Seamless-cored wires that reduce manganese exposure

Nazmi Adams, Senior Vice President at voestalpine Böhler Welding, introduces the new diamondspark GUARD range of seamless flux-cored welding wires, which have been designed to reduce exposure to manganese welding fumes – a potential cause of a Parkinson's-type disease called manganese toxicity.

Flux-cored wires are commonly used in electric arc welding of low-carbon steels, particularly in structural applications. However, concerns have been raised about the potential neurological effects linked to manganese exposure in welding fumes, which may pose significant health risks to welders and other employees in the workplace.

As a result, health authorities have defined the exposure limits for welding fumes in the general workspace. While the proper PPE may protect the welder, other workers in the workplace are being exposed to harmful gases as well.

Although South Africa has not yet defined welding fume exposure limits, South African companies typically seek to operate at very high safety levels.

Health effects of welding fume elements

The human respiratory system is divided into the upper airway system, which includes the nose, throat and oral cavity, and the lower airway system, which includes the trachea, bronchi and other airways, which continue to branch into increasingly smaller airways called the bronchioles.

All particles smaller than 10 µm are difficult for the nose and throat to filter out, and these therefore pass directly into the lungs. Welding produces fumes and gases with particles ranging in size from 0.01 µm to 10 µm, depending on many different aspects. "The fact is, however, that welding fumes can penetrate deep into our lungs without us immediately noticing. We often only feel the effects of welding fumes years later," says Nazmi Adams, Senior Vice President at voestalpine Böhler Welding.

In recent years, the development of neurological dysfunctions due to welding fume exposure have mainly been associated with manganese (Mn). It has been documented that Mn poisoning causes a Parkinson's-like syndrome called 'manganese toxicity' after humans experienced chronic exposure in other occupational settings. These neurobehavioral changes have also been observed in welders who were exposed.

Based on these considerations, lowering the Mn presence in the welding fume is a very important step towards improving the health of welders.

There are many factors that influence the amount of fume generated in a workplace and all elements should be considered. Safety regulation applies the STOP principle in which:

1 'S' stands for Substitution, reducing the risk at the source, ie, selecting a welding consumable, welding process and shielding gas that will produce the least fume and manganese emissions. It is the first and most effective fume mitigation measure.
2 'T' stands for Technical measures, such as isolating the worker from the hazard by using fume extraction, ventilation or enclosures.
3 'O' stands for Organisational measures: changing the way of working by organising the work and restricting access. Unfortunately, most welding stations cannot be completely isolated.
4 'P' stands for Personal Protective Equipment, providing welders with the PPE required. The Powered Air Purifying Respirator (PAPR) system is reputed to be the best, but unfortunately, this only protects the welder and not the other workers or staff in the vicinity.

The employer has a duty to ensure that 'Substitution' is used whenever practically possible and to establish the healthiest process for the workplace.

diamondspark GUARD rutile cored and metal-cored wires are used in the general construction industry and in shipyards.

In trials comparing the new diamondspark GUARD 420 MC metal-cored welding wire with the standard diamondspark MC wire, operator exposure to airborne Mn was significantly reduced, helping fabricators to meet recently revised exposure limits.

The seamless diamondspark GUARD 420 MC wire on trial at a shipyard. Inset: diamondspark GUARD wires provide the same level of welding productivity and welding performance as conventional diamondspark cored wires, with a substantial reduction in the manganese content in the welding fumes.

Product name	EN ISO 17632-A	AWS A5.20/SFA-5.20	Welding positions	Polarity	Shielding gas
Diamondspark GUARD 420 RC (rutile cored)	T42 3 P M21 1 H5 T42 3 P M20 1 H5	E71T-1M/T-9M/T-12M H4	All positions	DC+	M21, M20 (Ar+8; 25% CO_2)
Diamondspark GUARD 420 MC (metal cored)	T42 4 M M21 1 H5 T42 4 M M20 1 H5	E70C-6M H4	All positions	DC+	M21, M20 (Ar+5; 25% CO_2)

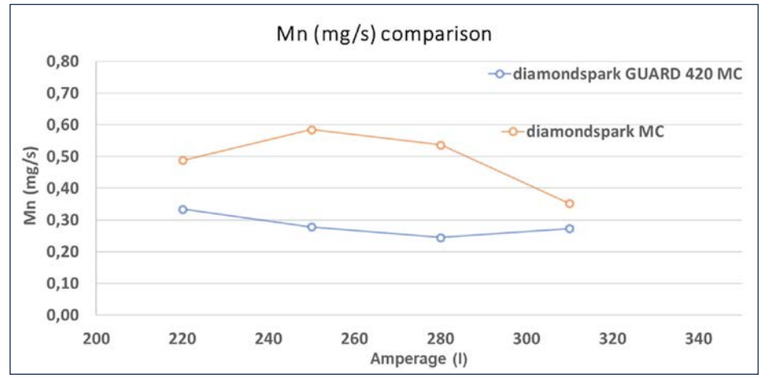
Table 1: Classifications for the new voestalpine Böhler Welding diamondspark GUARD 420 RC seamless rutile cored wire and the diamondspark GUARD 420 MC seamless metal-cored wire.

Wire speed [m/min]	Welding speed [cm/min]	Current [A]	Voltage [V]	Total FER [mg/s]	Mn FER [mg/s]
6.6	72	220	25.2	13.1	0.49
8.3	72	250	26.4	13.0	0.59
9.9	72	280	27.5	10.2	0.54
11.6	72	310	28	4.9	0.35

Table 2: Fume emission rate (FER) and Mn FER for the standard diamondspark MC wire.

Wire speed [m/min]	Welding speed [cm/min]	Current [A]	Voltage [V]	Total FER [mg/s]	Mn FER [mg/s]
6.8	72	220	24.8	12.6	0.33
8.9	72	250	26.5	13.7	0.28
9.8	72	280	27.5	11.1	0.25
12.2	72	310	28.8	6.1	0.27

Table 3: Fume emission rate (FER) and Mn fume emission rate for the new diamondspark GUARD 420 MC wire.



Mn fume emission rate for a classic diamondspark MC and diamondspark GUARD 420 MC at different welding parameters.

Low manganese diamondspark GUARD welding consumables

To meet the challenge of Substitution and reduce the risk of welding fumes at the source, voestalpine Böhler Welding has developed diamondspark GUARD consumables, which produce significantly lower emissions of manganese fumes during the welding process. "Our diamondspark GUARD 420 RC rutile cored and diamondspark GUARD 420 MC metal-cored wires are used in the general construction industry and in shipyards. As shown in the comparison tables and charts below, diamond spark GUARD cored wires are the perfect protection for welders," says Adams.

diamondspark GUARD wires are the latest in seamless-cored wire technology developed by Böhler Welding, and due to their innovative chemistry, they produce up to 60% lower manganese content in the welding fumes (mg/s) compared to conventional folded metal-cored wires. Yet diamondspark GUARD wires provide the same level of welding productivity and welding performance as conventional diamondspark cored wires, with a substantial reduction in the manganese content in the welding fumes.

Comparative welding fume trials

In trials comparing the new diamondspark GUARD 420 MC metal-cored welding wire with the standard diamondspark MC wire, operator exposure to airborne Mn was significantly reduced, helping fabricators to meet recently revised exposure limits.

The seamless design of the diamondspark wires delivers a large performance parameter window and is suitable for any wire-based welding process. It also delivers low diffusible hydrogen and outstanding mechanical properties.

The reduction of Mn in welding fumes is of crucial importance for the safety of welders and will become even more important in the future. The exchange of information, knowledge and research results make it clear that certain fumes are dangerous and that countermeasures need to be taken.

The increased safety standards are a great benefit for the health of welders. Manufacturers of welding consumables, equipment and personal protective equipment can focus on reducing Mn fume emissions, which leads to better welder health, better working conditions and greater satisfaction.

"It should be noted, however, that changing only this one parameter would not result in maximum protection. For effective Substitution to reduce the risk at source, the correct GUARD filler metal, shielding gas and an optimal set of welding parameters should be used.

"But if using a welding machines from voestalpine Bohler Welding, such as a URANOS or TERRA MIG/MAG welding systems, the ideal welding parameters for these diamondspark GUARD wires are already integrated and readily available," Adams concludes.

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