metco
joining & cladding

Solutions Flash

Wear Protection for Slurry Pipelines is Cost Effective and Long Lasting

SF-0033.0 – February 2024

Today's Situation

Slurry pipelines, as those used in oil sands, coal transport and the cement industry, are subject to extreme abrasive and erosive wear. In addition, some of these pipelines, like those for oil sands, can cover long distances from the point the oil sands are mined to the refinery. Hence, the pipe interior requires wear protection.

Pipelines transversing the landscape must conform to geologic features, such as hills, valleys, rocky outcroppings, lakes and more. They are also routed to avoid environmentally sensitive areas. In addition there may be pipeline equipment along the way such as pumping stations, isolation valves, etc. All require curves in the pipe that intensifies abrasion and slurry erosion.

To protect the inner diameter of the pipes from abrasion and slurry erosion, a number of different methods are traditionally used:

- Tungsten carbide overlays provide the best wear resistance, but are also very costly to apply.
- Chromium carbide overlays (CCO) are also popular and less costly than tungsten carbide. However, generally three layers of CCO are required. The first layer has about 30% dilution. By the deposition of the third layer, the deposit becomes more brittle which reduces overall impact and abrasion resistance.
- Rubber and polymer linings are also used which are relatively cost effective; however, the lining may be so thick that slurry flow is reduced. Linings often have to be customized to fit the pipe diameter and curved sections.

Example of rubber-lined transport pipe

The Metco Joining & Cladding Solution

Metco 8226 is an iron-based welding wire that forms hard molybdenum boride precipitates during the welding process. A single layer of Metco 8226 results in a deposit with optimum hardness that provides abrasion and slurry erosion resistance approaching that of tungsten carbide overlays without the high cost. The single layer of Metco 8226 achieves optimal performance, even with weld dilution, that compares with three layers of CCO.

Metco 8226 not only offers performance similar to tungsten carbide overlays, it's fine, homogeneous structure eliminates the possibility of carbide 'pull-out' that often occurs with tungsten carbide overlays, preventing additional wear of the softer matrix material where the pullout occurred.

When thicker deposits are desired for longer service life, a subsequent layer of Metco 8226-SLW can be applied over Metco 8226 while maintaining the compositional and wear resistance of a single layer of Metco 8226.

Furthermore, as our solution does not have the thickness of elastomer linings, the full flow volume of the pipe is maintained. A layer of Metco 8226 with an overlay of Metco 8226-SLW retains optimal performance while significantly extending the service life versus a single layer of Metco 8226.

Solution Description and Validation

1. Introducing Metco 8226 and Metco 8226-SLW

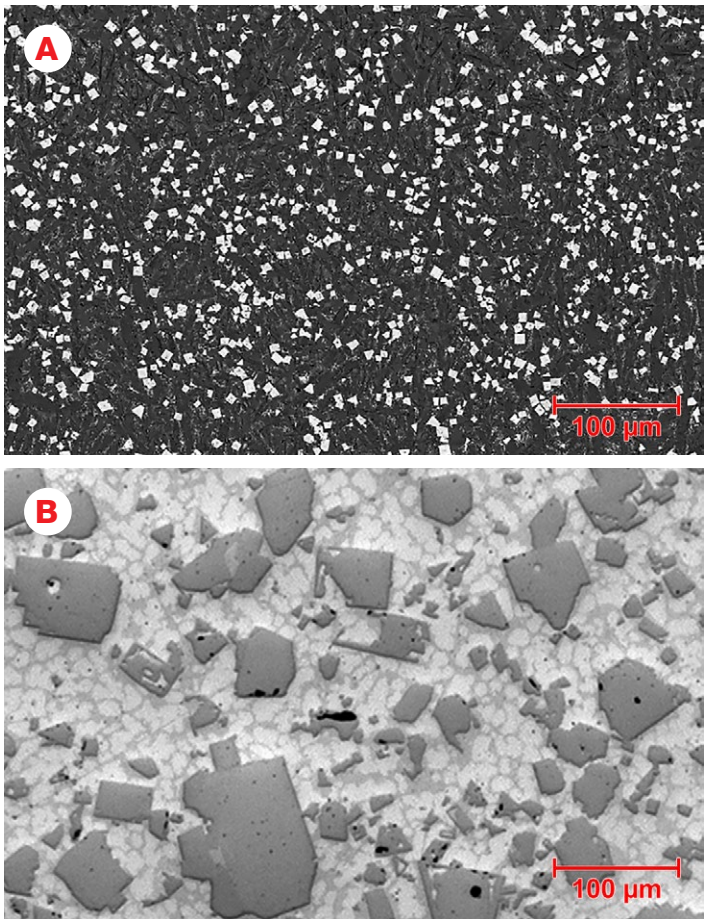
Metco 8226 and Metco 8226-SLW are weld wires of a proprietary and patented composition that, when welded, forms very fine carbide and molybdenum boride precipitates that are homogeneously distributed throughout the weld deposit.

As the hard phase is formed during the welding process, hard phase dissolution into the matrix is eliminated. Further, the very fine structure means that there is no large carbide 'pull out' during service that can result in exacerbation of matrix erosion. Also, in typical tungsten carbide overlays, the matrix wears causing the carbide hard phase particles to fall out. Metco 8226 has a very hard iron-based matrix with much better wear resistance than a typical carbide coating matrix.

Metco 8226 deposits achieve optimal hardness and wear resistance in a single weld pass. However, if longer service life is needed, a layer of Metco 8226-SLW can be applied over Metco 8226. The combination of Metco 8226 and Metco 8226-SLW maintains the performance characteristics of a single pass of Metco 8226.

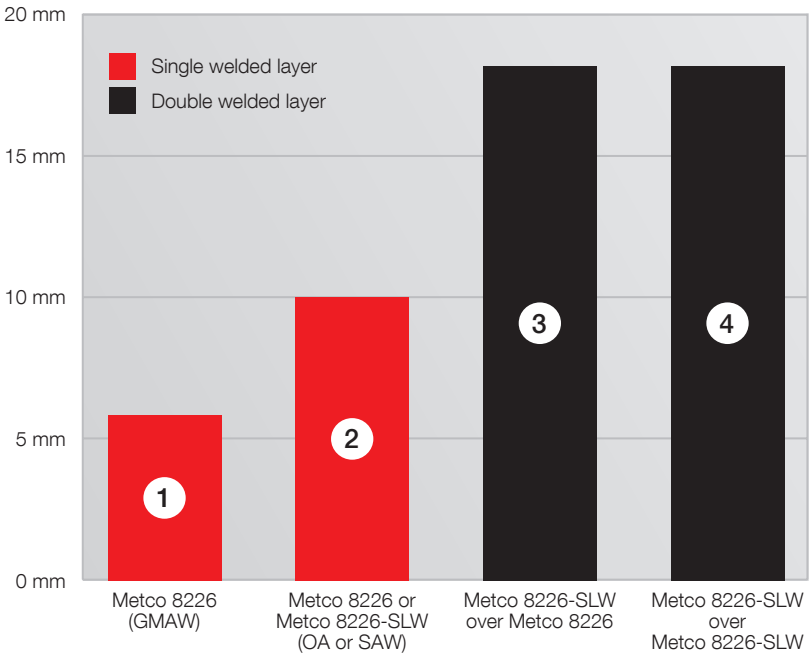
Metco 8226-SLW can also be used on its own as a single- or multi-layer deposit. The advantage is lower material cost; however, wear properties are slightly reduced.

Metco 8226 and Metco 8226-SLW are readily applied using conventional wire welding processes, such as GMAW (Gas Metal Arc Welding), SAW (Submerged Arc Welding) or OA (Open Arc Welding).



Microstructure comparison of Metco 8226 deposit **[A]** versus WC-Ni GMAW deposit **[B]**. Note the fine hard phase and more homogeneous structure created by Metco 8226 versus the very large hard phase particles in the GMAW deposit.

2. Achievable Maximum Weld Thickness



Weld thickness measured from weld fusion line to top of weld bead.

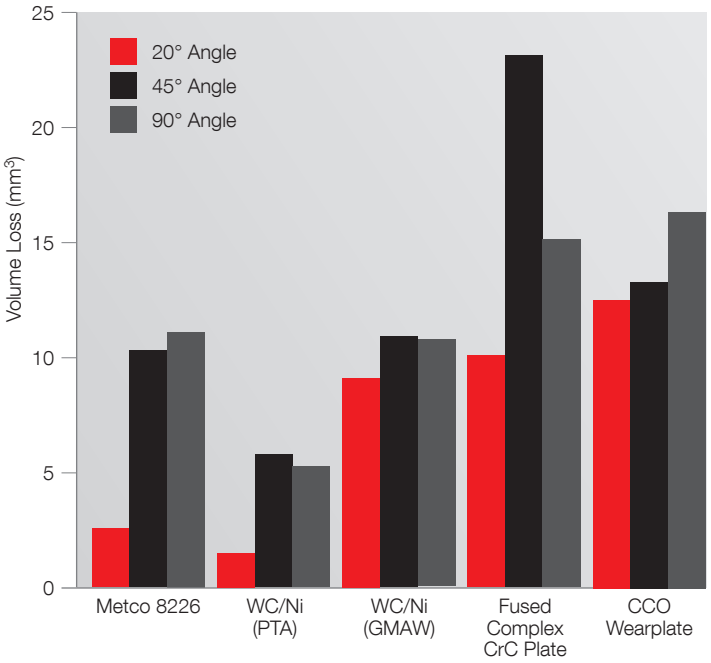
Relatively thick weld deposits are possible as shown in the graph to the left. When thicker welds are needed, a second layer of Metco 8226-SLW over Metco 8226 or a second layer of Metco 8226-SLW over Metco 8226-SLW is possible.

① Single layer of Metco 8226 applied using Gas Metal Arc Welding (GMAW), 1.6 mm diameter wire.
② Single layer of Metco 8226 or Metco 8226-SLW applied using Open Arc (OA) or Submerged Arc Welding (SAW), 2.8 mm or 3.2 mm diameter wire.
③ Metco 8226-SLW applied over Metco 8226 using OA or SAW (both layers).
④ Metco 8226-SLW applied over Metco 8226-SLW using OA or SAW (both layers).

Note: If thicker deposits are needed, please contact your Metco Joining & Cladding sales representative.

3. Wear Resistance

Slurry Erosion Resistance (lower is better)

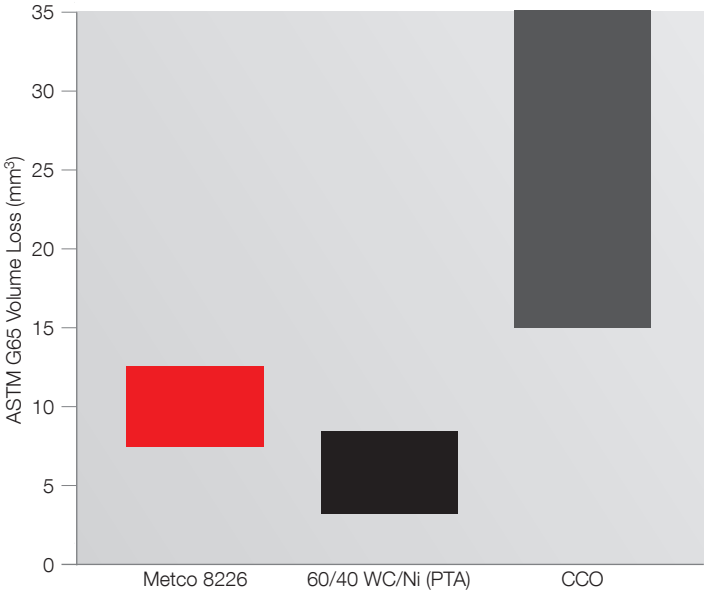


Metco 8226 demonstrates excellent slurry erosion resistance that is comparable to more costly tungsten carbide - nickel weld overlays. .

Slurry:	1:10 ratio (by weight) of 212 to 300 µm (50 to 70 U.S. mesh) AFS silica sand and potable water
Slurry Jet Velocity:	16 m/s (52.5 ft/s)
Test Duration:	2 h per angle
Test Temperature:	23 °C (73.4 °F)
Test Coupons:	76.2 x 25.4 mm (3 x 1 in) steel

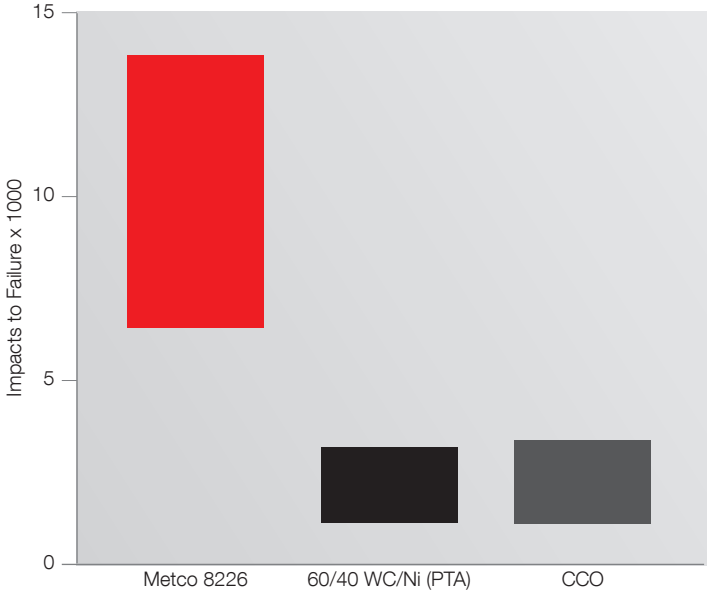
Results reported as volume loss calculated from the measured weight loss and material density, where the overlay materials were measured using the Archimedes method.

Range of Abrasion Resistance (lower is better)



Metco 8226 has abrasion resistance that approaches that of tungsten carbide overlays and is far better than CCO overlays.

Range of Impact Resistance (20 Joule Impact to Failure, higher is better)



Metco 8226 exhibits superior impact resistance when compared to both tungsten carbide and CCO overlays.

4. Spot Repairs

If necessary, Metco 8226-SLW can be used for in-situ spot repairs in the field on existing layers of either Metco 8226 or Metco 8226-SLW using a 'suitcase' welder. One need only to grind back the existing welded layers to achieve a clean surface and then weld immediately on top of the existing welded layers.

5. For Added Wear Protection

While Metco 8226 and Metco 8226-SLW provide excellent wear resistance, there may be areas of the pipeline where additional wear protection is required, such as pipe bends at high pressure flows. Metco Joining & Cladding recommends using our Woka 53025 which is a cast tungsten carbide blended with a nickel-chromium matrix in a ratio of 55:45. This product can be applied using spray and fuse powder welding. When spot repair of these areas is needed, WokaDur NiE-TM is recommended.

Customer Benefits of Metco 8226 and Metco 8226-SLW

Effective

- Provides excellent slurry erosion resistance combined with abrasion and impact resistance
- Appropriate for use wherever slurry erosion is a factor, such as for oil sands pipelines, coal slurries and cement slurries
- Wear resistance is superior to chromium carbide overlays and approaches that of tungsten carbide overlays
- Unlike traditional carbide overlays, Metco 8226 achieves optimal performance in the first welded layer
- Carbide and boride hard phase precipitates form during welding process eliminating hard phase dilution
- Very fine homogeneous microstructure eliminates pull-out and wear of softer matrix as is often seen in tungsten carbide overlays

Economical

- Lower material costs when compared to tungsten carbide
- Very thick, multilayer deposits are possible to provide long-lasting wear protection with no performance degradation for subsequent layers
- Lower density overlays results in less material usage compared to tungsten carbide

Efficient

- Easily applied using conventional welding processes such as gas metal arc welding, open arc welding and submerged arc welding
- Can be touched up or repaired in the field
- Spot repairs provide the same performance as the original welded overlays

The Metco Joining & Cladding Difference:

Metco 8226 and Metco 8226-SLW were developed using our patented and proprietary **Scoperta™** high throughput computational metallurgical process to evaluate millions of candidate alloy compositions. Potential candidates are then experimentally evaluated using an advanced screening process where both properties and alloy microstructure are measured.

The combined **Scoperta** computational and experimental approach allows Metco Joining & Cladding to rapidly design the final material with a much better accuracy than conventional empirically-based methodologies.

metco
joining & cladding

www.metcojoiningcladding.com
info@metcojoiningcladding.com