Increased Productivity in GTAW

Nimesh S. Chinoy, Sigma Weld, EDWPL, Mumbai

Gas Tungsten Arc Welding (**GTAW**) or Tungsten Inert Gas (**TIG**): The **GTAW** process is a very versatile, all-position welding process that is widely used to join Ni-/Co-base alloys. In **GTAW**, the heat for welding is generated from an electric arc established between a non-consumable tungsten electrode and the work-piece.

The welding quality and appearance makes it the preferred method for most of the critical and many non-critical applications. Also for Code requirements such as pressure parts welding is needed usually the root runs are specified with TIG. Applications such as cladding and critical welding in Nuclear and Aerospace applications where high quality bonding and precision welding is required the GTAW process is recommended over other faster processes such as GMAW, SAW or FCAW.

Though GTAW is generally considered as the best welding process for quality, superior joint appearance and bead formation, the possibility to use in all position welds, still it is avoided as it is considered a slow process. The energy efficiency of the process is poor. The skill level required for the welding is relatively high, as well.

The lower production rate makes it a difficult choice for shop floor where the drive for productivity is now paramount. However, GTAW has one basic advantage that it can be automated. There are now productivity enhancement tools available which helps make GTAW a faster process. Such as cold wire feeder, weavers, oscillators, fully automated systems using AVC (automatic voltage correctors), Hot wire GTAW, Keyhole GTAW. This article discusses the semi-automatic methods and their use on the shop floor across the globe.

Cold Wire Feeders :

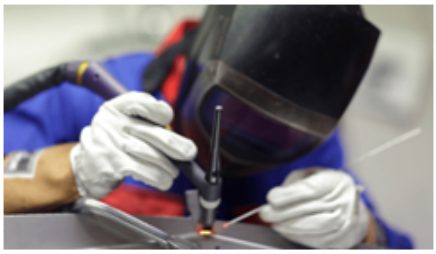

Figure 1 Manual GTAW Welding with Filler

The ***traditional manual welding of GTAW includes*** fusion and addition of filler material by hand into the weld pool. The filler material usually used is in cut lengths of about a meter ***Fig 1***. During welding the welder needs to stop when the filler length left to feed is too low (2 to 3 inches) and replaces it with the next filler wire. The stub end which is too short to be used is discarded. This can be typically 2 to 3 inches per meter which ***amounts to about 5% of consumable costs which is wasted.***

To increase the rate of deposition, usually ***filler wires of different thicknesses are used in the same job***, for example, the welder may use a 1.2mm wire for the root and 2.4mm or even 3.2mm for the fill up passes. This leads to ***high inventory of filler wire of same material but of varied thickness.*** Each time the welder stops for changing the filler wire the weld needs to be restarted with an overlap, this calls for more grinding during finishing. Also each start stop of welding results in additional gas consumption of pre-flow and post flow settings.

Figure 2 Semi-Automatic wire feeding with GTAW Torch

Cold Wire feeders help feed the wire directly to the weld pool using a Pen or special torch. A typical setup is shown in ***Figure 2***. This helps makes the process semi-automatic as the wire feeding is taken care by the ***motorized wire feeder***

while the hand movement and other aspects of the GTAW are still taken care by the welder. This helps increase weld speeds as the welder doesn't need to stop often for change of filler wire, the wire feed rate can be adjusted and increased for higher deposition rates. Typically 1.2 mm or 1.6 mm filler wires spools are used. To increase deposition rate, feed rate needs to be increased, ***this reduces the inventory of varied sizes of filler wires required.*** The ***stub end losses are also negligible*** as only at the end of spool the length is wasted. This results in *huge savings of consumable cost.* Lesser number of start , stop by the welder also leads to lesser grinding and saving of gas. As the welder experiences less fatigue he can weld longer lengths without stopping, giving increased weld speeds.

This can also be clubbed with a HOT Wire power source, which helps bring up the temperature of the filler wire before entering in the weld pool. So the arc energy used to melt the wire in the pool is less and deposition rate are increased significantly. With the help of Cold / Hot wire feeder the semi-automatic solutions can double the speed of GTAW as compared to manual welding process.

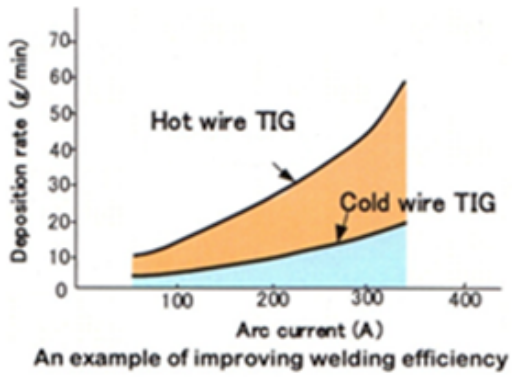

Figure 3 Comparison Cold Wire Vs Hot Wire

For a fillet weld of 150mm length when welded using a 1.6mm filler wire manually fed by the welder takes about 1 minute 50 seconds. Same fillet size is achieved within 1 minute 36 seconds when welded with a cold wire feeder considering Wire Size of 1.2 mm being fed at 900mm/minute. When clubbed with a hot wire power source at 40 Amps, results in the same weld completion in 1 minute 20 seconds with filler wire being fed at 1100mm/min.

Over a longer length will result in more savings as the number of start / stop will reduce drastically and so will the welder fatigue. As shown in Figure 3 Hot Wire has a considerable advantage in deposition rate. Significant productivity benefits of time and material saving are seen in Cold Wire Feeding, when combined with GTAW and Hot Wire GTAW.

For More Details:
Email: sigmaweld@edmail.in

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