Metal cored welding wires

boost productivity and quality

Kim Brightwell, consumables product manager for Afrox, puts forward the case for switching to metal cored wires for GMAW and SAW.

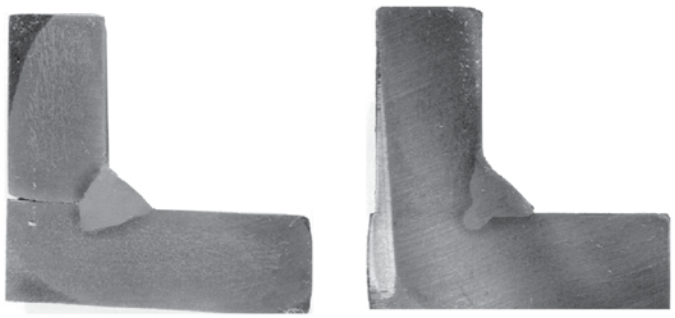

Figure 1: Nugget profiles for metal cored wire (left) and solid wire gas metal arc welds.

In manufacturing the world over, the pressure to produce components faster and more accurately continues to increase. To remain ahead in this competitive field, manufacturers constantly have to find ways of improving production. One area that has come under the spotlight in terms of component fabrication is welding, as this is often an area where production time is wasted reworking faulty parts or turning out high percentages of rejects.

Metal cored welding wires offer a cost effective solution to manufacturers in general and especially to those who employ automatic and robotic applications.

Essentially metal cored wires are a hybrid concept that brings together the characteristics and benefits of the solid wire and flux-cored wires used in both gas metal arc welding (GMAW) and submerged arc welding (SAW). Metal core wires have a composite tubular construction with a metal sheath and a core of various powdered materials.

Some of the key characteristics of metal core wires are:

- They produce no slag and minimal silicon islands on the face of the weld bead when used.
- They can bridge gaps due to poor fit-up without burn-through.
- They can be used to weld thin materials at higher amperages than solid wire electrodes without burn-through.
- They virtually eliminate spatter when used with high argon content shielding gases.
- They are suitable for robotic multi-pass and multi-layer welds without the need for cleaning between passes and layers.

A significant advantage of metal core wires over solid equivalents is the rate of weld metal deposition. Metal cored wires provide a 96% deposition efficiency. With the same electrode diameters at the same operating parameters (voltage and amperages), metal cored typically runs at wire feed speeds that are 30% higher than solid wires. In process tests conducted by Afrox and ITW/Hobart Brothers, at an amperage of 350 A and a wire diameter of 1,2 mm, metal cored wires achieved a 16 m/min wire feed speed as opposed to the 12 m/min of the solid wire. This translates into deposition rates of 7,5 kg/hour for the metal cored wire as opposed to the 5,6 kg/hour delivered by the solid wire process, an improvement of 34%. Generally though, when using a metal cored wire, it is normal practice to increase wire size from, say, a 1,2 mm to a 1,6 mm. This has the effect of increasing deposition rates even further, to as much as 8,3 kg/hour.

Typically, metal cored wires can help increase productivity in processes where 3,0 mm or heavier carbon steel is being welded with solid wires and where poor fit-up or inconsistent gaps are being experienced. The process is also suited to overcoming burn-through problems, inadequate fusion – eg cold lapping – and can improve process efficiencies where multiple welding passes are necessary.

Quality is also significantly impacted by using metal cored wires. Using an equivalent amperage setting, a metal cored wire will experience much higher current densities, improving heat transfer through a wider projection area with a less turbulent weld pool. The result is excellent side-wall and root-weld penetration for higher-quality and stronger weldments (*Figure 1*).

Metal cored wires can be highly effective in reducing the total cost of welding. A comparison with similar solid wire processes reveals that the total welding cost when using metal cored wires can be considerably less per metre of weld produced.

In a typical welding process, the filler material makes up 25% of the cost, the shielding gas 10%, the power 2%, and the 63% remainder comprises costs associated with labour and overheads.

Savings of up to 13% are achievable with metal cored wires as a result of a reduction in labour costs because of improved deposition rates – and consequently, faster welding – and the reduction in spatter clean-up time (*Table 1*).

The same benefits can be realised in submerged arc welding where the use of a metal cored wire also provides for higher deposition rates as well as the ability to add alloying elements in the form of metal powders into the weld. This lends itself to hard-facing wires in particular, especially the medium and high alloy wires used in steel mill roll reclamation, where chromium, nickel, molybdenum and other metals are added to give special properties to high deposition wires which would otherwise be difficult to manufacture. Experience has shown that when using metal cored submerged arc wires a 15% increase in deposition rate is possible.

Metal cored wires have been successfully used in several applications by overseas manufacturers to improve component quality and production line productivity. The combination of higher travel speeds and higher integrity welds means that metal cored wires can find applications in most industries from mining to automotive, heavy engineering to shipbuilding and many more.

	Solid wire cost	Metal core cost
Labour/Overhead	R12,46/m	R9,52/m
Gas	R1,65/m	R1,28/m
Filler Metal	R4,71/m	R5,57/m
Total cost	R18,82/m	R16,37/m

Table 1: Comparative costs of solid and metal cored wire processes.