Improving wear life with WEAR MAX®
Ceramic epoxy wear coating

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Data results provided by: ALS Industrial Pty Ltd Product Testing Report
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The lab tests replicate idealised wear performance, and validate the on-site improvements witnessed when using WEAR MAX. The real test for WEAR MAX happens every day on our client's sites and more than confirms these results. In fact, due to wear being a system property, WEAR MAX often exceeds the performance differential cited herein.

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Introduction

Equipment in the mining industry is exposed to extremely challenging conditions. Protecting equipment from wear is therefore a critical task. Failure to do so may cause any of number of unwelcome outcomes including:

- Deterioration in equipment performance.
- Reduced component life.
- Increase in parts inventories.
- Higher operating and maintenance costs.
- Increased machine downtime.

In addition to the negative economic impact, wear comes at a serious environmental cost. According to Holmberg et al. (2017), 2 EJ are consumed annually to remanufacture and replace worn parts, and to reserve and stock the spare parts and equipment needed due to wear failures, in the mining industry. Improvements in wear protection technology therefore offer a significant opportunity to reduce the mining industry's Scope 3 (indirect) carbon emissions.

Mining wear is variable, however where ceramic systems are most applicable wear is predominated by sliding and abrasive wear conditions where these tests are the most relevant lab equivalents.

An example of FLSmidth WEAR MAX® applied to surface of a HFC Feed Distributor

FLSmidth WEAR MAX

FLSmidth WEAR MAX is a proprietary mixture of epoxy and wear-resistant ceramic beads. It has been designed to reduce common wear problems associated with sliding abrasive wear on materials handling and minerals processing equipment including:

- Centrifuges.
- Screen bowls.
- Vibrating screens.
- Thickeners and flotation cells.
- Tanks and silos.
- Pipes, elbows, and tee junctions.
- Chutes and launders.

Supplied as 7kg kits comprising a bucket of Part A compound. a bottle of Part B liquid hardener, and all necessary mixing tools, FLSmidth WEAR MAX is easy to prepare and apply. Once mixed, it has a working time of 15 minutes and is hard cured in four hours. Maximum hardness is achieved after curing for 24 hours. Typical cured properties are detailed in Table 1.

This paper presents the results of independent testing of FLSmidth WEAR MAX against several competitor solutions with regards to erosion and abrasion wear performance.

Table 1. Typical cured properties of FLSmidth WEAR MAX

Working time	15 minutes
Hard cure time	4 hours
Max. hardness time	24 hours at 23°C (73°F)
Max. operating temperature	70°C (158°F)
Density	2.1kg/l (17.5lb/gal.)
Compression strength	70 MPa
Tensile strength	10 MPa
Flexural strength	15 MPa
Coverage 7kg @ 12mm thickness	0.272 m^2 (2.9 sq. ft)
Shelf life (unopened)	3 years

Product testing

Testing was undertaken by ALS, a global independent provider of testing and analysis services, at the ALS laboratory in West Melbourne, Victoria, Australia. Testing was performed to the following standard testing methods:

- Erosion testing per ASTM G76-18 "Standard Test Method for Conducting Erosion Tests by Solid Particle Impingement Using Gas Jets" with testing to include measurement of erosion rate values.
- Taber abrasion resistance per ASTM D4060-01 "Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser".

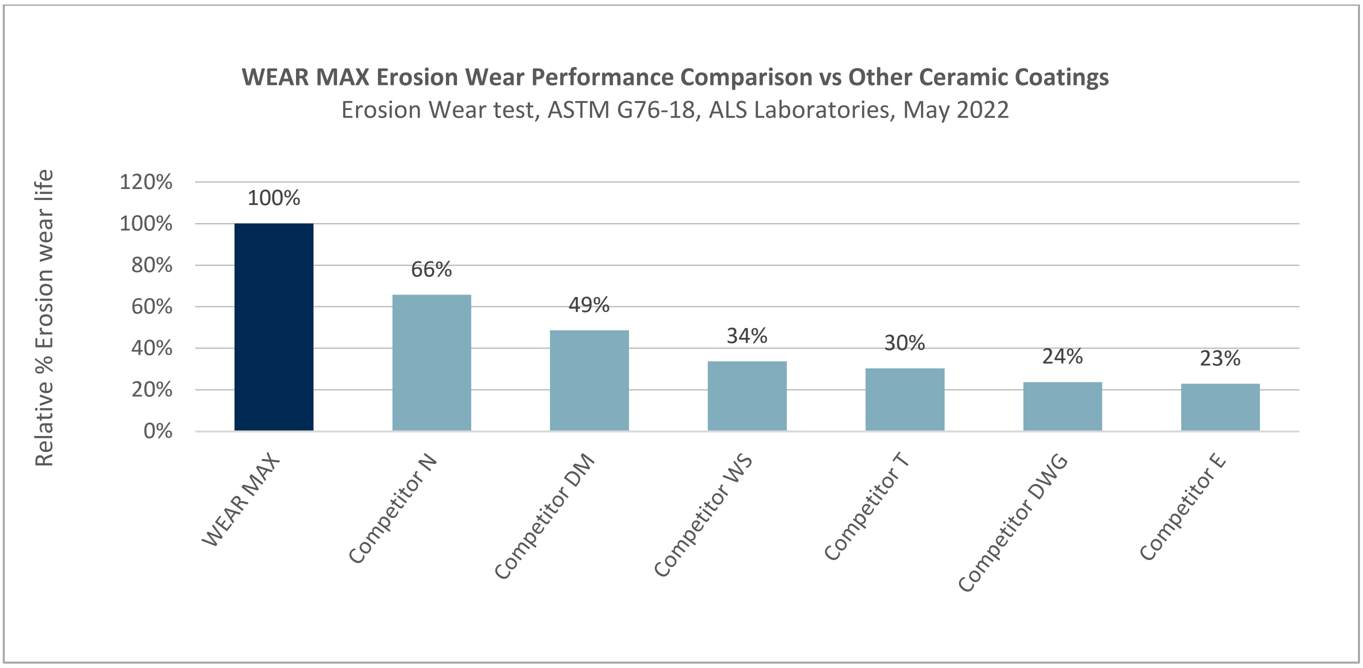
In total, ALS tested seven products: WEAR MAX and six competitor products. Samples of each product were prepared and submitted by FLSmidth according to the abovementioned standards.

Results: Erosion testing

Erosion testing measures material loss caused by exposure to gas-entrained solid particles from a jet-nozzle type erosion equipment. Specific testing parameters are detailed in Table 2. Results are presented in Figure 1.

Table 2. Erosion testing parameters

Test equipment	Erosion test system
Conditioning	23°C (±5°C) and 50% RH (±10%) 24 hours beforehand
Specimen type	Epoxy ceramic materials
Abrasive particle	Garnet 20/40
Air velocity	25 m/s
Particle feed rate	2.44 g/s
Testing angle	10° inclined nozzle relative to specimen
Testing distance	10 mm from nozzle to surface of specimen
Nozzle diameter	4.2 mm
Nozzle length	25 mm
Carrier gas	Dry air at 300 kPa



Results: Abrasion testing

Abrasion resistance is measured by the Taber abraser, a method of testing. This involves mounting a flat specific sample to a turntable. Two abrading wheels are lowered to touch the surface of the sample. When the wheels are in place, the turntable starts to rotate exposing the sample to rub-wear.

The test continues for a specified number of rotations; until a given mass of coating has been removed; or until the wheels expose the substrate. In this instance, testing was performed for 1000 rotations. Specific testing parameters are detailed in Table 3. Results are presented in Figure 2.

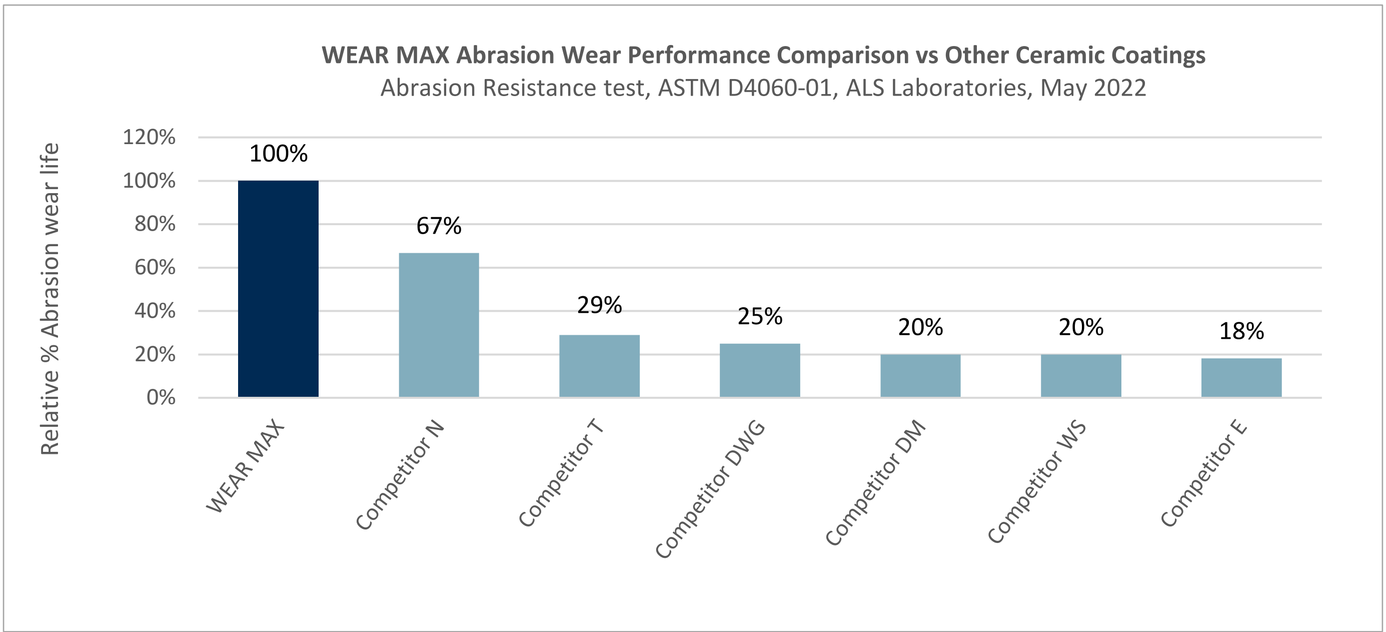
Table 3. Taber abrasion testing parameters	
Test equipment	Taber abrasion tester
Conditioning	23°C (±5°C) and 50% RH (±10%) 24 hours beforehand
Specimen type	Epoxy ceramic materials
Wheel type	H-18
Load	1000 g
Number of cycles	1000

Discussion

As can be seen from the results, WEAR MAX demonstrates significantly higher performance with regards both erosion and abrasion resistance compared to competitor products.

These results position WEAR MAX as a best-in-class solution, offering significantly longer wear life compared to competitor products. Switching to WEAR MAX therefore provides a pathway to extending time between wear lining replacement – with the following benefits:

- Reduced equipment downtime
- Improved productivity
- Lower wear lining consumption
- Less manhours spent preparing and applying wear linings
- Lower risk of equipment damage due to premature failure of the wear lining



References:
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Holmberg, K., et al., (2007), 'Global energy consumption due to friction and wear in the mining industry', *Tribology International*, Vol. 115, pp.116-139: https://doi.org/10.1016/j.triboint.2017.05.010