

ANALYSING THE SUITABILITY OF METAL-CORED WIRE IN WELDING



Introduction

When it comes to welding, there is no 'one size fits all' process. Weighing up the benefits of each process and its suitability to the applications of a business is essential. When matched with the right applications, metal-cored wire welding is a solution that provides a number of productivity and time-saving benefits. Metal-cored wire (MCAW) can significantly reduce weld cycle times, provide high deposition rates and increase travel speeds. Also, this process reduces the cleaning required during the welding process by removing spatter and slag and post-weld grinding. This, along with its unique 'plug and play' design makes it an attractive option for welders.

Investing in the correct process and equipment though is essential to improving workflow and achieving the positive outcomes that MCAW can offer. It is important that welders re-examine the welding process to get a clear idea of whether they will gain these advantages. This white paper discusses how businesses can maximise their welding operations when using the MCAW process. It assesses the benefits of different filler metals and illustrates the differences between MCAW and gas-shielded flux-cored wires (FCAW) for fabrication and manufacturing applications. It also provides context to that of a business converting from solid wires to MCAW.



About metal-cored wire

MCAW was first introduced in 1973. It consists of a tubular electrode made from a metal sheath filled with a blend of metals, minerals and chemical powders. The majority of the powdered core is iron. Other materials are added to produce certain welding qualities or effects such as higher impact strength or reduced oxidation. MCAW produce good deposition rates and deposition efficiency – about 96 per cent. This process is suitable for single-pass applications that currently employ solid wires longer than 3 inches. MCAW is also appropriate in situations where solid wire is used with spray transfer in a flat, horizontal position.

Benefits of metal-cored wire

There are a number of benefits to using MCAW, with high deposition rates and travel speeds ranking as key advantages. One of the biggest benefits though is that this process reduces the activities that usually take place before or after a welding operation such as grinding, sandblasting or chipping slag. MCAW welding provides excellent side-wall fusion and root penetration and has the ability to bridge part gaps without any burn-through. Additionally, MCAW has the capability to weld thin materials at high amperages without burn-through and to weld out-of-position with a pulsed spray transfer. MCAW is able to weld through mill scale, dirt and debris and the spray transfer mode it uses produces barely any – if any at all – spatter. While the wires cost more than solid wires, in the correct applications MCAW can provide significant savings when productivity and the amount of weld metal deposited is factored in.

Metal-cored wire compared with flux-cored wire

In fabrication and manufacturing applications, both MCAW and FCAW are common choices for welders. Compared with stick welding, these filler metals are far less time-consuming and costly and provide excellent productivity through fast travel speeds and high deposition rates. There are many similarities between MCAW and FCAW: both filler metals are tubular wires filled with alloying elements that provide certain welding characteristics; both require shielding gas and constant voltage; and both come in comparable diameters and packaging.

Where they differ is in their suitability to applications. MCAW is better suited to applications in the manufacturing industry, especially in automotive and heavy equipment production. The smooth, stable arc created by MCAW is well-matched to semi-automatic applications and the broader arc cone offers a wider penetration profile and weld bead compared with solid wires.

FCAW is a better option for applications that require deep joint penetration on thicker sections of metal. These include the mild and low-alloy steels found in shipbuilding, railcar manufacturing and heavy

fabrication. As they require gas, they are better suited to a shop setting, where the portability of gas cylinders won't be an issue. FCAW are appropriate for semi-automatic and robotic welding applications and are advantageous in that they are suited to all-position welding.

When it comes to making a decision between MCAW and FCAW, businesses need to look at the existing process they have in order to determine where improvements could be made. It's important to consider factors such as the availability of equipment, the skill set of the welders and the overall production goals of a business before converting from solid wire or choosing between MCAW or FCAW. Then, of course, the application of the welding process will be a key deciding factor. In situations where a company using solid wires wants to improve their quality and productivity, MCAW might be a preferable option. But for out-of-position applications where high deposition rates are required, FCAW would be best suited. Assessing these different factors and consulting with a trusted welding distributor or filler manufacturer will help businesses make a decision that will garner the best results for their situation.

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Maximising the metal-cored wire process

The best way to maximise on a MCAW welding operation is to utilise as high a wire feed speed – and amperage – as possible. Parts can be produced faster when the deposition rates are maximised as this in turn increases the travel speed.

In order to achieve the same amperage as a solid wire, MCAW require a significantly higher wire feed speed. For example, the difference between a 1.2 mm-diameter solid wire and metal-cored deposition rate may be about 13 per cent at 250 amps (5.05 versus 5.99 kilograms per hour, respectively). At 400 amps, the difference is even more substantial – 23 per cent (15.6 versus 19.2 kilograms per hour, respectively).

To benefit from the productivity that MCAW offers, proper equipment must be in place and be functioning



at full capacity. If feedability is an issue, it will affect productivity. To prevent wire deformation, it is recommended to exclusively use V-knurlled drive rolls that match the wire size and are set to the correct tension. It is also essential that the equipment provides sufficient duty-cycle for continuous operation at high-amperage, high-productivity parameters.

Putting it into context

Changing over to a new welding wire can be a solution in operations where productivity gains and cost savings are desired. In a situation where an automotive production company was considering the conversion to MCAW, expert filler metal specialists from Welding Industries of Australia (WIA) were consulted to assess and implement the change.

In terms of output, the company managed to increase their productivity from 4.55kg/hour with an average weld speed of 350mm/minute to 5.54kg/hour and an average weld speed of 400mm/minute with the implementation of Hobart cored wire. They also improved quality. Their previous issue was in a lack of root fusion on a 8mm single pass fillet weld. Changing from FCAW to MCAW with the broader arc resolved this.

As with all welding operations, having access to the right training and resources is integral. In this scenario, WIA provided onsite training to ensure that the welding operators were competent to use the wire and then also provided the appropriate welding qualifications. These procedures and welder qualifications had a 100 per cent pass rate.

Conclusion

There are many benefits to choosing a MCAW process in terms of productivity and achieving quality results. Some advantages include the high duty cycles, fast travel speeds, low fumes and cost effectiveness of metal-cored wires compared with solid wires. When considering a conversion to MCAW, it is important to make an informed decision. WIA are a trusted distributor of welding products and work closely with their customers to advise on which welding process will glean the best results for their specific operations. measurement technology that is easy to install and operate, offering maximum accuracy, safety and reliability.

For more information, visit: www.welding.com.au

1. <http://www.hobartbrothers.com/news/201/523/Flux>
2. <http://www.hobartbrothers.com/news/205/523/Rethinking-Metal-Cored-Wires.html>
3. <https://www.millerwelds.com/resources/article-library/new-welding-processes-technologies-and-retraining-help-address-labor-shortage>

