Technical Specification/Details

The principal disadvantages of TIG welding lie in the limited thickness of material which can be welded in a single pass, poor tolerance to some material composition (cast to cast variations) and the low productivity. Weld penetration achievable in single pass TIG welding of stainless steel is limited to 3 mm when using argon as shielding gas. In addition, austenitic stainless steel exhibits variable weld joint penetration during TIG welding due to small differences in chemical composition between heats of material. Variable weld penetration has been observed when welding austenitic stainless steels especially in autogenous TIG welds or the root pass of multiple pass TIG welds. Poor productivity in TIG welding results from a combination of low welding speeds and in thicker material the high number of passes required to fill the joint. Over the years, several strategies have been adopted to improve penetration depth or productivity of the TIG process.

The penetration capability of the arc in TIG welding can be significantly increased by application of a flux coating containing certain inorganic compounds on the joint surface prior to welding. The use of flux is also claimed to reduce the susceptibility to changes in penetration caused by cast-to-cast variability in material composition and reported to produce consistent penetration regardless of heat-to-heat variations in base metal compositions. In this process the A-TIG flux is applied by painting on a suspension of the flux in acetone. The acetone is evaporated leaving flux on the surface and autogenous TIG welding is carried out.

At Indira Gandhi Centre for Atomic Research, Kalpakkam, activated flux has been developed for enhancing the depth of penetration achievable in single pass welding up to 12 mm thick for type 304 LN and 316 LN austenitic stainless steels. The flux was found to mitigate the variable weld penetration observed in low sulphur containing type 316 LN austenitic stainless steel. The flux ingredients are patent protected and an international patent has been approved for the flux development. Figure 1 (a) & (b) shows the variation in depth of penetration as a function of current and torch speed for type 316 LN stainless steel during A-TIG welding.

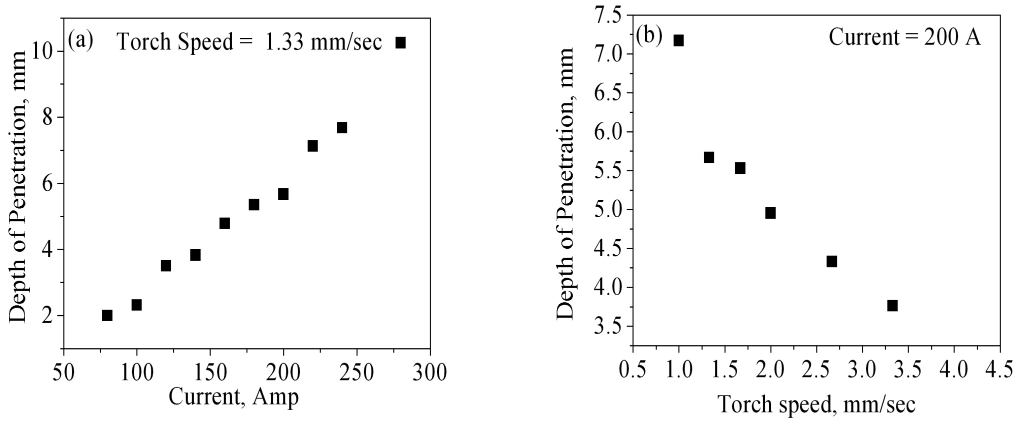

Fig. 1 Typical variation in depth of penetration in 316LN stainless steel weld produced by A-TIG welding in single pass as a function of (a) Current (b) torch speed

Figure 2 (a) &(b) show the weld cross sections for 10 mm thick type 304 LN stainless steel weld joints produced by A-TIG and multipass TIG welding processes respectively while figure 2 (c) & (d) show the weld cross sections for 12 mm thick type 316 LN stainless steel weld joints produced by steel weld joints produced by A-TIG and multipass TIG welding process respectively. All the above A-TIG weld joints were produced by single pass welding.

The welding procedure involve the application of the flux in the form of paste in the joint area prior to welding. The paste is applied on the joint area using a brush manually. The thickness of the coating is 12-15 μm. Then TIG welding is carried out. The significant improvement in penetration due to activated flux in the present study was attributed to the effect of flux on constricting the arc and as well as reversal of Marangoni flow. It is clearly established in the present work that the use of activated flux has overcome the variable weld penetration observed in type 316LN stainless steel with concentration of sulphur less than 50 ppm. There was no degradation in the microstructure and mechanical properties of the type 304LN and type 316LN stainless steel welds produced by A-TIG welding compared to that of the weld metals produced by conventional TIG welding. Thus, activated flux developed in the present work has greater potential for use during the TIG welding of structural components made stainless and duplex stainless steels.

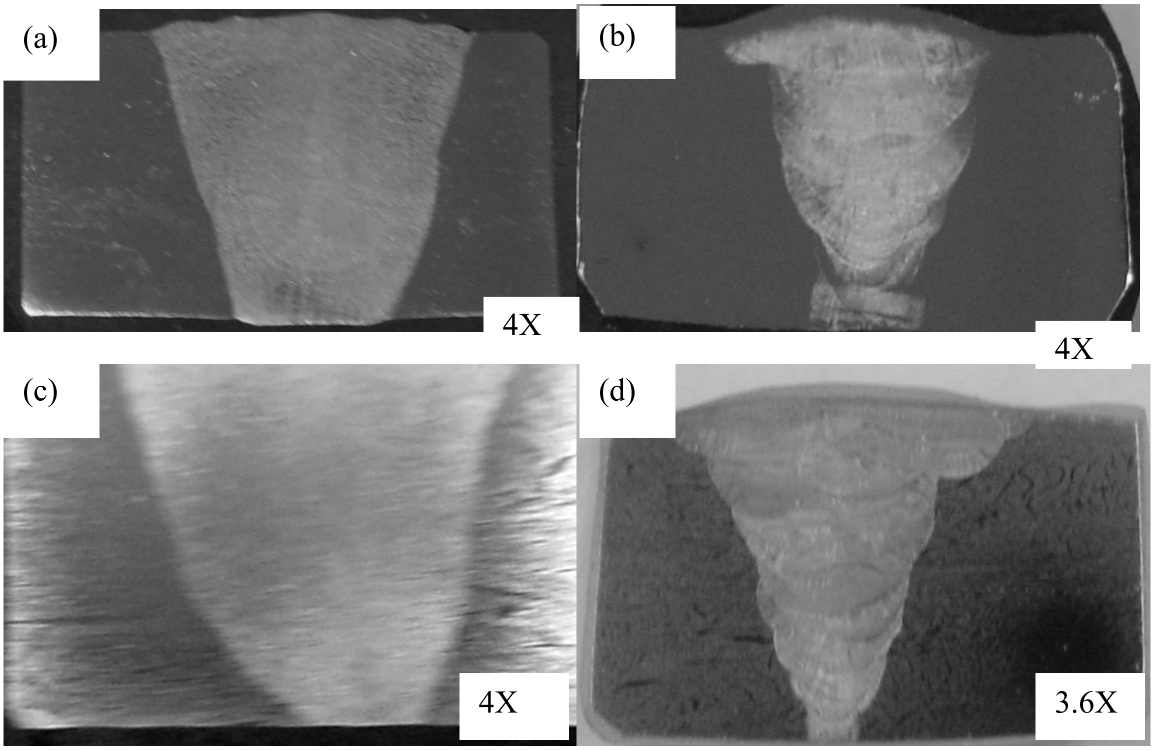

Fig. 2 Cross-sections of the weld joints produced by (a) A-TIG welding (b) Multi-pass TIG welding on 10 mm thick type 304 LN stainless steel (c) A-TIG welding (d) Multipass welding on 12 mm thick type 316 LN stainless steel respectively

Main advantages of the A-TIG Welding :

(1) Capability to TIG weld square-butt joints of austenitic stainless steels of up to 12 mm thickness in a single pass
(2) Reduced number of passes due to increased penetration
(3) Reduced requirement of filler material for TIG welding of section thickness greater than 5 mm.
(4) Reduced heat input for achieving a desired weld bead penetration
(5) Decreased volume of weld metal and heat affected zone
(6) Reduced distortion in welded joint
(7) Reduced cost towards weld joint edge preparation
(8) Overall reduction of welding time and cost and enhanced productivity.
(9) Reduced number of weld procedure specifications
(10) Improved bead shape.
(11) Improved mechanical properties

Potential Applications:

Oil & Gas Industries
Nuclear Fabrication
Pipeline welding
Ship building
Stainless steel rail coaches fabrication
Structural Fabrications