Extending the Life of Roller Screens Used in Pelletization by 3-6X using HybriComp-W104 Tungsten Carbide Coatings

Steel Mills using HybriComp-W104 tungsten carbide coatings on pelletizer roller screens save an average of $1M through reduced capital costs, and generate $1M in additional revenues through reduced downtime, maintenance, and replacement cost.

About Roller Screens/Rolls

The process of pelletization enables converting Iron Ore Fines into "Uniformed Sized Iron Ore Pellets" that can be charged into the blast furnaces or for Production of Direct Reduced Iron (DRI). During this process, very finely ground particles of iron ore fines of size less than 200 mesh are mixed with additives like bentonite and then shaped into oval or spherical lumps of 8-16 mm in diameter by a pelletizer and the lumps are then flame hardened. Pellets with their high, uniform mechanical strength and high abrasive strength increase production of sponge iron by 25% to 30% with same amount of fuel.

Roller Screens or Conveyors are used as a method of transportation, separation and selection for green iron ore pellets by rejecting undersize and oversize pellets. The spacing between the roller screens allows fines to pass between the roller, leaving uniform pellets to continue through the process. Roller screens are chosen over other screens since it is essential to prevent breakage and degradation of pellets along with efficient separation of fines for recycling in the pelletizer. Roller screens have a major impact on the overall performance of an iron ore pellet plant and on the subsequent production of Direct Reduced Iron (DRI). The green iron ore pellets have a humidity content between 9% and 12%; therefore, the rollers are subject to both abrasive and corrosive conditions.

On average, a single pelletization line uses anywhere between 35-70 rolls which are mostly thermally sprayed with tungsten carbide coatings to protect the roller screens from abrasive wear. However, the currently used coatings do not provide the required abrasion protection, and in a short period of time wear-off completely exposing the underlying steel (roller screen) to abrasion and corrosion. These screens are currently being replaced every 3-4 months since the abrasion leads to dimensional loss of the roller thereby allowing larger iron ore pellets to go through them. Pellets of uniform size contribute to faster reduction and high metallization rates, and hence it important to ensure that the roller screens retain their dimension for as long as possible to reduce early replacement, maintenance, and downtime costs.

Iron ore pellets screening

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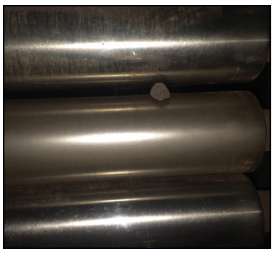
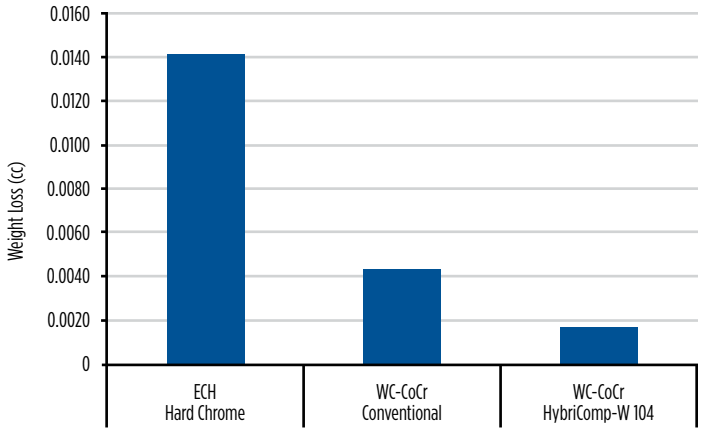
Case Study

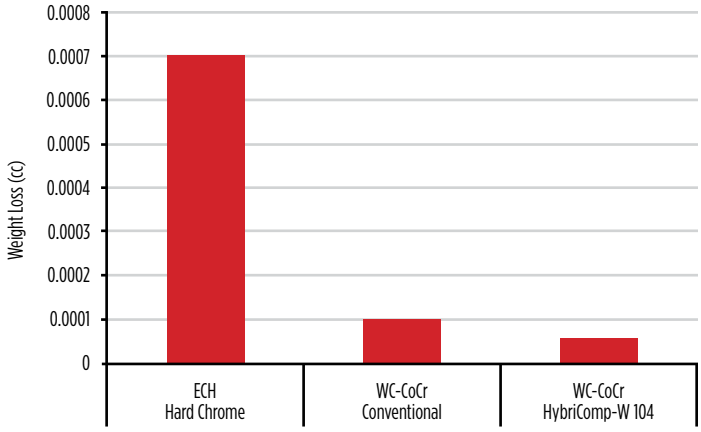
A roller screen coated with HybriComp-W104 coating was installed in the pelletizing line and was inspected for 9 months and compared with rolls coated with conventional tungsten carbide coatings which were installed at the same time. After 9 months, HybriComp-W104 coated roller screens looked as good as new and showed no signs of abrasion or dimensional loss compared to competitor's coatings which were worn-out, and showed a dimensional loss of 6-15mm and hence had to be replaced. The same HybriComp coated roller when evaluated again after 14 months had still shown no signs of abrasion whereas the rolls coated with conventional tungsten carbide coatings were again worn-out and hence the rolls had to be replaced; it is expected that roller screens coated with HybriComp-W coatings should last for 18 to 24 months and significantly reduce downtime and maintenance costs associated with early failure of coatings of roller screens.



The roll in the center has been coated by HybriComp-W whereas the other rolls were coated with conventional tungsten carbide coatings. It can be clearly seen that there is no sign of abrasion or wear in the HybriComp-W coated roll, whereas the other rolls have significant abrasion and wear. The rolls protected with the conventional tungsten carbide coatings showed a dimensional loss of 6mm to 15mm and required replacement.



ASTM G-65 Sand Abrasion test clearly shows that HybriComp W-104 performs 2-3X better than conventional tungsten carbide coatings



ASTM F1978 Dry Abrasion test clearly shows that HybriComp W-104 performs 2-3X better than conventional tungsten carbide coatings

Economic Value Proposition

The table below that takes into account a pelletizing line with 60 rolls and compares the value proposition of HybriComp-W with conventional tungsten carbide; g. On an average, if all the rolls are coated with HybriComp-W104, a company could save $1 million/year in capital cost and generate approximately $1 million/year in additional revenues.

	Conventional Tungsten Carbide Coating	HybriComp-W Coating
Abrasion loss/month	1-2mm/month	0.05mm/month
Average roll replacement time (months)	4 months	24 months
Number of coated rolls required every 24 months for a 60 roll pelletizing line	360	60
Average saving in coating costs for a 60 roll pelletizing line in 2 years	N/A	~$1,800,000
Additional revenues/year earned due to a 6 fold reduction in downtime, replacement, and maintenance	N/A	~$1,000,000

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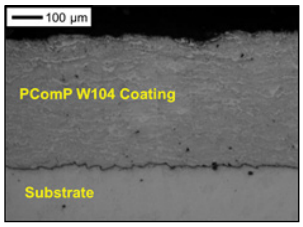
About HybriComp-W104 Thermal Spray Powders

HybriComp-W104 (86%WC, 10%Co, 4%Cr) is a premium high toughness nano-engineered tungsten-carbide-cobalt (WC-Co) material with a high deposition efficiency (better yields), and 5-7 times the ductility and toughness of conventional, micro-grain carbides.

These powders are nano-structured ceramic-metal composites formed with a nanocomposite core and binder coating, utilizing a combination of high hardness, high wear resistance and excellent corrosion resistant materials. The nanocomposite core contains nano and near-nano size WC (Tungsten Carbide) particles in a hard, corrosion resistant binder. This core is encased in a protective cladding that minimizes the adverse effects of the HVOF straying process on the hard particles and helps form the coating's hierarchical structure. This combination results in a high-toughness, ductile-phased toughened structure of high hardness tiles separated by ductile binder laminates.



HybriComp™ W104 test results from our customers have shown 3-7 times extended life over conventional thermal spray materials; leading to the lowest coating life cycle cost in this segment.

Snapshot

Characteristic	Data
Classification:	Tungsten-carbide-cobalt
Chemistry:	86WC 10Co 4Cr
Manufacturing:	Agglomerated and sintered
Morphology:	Spheroidal
Purpose:	Corrosion and wear resistance
Apparent Density:	4 – 5.5 g/cm^3
Service Temperature:	Up to 500 °C (930 °F)
Process:	HVOF

Chemical Composition

Weight Percent (Nominal)					
	W	Co	Cr	C (total)	Fe (max)
HybriComp W104	Bal.	9 - 11	3.5 – 4.5	4.5 – 5.5	0.1

Particle Size Distribution and Apparent Density

HVOF System	Nominal Range (µm)	Primary Carbide Grain Size	Apparent Density (g/cm^3)
DJ-5000	-38 + 10	200-400 nm	4.5 – 5.5
JP-5000	-45 + 15	200-400 nm	4.5 – 5.5

HybriComp™-W104 is an ideal replacement for Metco 5847-45, Metco 5163, Metco 5164, Metco 5165, Woka 3652, Woka 3653, Woka 3655, Woka 3657, Woka 3652 FC, Woka 3653 FC, Amperit 558.072 and Amperit 558.074 thermal spray powders, and offers longer-life at lowest life cycle cost compared to the coatings generated from these thermal spray powders.

Key Thermal Spray Coating Information

Specification	Typical Data
Recommended Process	HVOF
Microhardness (HV0.3)	1300 – 1450
Wear Rate (ASTM G65 B)	Less than 2 mm^3
Porosity	Less than 1 %
Corrosion Resistance	No corrosion after 1000 hours in salt fog test
Maximum Service Temperature	500 °C (930 °F)

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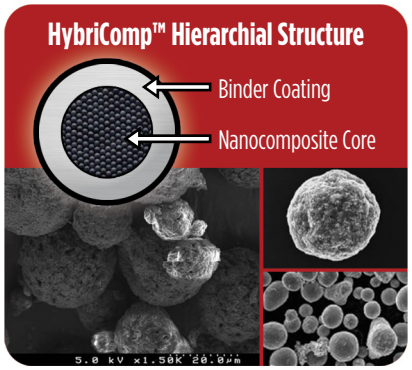
About HybriComp Long-Life Thermal Spray Coatings

HybriComp thermal spray powders are the only thermal spray powders that lead to coatings that are both hard and tough, and hence despite the high hardness the coatings do not spall (flake)when bent. Additionally, Hybrid Materials LLC is the only company in the world that manufactures titanium nitride and silicon nitride based HybriComp thermal spray powders; despite decades of research no other company has been able to make titanium nitride and silicon nitride based powders that can be sprayed using thermal spray coating systems.



Near-Nano Composite Core

- High hardness and wear resistance
- Contains nano-dispersed friction modifiers
- Provides for fast machining

Binder Coating

- Improves adhesion and efficiency
- Provides toughness and resiliency
- Provides corrosion resistance
- Prevents compositional changes

HybriComp coatings are cermets fabricated into a hierarchical structure, developed with microstructures, engineered at the nano-, micro- and meso- scale, to offer revolutionary performance and cost breakthroughs. These materials are formed with a nano-composite core and binder coating by combining low friction, high wear resistance and excellent corrosion resistant materials. The nano-composite core provides high wear resistance, low friction and, for Titanium-Nitride and Silicone-Nitride based powders, light weight, while the binders provide corrosion resistance, toughness, ductility, resiliency, and improved deposition efficiency. This combination results in a high toughness, ductile-phased toughened structure comprised of high hardness tiles separated by ductile binder laminates.

Important to note is that HybriComp is a manufacturing methodology and not merely a product, with the HybriComp manufacturing methodology, Hybrid Materials LLC can combine a variety of materials that usually cannot be combined thus leading to best-in-class corrosion- and wear-protection. HybriComp cermet coatings can replace electrolytic hard chrome, electroplating, spray and fuse, and thermal spray carbides to impart wear and corrosion resistance, and reduce friction in sliding wear applications. HybriComp coatings are easy and fast to apply that can be machined to tight tolerances for dimensional restoration of OEM or worn E&P components. The HybriComp family of coating materials has been designed to act as a drop-in replacement for thermal spray powders and will work with today's existing application systems.

To learn more about our HybriComp coatings please contact us by phone at +1(216) 453-0866 or email at info@Hybrid Materials LLC.com.