool was absolutely clean."

It is clear that a portable cost-effective system to remove contaminants from the shielding and backing gas would be useful, not only when working in the shop, but also in the field. A system has been developed using Nanochem® resin, a material that removes impurities from various gases. To prove the benefits of purification, alloys Ferralium 255 and E-Brite 26-1 were selected for a weld study because of their known sensitivity to contaminants and the effect these contaminants have on fracture toughness.

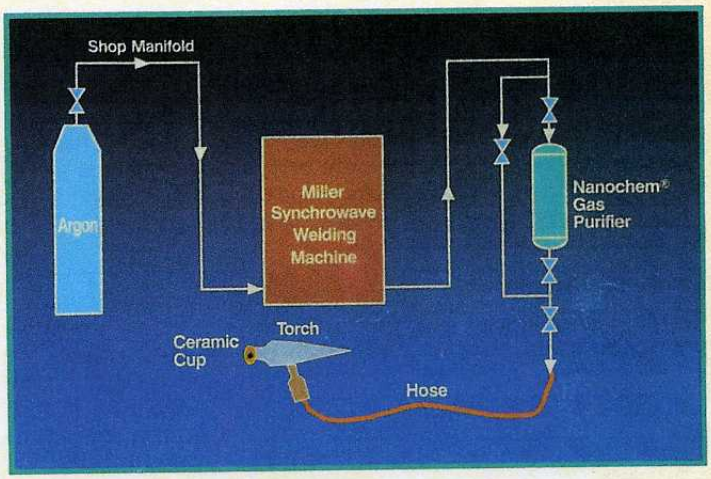

Fig. 1—Schematic of welding process.

Welding Tests

Welding tests on Ferralium 255 (duplex) and E-Brite 26-1 (ferritic) stainless steels were conducted at the Hercules Research Center's weld shop. Initial welds were made using the gas tungsten arc welding (GTAW) process with argon shielding and backing gas containing 40 to 42 ppm moisture and 18 to 20 ppm oxygen. Additional welds were then made using the same argon, but cleaned with a gas purification system installed between the welding unit and the torch. The system removed the moisture and oxygen impurities to less than 10 ppb at the purifier outlet. A schematic of this setup is shown in Fig. 1.

Test plates were beveled to provide a 75-deg included angle and assembled as shown in Fig. 2. Prior to welding, the plates and welding wire were solvent degreased with Freon 113. Freon 113 is a reliable degreasing agent that is commonly

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