

PROTECTIVE COATINGS
SUCCESS STORIES

FOR MINING AND ORE PROCESSING EQUIPMENT AND STRUCTURES

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How can coatings increase your uptime while lowering life cycle costs in your mining or ore processing operation?

Read the real-life customer stories in this book to learn how.

In the mining and mineral/ore processing industries, Mean Time Between Failure (MTBF) and the resulting loss of system uptime are of paramount importance. One of the primary causes of unscheduled outages and maintenance work orders in mining and ore processing operations is damage to material handling equipment and systems caused by highly abrasive and corrosive environments. Properly specified protective coatings can increase system reliability by reducing the impact of corrosion and wear.

The Business Case:

MINING AND ORE PROCESSING OPERATIONS

Improved Corrosion Management

- Lowered maintenance costs
- Decreased inspection/monitoring costs
- Improved ability to meet production goals
- Reduced product loss
- Extended equipment life cycles and reduced maintenance/replacement costs
- Improved public relations
- Fewer employee injuries due to better environmental controls

Equipment/Structure Wear In Mining Operations

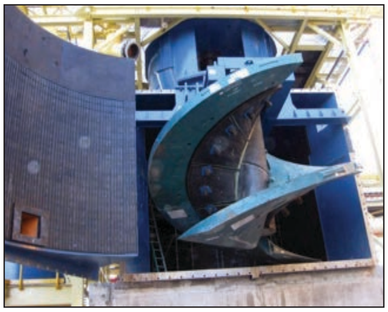
Few industries take as much of a toll on equipment and structures as mining and ore processing. Recognizing that impact—and preventing it before it occurs to new equipment—can reduce unplanned downtime and improve plant productivity levels. You'll also find that the use of coatings can play an enormous role in repairing equipment quickly and easily versus the costly and sometimes lengthy spare parts replacement approach.

Below are some classic examples of abrasion, erosion, and impact in the mining world, and the equipment and structures that are effected.

Gouging Impact Abrasion

This type of abrasion is similar to machining with a cutting tool—it cuts a deep furrow or groove into softer metal. Gouging impact abrasion effects the excavation, hauling, and primary crushing phases of mining and ore processing.

Impacts: *Drag Line Buckets, Excavators, and Crushers*



High-Stress Grinding

High-stress grinding occurs when an abrasive surface is crushed between opposing faces. The fracturing stress is transferred to the metal surface which results in micro cutting and furrowing.

Impacts: *Crushers, Grinding Mills*

Low-Stress Scratching Abrasion

This type of wear affects the movement of slurry and other systems where particles move freely across a surface. Unless the metal is hard enough to resist, the particles cut micro furrows and grooves into the surface. Chutes, gravity classifiers, screens and pneumatic conveying systems experience this form of wear.

Impacts: *Slurry Pumps, Chutes, Agitators, and Cyclones*

Chemical Attack Corrosion

This is probably the lowest rated form of attack on metal equipment and structures based on severity and its impact on plant performance. Electrochemical corrosion is a reaction between the surface (metallic or cementitious) and the chemical environment (fluid or gaseous). Heat will accelerate this reaction and hasten the rate of corrosion.

Impacts: *Gas Handling Fans, Ducting, Structural Steel, Secondary Containment, Drainage Sumps and Trenches*

Enhancing Equipment Performance

Coatings typically come in paste rebuilding and liquid resurfacing grades, allowing worn pumps or new pumps with significant casting defects to be resurfaced and coated. By effectively blocking the corrosion/erosion cycle, coatings can preserve and protect wet end corrosion from taking hold (see Figure 1).

Save on Maintenance and Energy

Coatings can play a significant role in lowering maintenance costs and even energy costs of some energy-intensive systems.

For example, it is estimated that energy and maintenance costs account for over 70 percent of a pump's lifetime costs. By combining mechanical upgrades (new wear rings, bearings, etc.) with rebuilding worn wet ends using a suitable protective coating, you can improve pump performance by as much as 30–40 percent.

If a pump's performance is upgraded and its energy consumption stays constant or is reduced based on duty cycles, there can be an additional energy savings opportunity benefiting of the plant's operational bottom line.

- The polymer-based coating provides both corrosion protection and reduction of surface roughness of the otherwise uncoated, wet-end base metal.
- Choosing a ceramic reinforcement system, such as that used in ARC coatings, enhances the overall wear resistance of the wet-end components by maintaining tolerances longer and reducing the effect of "wear eddies."

Replacing degraded/failing equipment is not only expensive, it also often results in significant downtime. As the success stories in this book show, the refurbishment and coating(s) can repair equipment and structures to near-new condition at a fraction of replacement costs.

Figure 1

Choosing the Optimal Industrial Coating

In selecting a coating, you will want to consider:

- Does the coating have the right performance properties to resist the exposure conditions while it is operating? Several key factors to consider are:
    - Fluid media and temperature
    - Suspended solids concentration and particle size range
    - Temperature and pressure/vacuum within system
- Can the coating be applied without impacting critical tolerances?
- What is the potential for and impact of a coating that disintegrates and contaminates the process flow?
- Cost and ease of application
- What is the Mean Time Between Failure (MTBF) of the equipment/application?
- Does the failure impact equipment or overall plant performance?
- Are you dealing with dry surface conditions or wet surface conditions? Dry conditions will involve more grinding and gouging, while wet service (slurry) applications involve more scratching abrasion and corrosion. This environment impacts the type of coating you should select for protection.

Success Stories

What follows are 10 customer success stories that illustrate the value of protective coatings in the mining / ore processing environment. These are real-life examples of the reliability improvements, cost savings, and extended equipment life that prove how valuable the right refurbishment, surface preparation and industrial coating(s) can be.

Aluminum Smelter Vertical Mill Mixer: $178K Savings

Mineral & Ore Processing — Refining
ARC 855, 858, BX1* and BX2* Coatings
Case Study 006

Challenge

Goals

- To refurbish 12 vertical mill mixers that required maintenance bi-monthly at a cost of $1.9K/M
- Extend the MTBR to > 9 months to reduce downtime and maintenance cost

Root Cause

The high temperature caustic mix in mills were abrading and damaging the fiberglass and rubber linings from the OEM. Additionally, the lining adhesive disbonded and delamination occurred. The metal substrate corroded.

Worn mill after failure of rubber and fiberglass.

Solution

Preparation

- Pressure wash and decontaminate surfaces
- Grit blasted to Sa 2.5 with 3 mil (75 µm) profile

Application

1. Apply **ARC BX1*** in lower section
2. Apply **ARC BX2*** in upper section
3. Smooth out irregularities with **ARC 858**
4. Topcoat with **ARC 855** to reduce friction and protect against corrosion

**ARC BX1 is the "Bulk" package size of ARC 890*
**ARC BX2 is the "Bulk" package size of ARC 897*

Application of ARC coatings.

Results

Total applied cost ARC (12 mixers): $ 47K

Client Reported After 24 Months

Extended MTBR of mills to >18 months vs. 2 months

First Year Savings:	$ 89K
1st year maintenance cost avoidance: (based on 12 mixers)	$136K
Total Savings:	$178K

First mill after repair ready for delivery.

Increasing Efficiency of Mine Dewatering Pumps

Mining/Mineral & Ore Processing — Extraction
ARC 855, 858, and MX2 Coatings
Case Study 023

Challenge

Issue
Mine production impacted by insufficient pump performance to meet required 300M^3/hour flow.

Goals
- Avoid purchasing additional pumps with an acquisition cost of $28.5K and operational (electricity) cost of $3.5K
- Meet flow demand and reduce maintenance and operational costs

Root Cause
Over 20,000 hours of operation in acidic mine water with entrained solids degraded the pump internals and critical tolerances.

Bank of dewatering pumps.

Solution

Preparation
Surfaces grit blasted to Sa 2.5 with 3 mil (75 µm) angular profile.

Application
1. Apply ARC 858 to rebuild pump back to tolerances where abrasion and erosion had damaged casing and impeller
2. Apply ARC MX2 in high wear regions to address abrasive suspended solids
3. Apply final topcoat of ARC 855 for additional corrosion protection and to improve flow efficiency

Pumps rebuilt with ARC 858 and ARC MX2. Top coated with ARC 855.

Results

Inspection Results
After repair, pumps operated at >94% of OEM efficiency with 3% less energy consumed.

Cost Avoidance

New pump installation/operation:	$28.50K
ARC material and labor:	-$ 6.80K
Associated energy saving:	-$ 3.29K
Total 1st year savings (per pump):	$ 18.41K

Coated sections of pump.

Cyclone Tub: 50% Fewer Unscheduled Shutdowns

Mining/Mineral & Ore Processing — Beneficiation
ARC I BX1 and MX1 Coatings
Case Study 142

Challenge

Issue

Cyclone launders experienced extreme wear at discharge after 4 years in operation. Existing rubber lining and ceramic tiles were failing to protect against high impact and abrasive flow.

Goal

Replace failing system with a solution able to protect against high impact and abrasive flow.

Root Cause

High-impact flow induced slurry abrasion

Krebs Cyclone

Solution

Preparation

Surfaces cleaned with H.P. water then mechanically abraded to roughen surfaces to SP11 cleanliness with 2 + mil profile

Application

Apply ARC I BX1 @ 0.6–0.95 cm (0.25–0.375") thickness to damaged regions

Previous product application

Results

Client Reported

- Unscheduled shutdowns have been reduced 50%. Each shutdown now takes one-third as long as previous weld repair
- Client reports saving >$100 K/year on maintenance per cyclone

Expertly trained ARC Certified application.

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Inverted Discharge Chutes: Increased MTBR by 3X

Mining/Mineral & Ore Processing — Beneficiation
ARC BX1 and S2 Coatings
Case Study 077

Challenge

Issue

Premature wear of tile and rubber lined discharge chutes at 1,500 hours reduced development of heap leach piles, impairing enriched leachate production rate.

Goals

- Protect existing chutes without exceeding current material cost >25% ($3,125)
- Maintain leachate production

Root Cause

Highly abrasive copper ore, treated with H_2SO_4, wears away lined chutes and perforates steel substrate.

Circles indicate location of deflector chutes.

Solution

Preparation

- Clean surface with high pressure water
- Mechanically roughen exposed surfaces

Application

1. Apply ARC BX1 @ 2.5 cm (1") thickness to remaining tile and rubber surfaces
2. Apply 2 coats of ARC S2 @ total DFT 20 mils for reduced hang-up

Rubber and tile lined chute after 1,500 hours.

Results

Client Reported

Chute life extended to > 4,500 hours (3X)

Client Estimated Cost Breakdown

Previous lined chute:	$ 2,500
Annual maintenance (60 hr):	$ 2,700
Total annual cost:	$ 5,200
ARC lined chute:	$ 3,000
Annual maintenance (10 hr):	$ 450
Total:	$ 3,450
Savings per chute/year:	$ 1,750
Savings based on 50 chutes/year:	$ 87,500

ARC BX1 coated chutes with ARC S2 topcoat.

Valve Bodies: Extended Life Cycle by 2X

Mining/Mineral & Ore Processing — Beneficiation
ARC BX1 Coating
Case Study 076

Challenge

Issue

The lined plunger-pump suction valves in a bauxite reactor required expensive change-outs. To upgrade valve bodies to high alloy is cost prohibitive.

Goals

- Increase liner life of valve
- Avoid cost of high alloy upgrade

Root Cause

Abrasive bauxite slurry in alkali solutions at 160°F (70°C) wore previous coating, exposing base metal of valve.

Worn coating exposes metal in <3000 hours.

Solution

Preparation

- Machine new valves to create liner cavity
- Grit blast to Sa 2.5 with 3 mil (75 µm) angular profile

Application

1. Apply ARC BX1 to internals of valve at nominal thickness of 260 mils (6.5 mm) and re-machine to tolerances

Valves machined and ready for coating.

Results

Client Reported

- Valve life extended to >8000 hours (2.5 x previous life)
- Worn valves can be repaired and sent back to field without need for spare parts replacement
- Ongoing application with high success

ARC BX1 coated valve

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Transport Auger Screw: Saved $12K/Year

Mining/Mineral & Ore Processing — Beneficiation
ARC MX1 & 855 Coatings
Case Study 116

Challenge

Issue

Weld repair of screws with service life of <6 months reduced throughput and affected plant operation. Weld technique resulted in scrapping of screw after 2 repair cycles due to heat fatigue stresses.

Goals

- Increase MTBR and operational efficiency
- Avoid scraping of screw after 2 weld repair cycles

Root Cause

Abrasive ore wears flyght faces and heat exposure from welding leads to stress cracking.

Old screw showing weld overlay repairs.

Solution

Preparation

Grit blast to Sa 2.5 and 3 mil (75 µm) angular profile

Application

1. Apply ARC MX1 @ 250–375 mils (6–9 mm) to flyght faces and shaft
2. Shaft to flyght coved with a 500 mil (12 mm) 45° transition
3. Apply 1 coat of ARC 855 @ 10 mil (250 µm)

Screw during ARC MX1 coating process.

Results

Client Reported

Service life extended to > 18 months with ARC MX1

Cost of new screw (every 12 months):	$10,000
Weld repair every 12 months:	$ 7,000
Total cost with ARC:	-$ 5,000
Savings:	$12,000

Client is using ARC MX1 in additional areas of plant including chutes, deflector plates, and hoppers.

ARC-coated surfaces

Coal Screen Deck: Annual Maintenance Costs Down 30% to Date

Mining/Mineral & Ore Processing — Beneficiation
ARC BX2 and S2 Coatings
Case Study 109

Challenge

Issue

Corrosion occurs at weld seams, requiring welding within 3 years. Loss of screen deck structure can shut down plant.

Goals

- Provide an easy-to-apply erosion/corrosion resistant liner
- Increase service life to 48 months

Root Cause

Urethane liners fail prematurely. Acidic wash water combined with erosive particulates attacks exposed steel at weld seams.

Damaged coal screen

Solution

Preparation

- Remove remaining urethane liners
- Decontaminate surface
- Grit blast to Sa 2.5 with 3 mil (75 µm) angular profile

Application

1. Stripe coat all edges and welds with ARC S2
2. Spray two coats of ARC S2 @ 15 mils (375 µm)
3. Apply ARC BX2 @ 120 mils (3 mm) on top rails

ARC S2 grey applied to coal screen

Results

Client Reported

- ARC-lined screen decks have been in service for over 4 years without any required maintenance
- Service life increased by 33% to date
- Application cost reduced by 50%
- Annual maintenance costs cut by 30%

ARC BX2 applied to top rails

Ventilation Fan: Saved Nearly $600K/Year

Mining/Mineral & Ore Processing — Extraction
ARC BX2 and 855 Coatings
Case Study 107

Challenge

Issue
Unscheduled shutdowns due to bearing vibration failure result in production losses and increased maintenance costs.

Goals
- Reduce dust attachment to fan blades and resulting imbalance and vibration
- Extend bearing life and MTBR
- Control corrosion and abrasion

Root Cause
High humidity atmosphere with chlorides corrodes fan blades and accelerates dust attachment, creating fan imbalance.

Build-up on fan blades

Solution

Preparation
- Decontaminate to remove chlorides
- Dynamic balancing of fan
- Grit blast to Sa 2.5 with 3 mil (75 µm) angular profile

Application
1. Apply ARC BX2 @ 120 mil (3 mm) to leading edge of vanes
2. Apply ARC 855 @ total DFT of 20 mil (500 µm)
3. Fan is statically balanced

ARC BX2 applied to leading edge.

Results

Client Reported
- Shutdowns reduced to 1 per year at cost of $25,000
- Bearing life extended due to reduced vibration

Estimated Savings

Annual fan costs including semi-monthly cleaning:	$628,000
ARC material and labor:	$ 32,000
Estimated yearly savings:	$596,000

ROI <1 month

Protected fan

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Secondary Containment: Concrete Protected from Acid Leaks

Mining/Mineral & Ore Processing — Refining
ARC 797 and 988 Coatings
Case Study 065

Challenge

Issue

Regular spills of acid damaged the existing coating and underlying concrete after 1 year. Safety risk in traffic areas and associated environmental fines were also an issue.

Goals

- Protect concrete infrastructure against regular leaks from acid leach tanks
- Minimize safety risk and environment fines

Root Cause

30% H_2SO_4 attacks cement in concrete—damaging sumps, tank pads, and pump bases.

Pre-existing condition of concrete.

Solution

Preparation

- Pressure wash and decontaminate concrete
- Mechanically roughen to CSP3 finish

Application

1. All surfaces primed with ARC 797
2. Pitch to grade and top coat with a 6,4 mm (0.25") of ARC 988 system

Initial application completed in 2002.

Results

Client Reported:

- Achieved goal of protecting concrete from acid leaks
- Safety risks from damaged concrete addressed
- ARC coated and lined surfaces are damage free for over 8 years
- Client continues to use ARC 988 as preferred lining system for concrete protection in all plant areas exposed to acid

ARC coated surfaces with minimal repairs indicated in 2010.

Exhaust Fan: MTBR Extended 3X

Mining/Mineral & Ore Processing — Refining
ARC 858 and HT-T Coatings
Case Study 031

Challenge

Issue

The exhaust fan required unscheduled weld repairs every 2 months and complete replacement after only 6 months. Cost and service life were unacceptable.

Goals

- Extend MTBR of fan to a minimum of 3X previous cycle time
- Reduce maintenance cost

Root Cause

Corrosive exhaust gases from a smelting operation at 120°C attack the fan.

Condition of fan rotor after sandblasting.

Solution

Preparation

- Dynamically balance fan and adjust as required
- Grit blast to Sa 2.5 with 3 mil (75 µm) angular profile

Application

1. Use ARC 858 build eroded volute and parts
2. Apply 2 coats ARC HT-T to total DFT of 40 mils (1 mm)
3. Statically balance fan

Fan being coated.

Results

Client Reported

- MTBR has increased from 2 months to 6 months with inspection and minimal repairs done in field without fan disassembly.
- Fan life extended from 6 months to 3 years

Annual cost of previous method:	$54,000
Annual ARC Solution Cost:	-$31,200
Annual savings over 1 year:	$25,200/fan

Completed application to 1600 mm fan.

ABOUT OUR PRODUCTS

ARC SD4i

High-Temperature, Abrasion Resistant Coating

Use to create an abrasion-resistant surface that extends equipment life, reduces spares, and decreases downtime. This 100% solids, advanced reinforced, thin-film coating protects structures/equipment in extreme immersion and aggressive chemical immersion services.

Mining Applications: *Slurry Tanks and Pipes, Pumps and Fans*

ARC 858

Abrasion-Resistant Rebuilding Coating

Upgrade new and old equipment exposed to abrasion, corrosion, or chemical attack with this 100% solids, thick film, ceramic-reinforced abrasion control epoxy compound. Use 858 to rebuild surfaces with erosion resistant protection that outperforms weld overlays. It also fills grooves, pits, etc. in metal prior to overcoating with another ARC product.

Mining Applications: *Pump Casings, Tanks and Vessels, Fans and Blades*

ARC BX2

Fine-Particle, Moderately Abrasive-Sliding Wear Coating

Protect areas exposed to moderate sliding abrasion. BX2 is a 100% solids, modified epoxy formulation, reinforced with a proprietary blend of ceramic beads and powders for fine particle, abrasive sliding wear environments. Use to resurface damaged metal in lieu of more traditional weld overlays. Trowel grade.

Mining Applications: *Chutes and Hoppers, Slurry Pumps, Fan Blade and Housing*

ARC I BX1

Impact-Resistant and Severe Abrasive Wear-Resistant Epoxy Composite Coating

Protect surfaces exposed to impact <50 ft lb (<68 Nm) and sliding abrasion and provide a longer lasting alternative to rubber lining and ceramic tiles. ARC I BX1 is a 100% solids, impact resistant, ceramic reinforced, epoxy/urethane hybrid coating that can be applied by trowel.

Mining Applications: *Hoppers and Chutes, Pulverizer Exhausters, Slurry Pump Cutwaters*

ARC MX1

Coarse Particle, Extreme Sliding Wear and Impact Coating

Protect surfaces against dry, coarse particle erosion, wet slurry abrasion, and impact; restore worn equipment to near original condition. This coating also provides a longer lasting alternative to rubber linings and ceramic wear tiles. ARC MX1 is a 100% solids, ceramic reinforced, multi-component system formulated for extreme impact, and sliding-wear abrasion, and impact caused by medium to coarse particle flow. Trowel grade.

Mining Applications: *Pulverizers, Conveyor Screws, Dredge and Slurry Pumps*

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Chesterton's global capabilities include:

- Servicing plants in over 113 countries
- Global manufacturing operations
- More than 500 Service Centers and Sales Offices worldwide
- Over 1200 trained local Service Specialists and Technicians

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CHESTERTON®
Global Solutions, Local Service.

A.W. Chesterton Company
860 Salem Street
Groveland, MA 01834 USA

Telephone: 781-438-7000
Fax: 978-469-6528
chesterton.com

Form No. EN36586
Mining Case Study eBook – English
05/18