

MINING: HOW TO CONTROL ABRASION AND EROSION IN THE MOVEMENT OF GROUND ORES AND CONCENTRATES

March, 2026

Introduction:

In processes related to the extraction of commercially valuable minerals (copper, gold, silver, etc.), we face variables such as abrasion and erosion. These effects often lead to operational downtime for equipment, significantly impacting the operational and economic management of mineral processing plants.

These phenomena are unavoidable, and we must strive to be at the forefront of applications where both engineering and the various lines of anti-abrasive products provide solutions tailored to our needs.

Starting with the problem to be solved, different ways to minimize it can be found, and this is where experience and knowledge of the subject and the industry.

The wear of materials by abrasion and erosion differs mainly in how the particles interact with the surface: by sliding (abrasion) or by impact (erosion).

1. Abrasive Wear Mechanisms

This occurs when hard particles or rough protrusions slide over a softer surface, gradually removing material. The main mechanisms are:

- **Micro-plowing:** The particle displaces the material to the sides of its path, forming furrows without immediately removing it. The material accumulated on the ridges is more vulnerable to detachment later due to fatigue.
- **Micro-cutting:** The particle acts as a cutting tool, removing material chips directly from the surface.
- **Micro-fatigue:** Repeated passage of particles over the same point causes load and unload cycles, generating sub-surface cracks that eventually cause the material to flake off.
- **Micro-fracture:** Common in brittle materials (such as ceramics or white cast iron); particle stress causes cracks that propagate and cause large pieces of material to break .

2. Erosion Wear Mechanisms

It is caused by the impact of particles (solid or liquid) transported by a fluid at high speed. The damage depends critically on the angle of impact:

Solid Particle Impact Erosion:

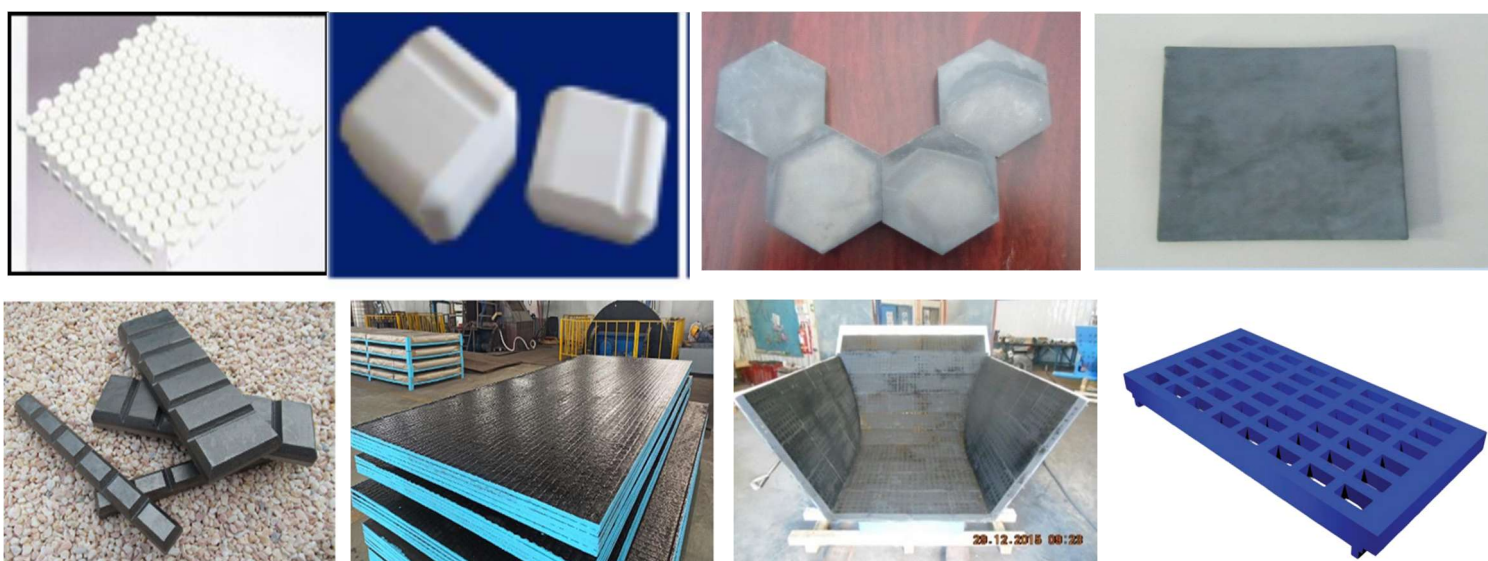
- **Low angles (sliding):** Cutting mechanisms similar to abrasion predominate.
- **High angles (perpendicular):** Plastic deformation predominates in ductile materials, while brittle fracture occurs in hard materials. Direct impact "crushes" the surface, creating fatigue and cracks.
- **Cavitation erosion:** This occurs in liquids when vapor bubbles implode near a solid surface. The resulting shock waves generate extremely high-pressure micro-impacts that fatigue the material until it tears away, creating characteristic pitting.

Types of wear-resistant materials:

There are many lines of anti-wear products, the most important of which are:

1. Ceramic Materials
2. Vulcanized Modules
3. Wear-Resistant Resins
4. Bimetallic Plates
5. Polyurethane Rubber Panels
6. Monolithic and Preformed Materials

1. Ceramic Materials:



There are various ceramic materials on the market with diverse chemical compositions, physical characteristics, and formats.

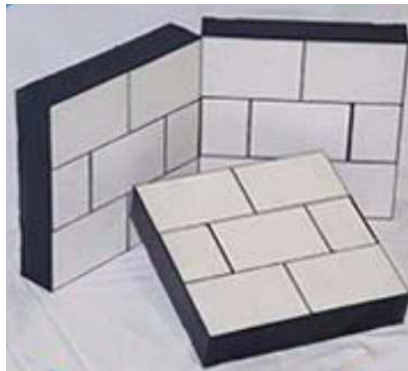
The following table shows some of the main types, along with selection criteria based on their intended use:

Producto	Alúmina		RBSiC	Alúmina Zirconia		Zirconia Alúmina	Zirconia Itria
	92%	95%	SiSiC	ZTA 400	ZTA 430	ARZ	YTZP
Wt% Al ₂ O ₃	92%	95%	85% (SiC)	85%	80%	20%	-----
Wt%	5,3% (SiO ₂)	3 a 4% (SiO ₂)	15% (Si)	15% (ZrO ₂)	20% (ZrO ₂)	80% (ZrO ₂)	94,6% (ZrO ₂) + 5,4% (Y ₂ O ₃)
Dureza Vickers (HV ₅₀)	1200	1250	1620	1400	1300	1200	1100
Resistencia a la Flexión (MPa)	230	275	280	480	500	800	1000
KIC (MPa m ^{1/2})	4,3	4,5	4,0	6,0	7,0	8,0	8,0
Densidad (gr/cc)	3,61	3,65	3,02	4,0	4,3	5,3	6,02
Aplicación	Alto Desgaste	Alto Desgaste	Desgaste Severo	Alto Desgaste + Impacto	Alto Desgaste + Impacto	Impacto + Desgaste	Impacto + Desgaste

2. Vulcanized Modules:

High-Strength Natural Rubber with Anti-Abrasive Ceramic Inserts

Using a vulcanizing plant for high-strength rubber coatings with anti-abrasive ceramic inserts yields excellent results in high-impact areas and with particle sizes larger than 10 inches. We can also use anti-abrasive rubber modules alone, whose characteristics make them ideal for protecting all types of elements subjected to abrasion and impact. The rubber composition will depend on the specific conditions to which it is exposed.



3. Anti-wear resins:

When we install erosion- and wear-resistant coatings, we inevitably create unprotected areas that can become critical.

These areas are the junctions between plates, panels, or whatever component we've designed—in other words, joints where we need to take effective action.

For these areas, we use materials that combine resins with abrasion-resistant powders.

- ***Epoxy resin with fine anti-wear particles.***
1 kit (28 Lbs)(1 galón Resin+Alúmina / 1 galón hardener +Alúmina)
- ***Epoxy resin with fine anti-wear particles (Fast setting)***
1 kit (28 Lbs)(1 galón Resin+Alúmina / 1 galón hardener+Alúmina)



4. Bimetallic Plates:

Bimetallic plates are objects composed of two different metals bonded together inseparably, either to take advantage of different properties such as electrical conductivity, wear resistance, or thermal expansion.

There are two main types of bimetallic plates, each with very different applications:

4.1. Bimetallic Plates for Wear Resistance

These plates are designed to withstand extreme abrasion and typically consist of a structural steel base plate (such as ASTM A-36) with a hard alloy coating, commonly chromium carbides, fused to the surface.

Composition: A steel base layer to provide structural support and a hard surface layer rich in chromium carbides for wear resistance.

Properties: They offer extreme surface hardness, combined with the flexibility and toughness of the steel base layer.

Applications: They are widely used in the mining industry to line equipment exposed to severe abrasion, such as chutes, hoppers, loader buckets, screw conveyors, and pipelines.

The described material is developed through a fusion process on the base material and is produced using an electrode to which ferroalloys, formulated for each application, are added at the base of the electric arc. This process allows for up to 50% more carbides to be added than traditional welding processes.

Typical chemical composition :

Carbon:	4.0-5.5%
Chromium:	18-35%
Manganese:	3.3%
Others:	0.5%
Hardness:	55-62 HRC

4.2. Electrical and Thermal Bimetallic Plates:

These plates take advantage of the union of metals with different electrical properties or different coefficients of thermal expansion.

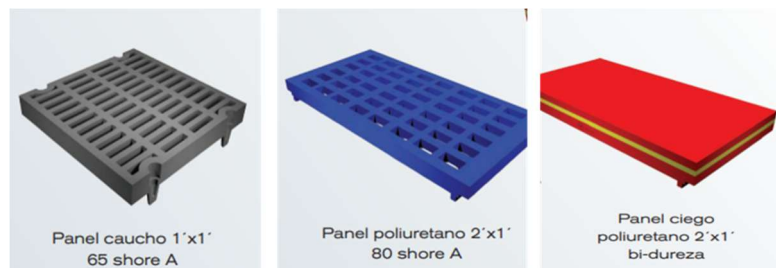


5. Rubber-Polyurethane Panels:

We can find two types of panels: self-cleaning and solid.

Self-cleaning panels guarantee that their perforations will not become clogged by oversized stones. They are manufactured from 60 Shore A rubber or 70 to 90 Shore A polyurethane with high abrasion resistance.

Solid panels are used for protection in feeding and unloading areas. They are bi-color panels, manufactured with two hardness levels: an exposed surface with high abrasion resistance (95 Shore A hardness), and an intermediate layer with high impact energy absorption (65 Shore A hardness)



6. Monolithic materials resistant to abrasion/erosion wear:

These are dry, powdered compounds that, when mixed with water using high-intensity mixers, create a material that can be applied to an expanded metal base, which is welded to the surface to be protected.

This type of material allows us to work in locations that might be difficult to install other materials, either due to their geometry or because they are subject to movement and vibration.

When feasible, pre-molded pieces can be manufactured and then installed in their final location.

We define two formats:

- Monolithic: prepared and installed on-site
- Pre-formed: pieces are manufactured beforehand and then installed using the corresponding equipment

Let's look at some examples of both:

6.1. Monolithic type:



6.2. Pre-shaped type:



Examples of applications:

Below we will show real examples where we have participated in some way.

- **Drawer Line Thickeners**



- **Cuba SAG Mill**



- **Manifold Nozzles**



- **Stainless steel receiving chute with agglomerated feeder channel**



- **Lifter T**



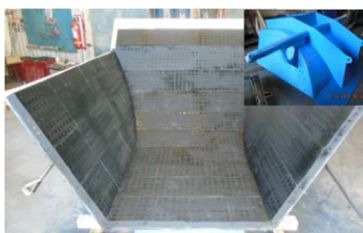
- **SiC lining for chipboard deflector**



- **Guide rail in crushing (chancado) and gravel area**



- Deflector Olap Stacking area in MEL



Conclusions:

For every erosion-related problem—whether it involves the type and size of rocks affecting structures, the angles of attack, or the predominance of abrasion or impact erosion—**there is always a technical solution to mitigate it.**

Our company has all the necessary resources to address these issues.

- Top-tier technical consulting: specialists who have served mining companies in Chile
- State-of-the-art materials
- Lining design
- Installation of various materials

Soluciones Refractarias SRL, not only can it provide the best refractory, insulating and anti-erosion products, design the appropriate profiles, perform the thermal calculations, but it also provides the complete professional installation service for them, and finally can do the complete drying following a predetermined dry-out curve.

Our WEB : www.solucionesrefractarias.com.ar

Our Media nets : <https://taplink.cc/solucionesrefractarias>

Consults to : info@solucionesrefractarias.com.ar

Related Links :

[Installation service :](#)

[See Interview in “Fuerza Minera magazine” :](#)

[Productos específicos para EROSION :](#)

Note: This report is intended to illustrate all aspects and complexities of the topic covered. It should not be taken literally for final valuation decisions regarding the scope of the report. For specific calculations or decisions, we recommend consulting the relevant experts..

All aspects concentrated in one place, our space !!!!

