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IntegriMat Inc.

Tungsten Carbide Wear Engineering Division

WHITE PAPER

Tungsten Carbide Under Pressure

Supply Constraints, Cost Volatility, and Engineering Alternatives for Wear-Critical Applications

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When tungsten carbide availability becomes uncertain, the engineering requirement does not disappear.

The question changes from "Where can we buy the same material?" to "What material system can deliver the performance we actually need?"

Executive Summary

Tungsten carbide has become one of the most important materials for severe wear applications across mining, oil and gas, construction, mineral processing, drilling, recycling, and other demanding industries. Its combination of exceptional hardness and abrasion resistance makes tungsten-carbide-based materials difficult to replace in many applications.

However, relying on tungsten carbide also introduces challenges.

Supply constraints, geographic concentration of raw-material production, changing trade conditions, long lead times, and price volatility can affect the availability and economics of conventional tungsten-carbide solutions.

For engineers and procurement teams, simply replacing tungsten carbide with a lower-cost material is rarely the correct approach. Wear performance depends on the complete material system: carbide type and morphology, particle size, carbide fraction, metallic matrix, deposition method, operating temperature, impact loading, corrosion environment, and the dominant wear mechanism.

This white paper examines these challenges and presents an engineering framework for evaluating tungsten-carbide systems and potential alternatives.

At **IntegriMat Inc.**, we approach wear protection as a materials-engineering problem rather than simply a product-selection problem. Our capabilities combine engineered wear materials, tungsten-carbide hardfacing products, material selection, failure analysis, metallurgical consulting, and customized technical solutions.

1. Why Tungsten Carbide Matters

Industrial components operating in abrasive environments experience progressive material loss caused by mechanisms including abrasion, erosion, impact, adhesion, corrosion-assisted wear, and combinations of these mechanisms.

Tungsten carbide is particularly valuable because of its extremely high hardness and ability to maintain wear resistance under severe abrasive conditions.

Typical applications include:

- Mining and mineral-processing equipment
- Ground-engaging tools
- Augers and drilling components
- Crushers and screens
- Wear plates and liners
- Dredging components

- Pump components
- Oil and gas equipment
- Agricultural and earth-moving components

Yet the term **"tungsten carbide" does not describe a single material solution**. Performance can vary significantly depending on carbide morphology, carbide chemistry, matrix composition, particle distribution, manufacturing route, and application method.

2. The Emerging Challenge: Supply and Cost

Tungsten Is a Strategically Important Raw Material

The global tungsten supply chain is geographically concentrated. This creates exposure to changes in raw-material availability, export conditions, logistics, geopolitical developments, and pricing.

Source: U.S. Geological Survey (USGS), Mineral Commodity Summaries — Tungsten, 2026.

For industrial users, these factors may appear as:

Longer lead times

Price volatility

Supplier concentration

Inventory pressure

Qualification challenges

Should industry search for another source of the same tungsten-carbide material—or engineer the wear solution differently?

The answer depends on the application.

3. There Is No Universal Replacement for Tungsten Carbide

Replacing tungsten carbide should not begin with a list of cheaper materials.
It should begin with the **wear mechanism**.

A material that performs exceptionally under sliding abrasion may fail rapidly when exposed to repeated impact. Similarly, a very hard material may not provide the best solution where toughness, corrosion resistance, thermal cycling, or repairability dominates component life.

4. Engineering Alternatives

Depending on the application, potential material systems may include:

Tungsten Carbide–Based Systems

Tungsten carbide may remain the optimum solution, while its formulation is optimized through changes in carbide morphology, carbide loading, particle size, or matrix composition.

Chromium Carbide Systems

Chromium-carbide-based materials can provide an attractive balance between abrasion resistance and cost for selected applications.

Nickel-Based Hardfacing Alloys

NiCrBSi and related nickel-based alloys provide combinations of hardness, corrosion resistance, wettability, and metallurgical compatibility.

Cobalt-Based Systems

Cobalt-based hardfacing materials can be considered where elevated temperature, galling resistance, corrosion, and complex wear mechanisms are important.

Iron-Based Hardfacing

Iron-based systems may provide an economical solution for large surfaces and applications where extreme tungsten-carbide performance is unnecessary.

Ceramic and Composite Solutions

For selected geometries and operating conditions, engineered ceramics and composite wear components may provide an alternative approach to deposited hardfacing.

The optimum solution is therefore not necessarily:

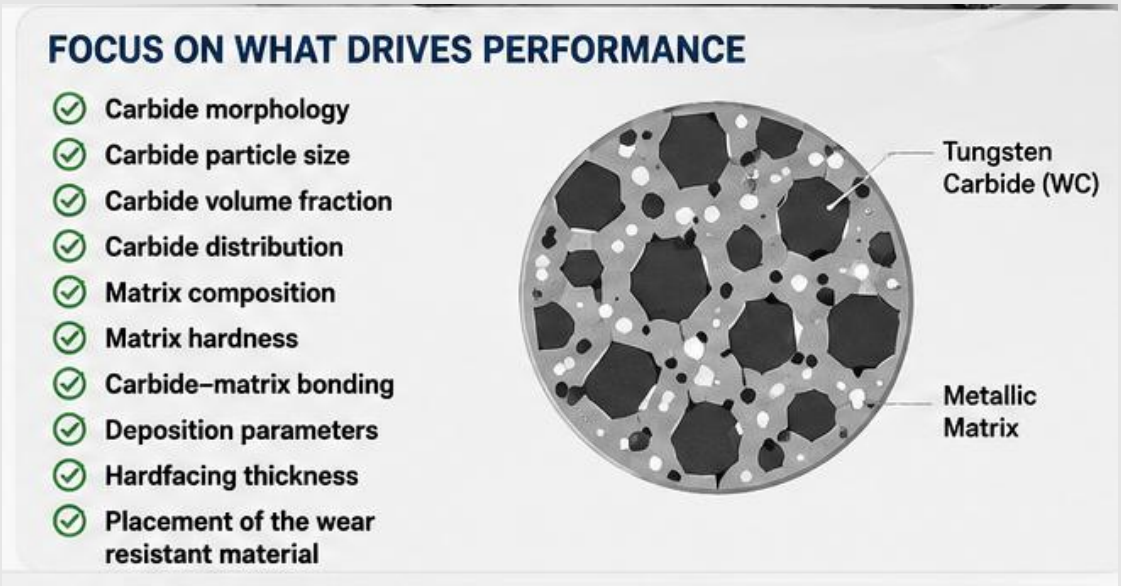
“What material is as hard as tungsten carbide?”

A better question is:

“What material architecture provides the required component life under the actual operating conditions?”

5. Optimizing Tungsten Carbide Before Replacing It

In many applications, eliminating tungsten carbide entirely may not be necessary. Significant optimization can be achieved by controlling:



For example, wear protection can sometimes be concentrated only in high-wear zones instead of covering the entire component.

This reduces tungsten consumption while maintaining protection where it provides the greatest value.

This concept can be described as:

Use the right material, in the right amount, in the right location.

6. IntegriMat Inc. — Materials Engineering Beyond the Product

IntegriMat Inc. is a Canadian materials engineering company focused on engineered materials, wear solutions, metallurgical services, and industrial applications.

Our approach combines **materials, application engineering, and technical support**.

Engineered Wear Products

Our product capabilities include tungsten-carbide-based hardfacing materials such as:

IntegriClad™ Wear Solutions

Engineered tungsten carbide welding materials developed for demanding abrasion and wear environments.

Available material architectures can incorporate different carbide morphologies and matrix systems depending on application requirements.

IntegriClad™ solutions are intended for applications including mining, drilling, earth-moving, mineral processing, and industrial wear protection.

Other IntegriMat product capabilities include:

- Tungsten carbide components
- Wear-resistant materials
- Industrial ceramics
- Industrial knives and blades
- Engineered material solutions

7. Engineering and Metallurgical Services

Selecting a material without understanding why the existing component fails can result in expensive trial-and-error.

IntegriMat supports customers through engineering services including:

Failure Analysis

Identification of material degradation and failure mechanisms through systematic metallurgical investigation.

Material Selection

Evaluation of candidate materials based on operating conditions, wear mechanisms, mechanical requirements, environment, and lifecycle considerations.

Metallurgical Consulting

Technical support for material specifications, manufacturing challenges, wear problems, coatings, hardfacing, and material-performance optimization.

Material Characterization

Hardness evaluation and other material characterization approaches can be incorporated into engineering investigations and quality assessments.

8. From Material Supplier to Engineering Partner

A wear problem should not always begin with a product catalogue.

It should begin with the component.

What is failing?

Where is material being lost?

What is the dominant wear mechanism?

What operating conditions cause the damage?

What service life is required?

What manufacturing and repair processes are available?

Once these questions are understood, the material system can be selected more intelligently.

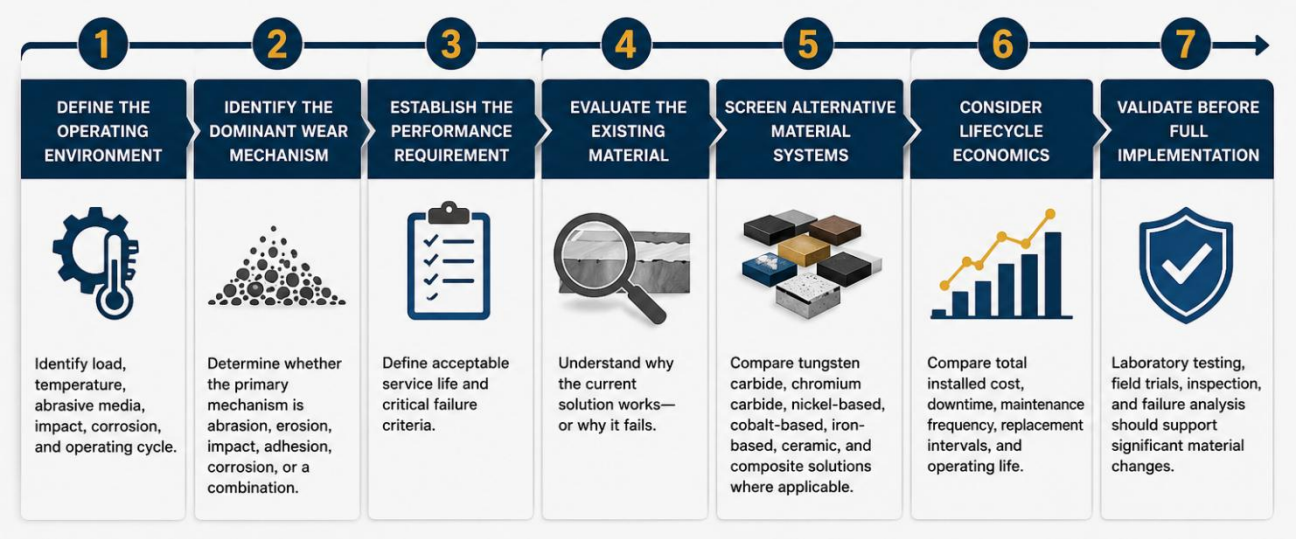
IntegriMat's objective is to connect these elements:

Application → Failure Mechanism → Material Selection → Engineered Solution → Verification

This approach allows customers to evaluate not only conventional tungsten-carbide solutions but also optimized carbide systems and alternative materials when technically justified.

9. A Practical Decision Framework

When tungsten carbide supply or cost becomes problematic, engineering and procurement teams can follow a structured process:



10. The Opportunity Behind the Supply Challenge

Tungsten carbide supply constraints create risk, but they can also encourage better engineering.

Instead of automatically specifying the same material used historically, organizations can reassess:

- Why tungsten carbide was originally selected
- How much tungsten carbide is actually required
- Where it provides the greatest value
- Whether carbide architecture can be optimized
- Whether another material system can meet the actual performance requirement
- Whether component design or hardfacing placement can reduce material consumption

This shifts the conversation from **material substitution** to **wear-system optimization**.

Conclusion

Tungsten carbide remains one of the most important materials available for severe wear protection, and in many demanding applications there is no simple equivalent replacement.

However, supply constraints and cost volatility make it increasingly important to use tungsten carbide strategically.

The engineering objective should not be to replace tungsten carbide at any cost.

It should be to achieve the required **performance, reliability, availability, and lifecycle economics** using the most appropriate material system.

At IntegriMat Inc., we combine engineered wear products with materials-engineering expertise to help industrial customers evaluate tungsten-carbide solutions, investigate failures, select materials, and develop application-specific approaches to wear protection.

Need to Reduce Tungsten Carbide Dependency?

If your operation is experiencing tungsten-carbide supply challenges, increasing material costs, premature wear, or difficulty selecting an alternative material, IntegriMat can evaluate the application from a materials-engineering perspective.

Send us your component, operating conditions, current material specification, and wear problem.

We can help determine whether the appropriate path is:

Optimize it. Substitute it. Redesign it. Or keep tungsten carbide where it matters most.

TALK TO A MATERIALS ENGINEER:

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