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"Analysis of Wear Resistance Liners for Increasing Life Cycle of Industrial Steel Part"

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Abstract: *Wear is the single biggest cause of downtime and lost production in mining and mineral Processing, Cement & Steel industry. Wear resistance products/liners introduce wear solutions for increasing life cycle of Industrial parts & Equipments. Wear resistance product having highly alloyed wear resistant surface. Field trials in the iron ore processing industry show that most cases Wear resistance Designed casted steel product will outperform then increasing wear life up by up to 2-3 times.*

Wear resistance products are Wear plate (cladded chromium carbide steel) , Designed casted Mn steel Grade-7, Hot rolled through hard steel, High alumina Ceramic tiles/lined products for temperature resistance plate. Application of wear resistant product for heavy industries It's used for maintenance and repair of MINING, EXCAVATING AND COAL INDUSTRIES & STEEL MILLS, Rock crusher jaws, mantles & hammers, shovel buckets,

stone chutes, conveyor chain wear strips elevator buckets, quarry truck bottoms, crusher liners, bulldozers & scrapers, mucker, sintering seal bars, shake-out machines, shot blast cabinets, scrap ore bucket, scrap handling equipmentmen zone ensures minimum metallurgical degradation.

Keywords*: Cladding, Wear plate, Composite steel plate, Alloy overlay, Cast-fused wear plate, Ceramic lining, Impact, Hardness, Temperature resistance, Wearing & Tearing.*

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I. INTRODUCTION

Wear-resistant materials are dedicated alloys with supreme hardness that are simultaneously weldable and resistant to moderate impact loading. Contemporary wear-resistant steels, due to high metallurgical purity, are characterized by high strength, good weldability, workability, and acceptable machinability. The production costs of these steels, however, remain high Wear resistance steel plates is a duplex material consisting of a very tough and highly wear resistant alloy overlaid into a shock absorbing mild steel or chromium steel backing plate.

A wear resistant plate is an item that you can use to protect or secure machine parts. You can apply and install it to a wide range of equipment, like crushers, buckets, chutes, etc. to secure and keep their performance. Wear resistance product are expendable items that are used to prevent excessive wear or damage to expensive equipment. The intensive wear of machine and apparatus parts in mining, quarrying, petrochemical,metallurgical, cement, construction, and power generation industries, among others, drives increasingdemand for wear-resistant plates and liners

Wear plate is commonly a type of abrasion resistant steel plate that is considered extremely durable, especially under harsh conditions. Wear, the removal of material from a solid surface as a result of mechanical action exerted by another solid. Wear chiefly occurs as a progressive loss of material resulting from the mechanical interaction of two sliding surfaces under load wear, the removal of material from a solid surface as a result of mechanical action exerted by another solid. There are four basic types of wear: adhesive, abrasive, corrosive, and surface-fatigue.The material surface properties such as hardness, strength, ductility, work hardening etc. are very important factors for wear resistance, but other factors like surface finish, lubrication, load, speed, corrosion, temperature, and properties of the opposing surface etc.

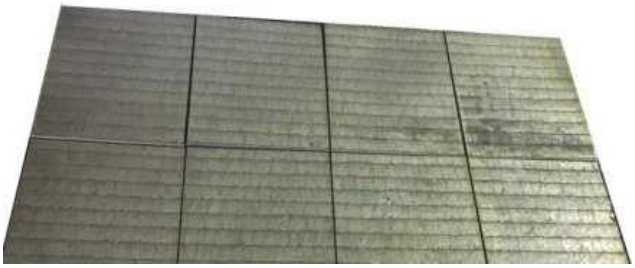

Fig 1: Picture of wear resistance liner (Chromium carbide overlay)

II. WEAR RESISTANCELINERSARE, AS PER USE OFINDUSTRIAL PARTS/APPLICATIONS:

- **Wear plate** (Composite steel liner)use wherever, high abrasion resistance area
- **High Mn steel casting liner** use wherever,high impact resistance area
- **Hot Rolled through hard steel liner** use wherever, sliding/erosionresistance area
- **Cast-fused overlay plate liner**use wherever, high abrasion & moderate impact & severe abrasion & high impact at elevated temp.
- **Ceramic liner**uses wherever, high temperature resistance

III. WEAR PLATE (Composite steel)

Cladding process made this wear plate (6mm Mild steel + 4mm Chromium carbide overlay). Standersavailable thickness: 6+4mm, 8+4mm, 10+4mm, 16+4mm, 20+4mm ect. Wear plate is an extremely strong abrasion resistant complex composite fused on weld able hardresistant metal which can be formed in any shape size and orientation.Exclusive alloying formulation offering excellent protection to industrial components against wearfactor: i) Severe abrasion including impact ii) Corrosion and heat.

Features: -

1. Excellent Resistance to severe Abrasion, Erosion & Mild Impact at elevated temp.
2. Special Alloying formulation give excellent hot hardness facilitates working temperature till 550°.
3. Can be used for major industrial applications involve heat and abrasion simultaneously.
4. Bulk material movement involving sliding very often causes heavy wear of the equipment used, resulting in damage to equipment, lower reliability, production losses, and lower capacity utilization. Installation of this wear plate is a solution and is a necessity where equipment availability and low operating costs are essential.
5. Apart from standard sizes, we offer both types of tiles pre-engineered to suit specific design equipment. CAD is used to ensure a good fit for the contours of the lining surface.

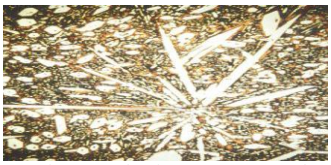

Fig. 3.1 (Microstructure)

Fig. 3.2 (Normal view)

Overlay alloys & their chemical composition:

Alloys	C	Cr	Si	Mn	Ni	B	W	Fe
(%)	3.45 – 4.0	30-32	2.0-3.0	2.00 max	0.71 max	1.0 max	1.0 max	Balance

Hardness: 60 to 65 HRc

In Industrial application used: -

- Steel Plant: Sinter plant chutes, BF liner, Coal handling plant liner.
- Power Generation: Coal Mill (Inner Cone, Multiport Outlet Valve, Mill Discharge pipeLining, Orifices, Venture Vanes)Bends (Transitions & Y- Pieces) Ash Handling (Bends & SlurryPipes) and in Cement Industry for Coal Mill liner, Raw Mill liner.

IV. HIGH MANGANESE STEEL CASTING LINER

High Mn steel casting liner is an extremely high impact moderate abrasion resistant plate designed to sustain complex wear of severe impact & abrasion. Easily weld able metal which is difficult to bend. When direct carbides blended with casting it gives wear protection patterns much better than normal hard facing with welding or any other protective coatings. These carbide inserts have excellent wear resistance property and contains very superior alloys like, Chromium Carbides, Molybdenum, Complex Carbide. These plates have been extensively tested on various impact tests and have been proven to outperform any other wear plates.

PHYSICAL PROPERTIES:

Yield Strength	60,000 - 85,000 psi
Tensile Strength	120,000 - 130,000 psi
% of Elongation in 2"	35% - 50%
Normal Hardness	45 HRc
Working Hardness	54 HRc

Fig 4.1: Picture High Mn steel casting liner

Alloys & their chemical composition: -

Alloys	C	Cr	Si	Mn	P	S
(%)	1.00 – 1.25	4-5	0.60 max	14-16	0.05 max	0.04 max

In Industrial application used: -High Mn steel casting liner for heavy industries It's used for maintenance and repair QUARRY, MINING,EXCAVATING AND COAL INDUSTRIES & STEEL MILLS

V. HOT ROLLED THROUGH HARD STEEL LINER

This wear resistance product/liners provides maximum wear resistance from impact and sliding. The finegrained, thru-hardened alloy steel chemistry makes this plate have the optimum hardness/toughnessratio. Rolled steel plate resistant to wear & surface pressure, suitable for sliding and gouging abrasionapplications.
Hot Rolled through hard steel wear plates is a abrasion resistant steels, with an averagehardness of 500 HBW. This is a wear resistant plate for abrasive wear caused by rolling contact andhigh surface pressure. Can be used to significantly lower the costs generated by wear and breakdownof structural components. Despite its strength and hardness, weld ability and formability of thesteel grade is very good.

Fig 5.1: Picture of Hot Rolled through hard steel liner

Mechanical Properties:

Hardness -440 - 510HBW, Yield Strength 180 ksi, Tensile Strength 250 ksi Elongation 12%

Alloys & their chemical composition: -

Alloys	C	Si	Mn	P	S	Ni	Cr	Mo	B
(%)	0.3	0.71	1.62	0.024	0.011	1.52	1.42	0.62	0.005

In Industrial application used: -Buckets & Components, Bucket Lips Chip Silo Components Chipper Hoods & Components, Chutes Conveyors & Liners Crusher Components, Cyclones Dozer Blade Liners Debarking Drum Components, Down comer Spout Liners.

VI. CAST-FUSED OVERLAY LINER

Cast fused overlay plate liner is new latest type of wear resistance products/liner. The unique blend of Toughness and Hardness produces the highest Impact and Abrasion Resistance in a Single Plate. The presence of extra high density and ultra-abrasion resisting alloy in the overlay provides highresistance to Abrasion, Erosion, and Impact.

The unparalleled smooth surface is practically free from cracks, ripples and strains which allows alaminar flow of material and prolongs the component life.Extra low coefficient of friction ensures 200-600% efficiency improvement in wear resistance overconventional weld cladded composite wear plate which offers exceptional reduction in hang-up andcarry-back.

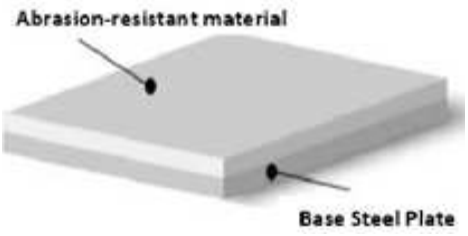

Fig 6.1&2: Picture of Cast fused steel liner (10mm base steel plate +10mm abrasion resistance material)

High Abrasion & Moderate Impact (< 600 Deg.C) (Hardness: 55 — 62 HRc)
Severe Abrasion & High Impact at Elevated temp. (Hardness: 60— 65 HRc)

Advantages:

- Smooth surface with no weld beads results ease fabrication for any direction of material flow.
- Low friction co-efficient (39% less coefficient friction than SS in service).
- Uniform microstructure down to fusion line single pass overlay.
- No plate distortion.

In Industrial application used: -Steel plants: Chutes(material flow avoid jamming at sliding place), coal powder & duct flow through feed tube & conical pipes.

VII. CERAMIC LINER

Ceramic tiles products/liners use for high temperature resistance application areas. Its manufactured from high purity fine grains consisting more than 85%-95% alumina oxide produced in different shapes like tubes, tiles, nozzles sintered to resist extreme erosion, fine particle abrasion , high temperature. Ceramic tiles provide advanced ceramic wear brick for a variety of applications in mining, material processing, and material handling. Our wear-reduction experts help you decide the best material, configuration, and bonding method to ensure optimal performance.

Fig 7.1&2: Picture of Ceramic liners

Features Bulk material movement involving sliding very often causes heavy wear of the equipment used, resulting in damage to equipment, lower reliability, capacity utilization. Installation of ceramicliners is a solution and is a necessity where equipment availability and low operating costs areessential. Ceramic tiles weld able and paste able alumina ceramic tiles that can be bonded onto thesurface to be protected from wear.

Ceramic provides exceptional performance:

• Hard – Superior abrasion resistance compared to steel
• Corrosion resistance – highly resistant to the acids and alkalis, Low friction – reduces drives loads.
• Low friction – reduces drives loads. Low friction – reduces drives loads.

SL No	Specification	Unit	Value
1	Alumina	%	85 - 95
2	Density	Gm/cc	3.3
3	Colour	visual	White
4	Strength	MPa	230
5	Hardness	Moh's	9

7.1. Ceramic embedded rubber liner

Ceramic embedded rubber composite liner which gives the advantages of boththe product in combination. i.e. Alumina works against erosion whereas rubber on back take the impact load and thus after impact the sliding abrasion will be taken care of by Ceramic. These rubber back ceramicliner are more useful in application like Chute, Hoppers where we have impact and erosion.Cylinders and cubes, all of which have a high alumina silica content that withstands severe impactand high abrasion.

Heavy Duty Ceramic wear plates can be used in a wide variety of high wearapplications and can be easily installed by studs welded to the backing plate, counter bored holes
moulded into the line or by welding.

Fig 2.5: Picture of Ceramic embedded rubber liner

An added benefit of these liners also provides significant reductions in noise pollution compared tosteel liners. These liners are extremely versatile and are suitable for many types of installations,including the following:

In Industrial application used: -Crusher Main Frame Liners Screen Feed Box Liners Discharge Lip Liners Crusher Feed TubesCrusher Feed Plates Launder Liners Chute Liners, Crusher Feed Hoppers Transfer Point LinersScreen Side Liners Dead Bed Lip Liners Grizzly Bars Impact Pads

VIII. CONCLUSION

Industrial wear plates are duplex materials that consist of wear resistance and tough alloy that is overlaid into the shock absorbing chromium steel or mild steel backing plates. These properties render the product ideal for use under extreme working conditions where the costs of downtime outweigh the initial capital and expenditure outlay of replacement. With the need for wear-resistant products and materials in industries, businesses should make use of the industrial wear plate products since they are strong enough to reduce abrasive wear.

Wear plates will also help businesses reduce the direct costs of replacing consumables and the labour for change-outs such as production losses and inventory expenses. Industrial wear plates increase the in-service life of business materials, translating into significant improvements in business profitability. In some businesses, correct materials selection provides prospects for major service life increases. Here are the emerging technology trends with the creation of industrial wear plates

Laser shock processing is an emerging technological trend in industrial wear plate creation. The technique is based on the generation and deformation of shockwaves in the metallic materials which enhance surface properties against crack growth, wear and stress corrosion cracking. The laser shock processing technique has been used in various alloy manufacturing companies, and it has proved to enhance the wear resistance and extended the useful life of industrial machines. The method utilizes computational models to optimize the entire design and production process resulting in high resistance industrial wear plates.

Nowadays wear becomes a major problem in automobile and industries. Owing to wearmachine life and machine element damaged after long duration work. Wear rate and wear resistance improved using coating method like thermal spray coating and plasma spray coating.

Industrial wear plates help the industry grow and keep business moving. They reduce friction between machine components minimizing both production and maintenance costs. They also help increase the service life of industrial components which translates into great improvements. This results in more profits for the business. Industrial wear plates keep the enterprise moving by minimizing the direct expenses of the replaceable parts and the labor for the change outs cases, they are used to control and prevent damage to the main machines and increase their operating.

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