Excavator Bucket Liners

The Makuri I+M+D Technology liner system for excavator buckets offers both: longer life and low weight liner designs, plus the choice of anti-hang up internal liner designs and low friction external liner designs.

Installation

Both internal and external liners are fully grouted using the patented Makuri MAK-Liner Grout process.

Materials

Typical internal liners for excavator buckets are the choice between WA HardRock Chrome A / Chrome X or, for extreme abrasion applications, WA HardRock Ultra Alloy. External liners are all typically WA HardRock Titanium Plus. Selected use of MAK-Bloks in both custom and standard configurations are used to complement the designs.

Design

The bucket and liners are looked at as a critical part of the overall performance and cost effectiveness of the excavator including:

- The life of the bucket,
- The weight of the liners,
- The life of the liners,
- The amount of carry back, and
- The digging resistance

All contribute to the operating costs / tonne, or hour, of the machine and all must be addressed if optimum performance and lowest costs are to be had.

Bucket Life

Bucket structure life can be increased substantially due to increase structural stiffness offered by the fully grouted designs and internal anti hang-up inserts when used too.

Maintenance

Less “in field” and “rebuild shop” maintenance required, as there are less premature liner failures and/or structural damage problems.

Examples of Common Configurations using Q&T plate and/or Chrome carbide liners*

*Please note estimates, averages and/or specific examples have been used for indicative purposes only.
Excavator Bucket Liners
Makuri Excavator Liner Designs

With anti hang up inserts

Without anti hang up inserts

Front view

Back view

Anti friction "no heel block" designs
Electric rope shovels are the highest value downtime piece of equipment on the mine site. Dipper life and weight significantly impact short and long term performance and operating costs.

The Makuri I+M+D Technology liner systems can significantly reduce operating costs / tonne by both extending liner life and reducing liner weight.

Installation

Internal liners are fully grouted using the patented Makuri MAK-Liner Grout process and external liner systems use the proprietary MAK-Bloks system.

Materials

Internal liners for shovel dippers are typically made using WA HardRock Ultra Alloy and externally are typically all Makuri MAK-Bloks in both custom and standard configurations.

Dipper Life

Dipper structure life can be increased substantially due to increase structural stiffness offered by the internally grouted design.

Maintenance

Less “in field” and “rebuild shop” maintenance required as there are less premature liner failures and/or structural damage problems.

Design

• Designed for both life and weight targets as required by the customer.
• Typically can achieve both liner weight savings and longer liner life.
Shovel Dipper Liners
Case Study

Background

In 2009, the customer was searching for better liner package options as their P&H 4100 55 cu yd shovel dipper liners life had dropped from around 3,000 hrs, to as low as 1,200 hrs in the most extreme cases, due to both the ore and waste becoming harder and more abrasive. The liner weight was already at around 7 tonnes with all other options only offering thicker heavier liners. As the existing liners were already overweight, any further increases in liner weight would seriously impact machine performance.

Operating conditions

The customer’s target was an internal dipper liner set that will last a minimum of 5,000 hrs, under any digging conditions, and not weigh any more than the current standard OEM liner system and less if possible.

The Makuri Technology team took the challenge and developed the solutions for customer using the Makuri I+M+D Technology and Welding Alloys advanced carbide overlay plates.

Results

The OEM Standard Liners lasted <3,000 hrs on average with weight around 7.0 tons.

The final Makuri I+M+D Technology liner system design lasted the minimum of 5,000 hrs, under all types of digging conditions, with some lasting up to 6,500 hrs, with the weight at around 5.3 tonnes, or 1.7 tonnes less than standard OEM designs.

<table>
<thead>
<tr>
<th>Liner Weight Comparisons CAT 7495</th>
<th>Liner Weights in Kgs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dipper Liners to suit Standard 57 cu yd Straight Sided</td>
<td>OEM</td>
</tr>
<tr>
<td>DoorInner*</td>
<td>1,094</td>
</tr>
<tr>
<td>BodyInner</td>
<td>3,396</td>
</tr>
<tr>
<td>DoorOuter</td>
<td>0</td>
</tr>
<tr>
<td>BodyOuter**</td>
<td>869</td>
</tr>
<tr>
<td>* Additional upper liners included</td>
<td>** Same liner area coverage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BD</th>
<th>RQD%</th>
<th>WIC</th>
<th>AI x 100</th>
<th>WIRM</th>
<th>WIBM</th>
<th>PLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.89</td>
<td>42.33</td>
<td>7.45</td>
<td>22.71</td>
<td>14.27</td>
<td>11.94</td>
<td>4.18</td>
</tr>
</tbody>
</table>

The final design lasted 6,500 hrs.
Ever increasing truck payloads are being sort after by mining operators. Equipment suppliers in turn provide trays with lighter weight, but poor and/or incomplete liner systems, in many cases, to allow for this.

100% tray coverage can be had with the Makuri I+M+D Technology liner systems which in most cases will still comply with the 10/10/20 guidelines of OEMs.

A high performance, lower friction, greater wear resistant liner system is designed to obtain lighter weight body for increased payloads whilst adding more structural strength and stiffness, thereby significantly reducing operating costs / tonne over the full life of the truck.

Installation

Truck tray liners are fully grouted using the patented Makuri MAK-Liner Grout process.

Materials

Typical internal liners for haul truck trays are a combination of WA HardRock Chrome A / Chrome X and WA HardRock Titanium Plus. Selected use of MAK-Bloks in both custom and standard configurations are also used to complement the designs.

Design

Designs are balanced between the high impact central bed area using WA HardRock Titanium Plus, the high abrasion tail section using MAK-Bloks and the moderate impact and abrasion side-walls using WA HardRock Chrome A / Chrome X.

Tray Life

Tray life can be increased substantially due to increase structural stiffness offered by the fully grouted design.

Maintenance

Less “in field” and “rebuild shop” maintenance required, as there are less premature liner failures and/or structural damage problems.
Haul Truck Tray Liners

Makuri Haul Truck Tray Liner Designs

<table>
<thead>
<tr>
<th>Haul Truck</th>
<th>Current Liner Coverage</th>
<th>Current Weight Kgs</th>
<th>Makuri Liner Coverage</th>
<th>Makuri Weight Kgs</th>
<th>Nett Loss / Gain Kgs</th>
<th>Projected Increase in truck availability from less maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1500</td>
<td>100%</td>
<td>10,200</td>
<td>100%</td>
<td>6,300</td>
<td>-3,900</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>60%</td>
<td>9,500</td>
<td>100%</td>
<td>9,900</td>
<td>400</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>24%</td>
<td>4,800</td>
<td>100%</td>
<td>12,300</td>
<td>7,500</td>
<td>2%</td>
</tr>
</tbody>
</table>

*Meets Komatsu 10/10/20 loading policy

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Weight Comparisons Kgs

<table>
<thead>
<tr>
<th>Haul Truck</th>
<th>Current Liner Coverage</th>
<th>Makuri Liner Coverage</th>
<th>Nett Loss / Gain Kgs</th>
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<tbody>
<tr>
<td>HD1500</td>
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<td>100%</td>
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<td>100%</td>
<td>400</td>
</tr>
<tr>
<td></td>
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<td>100%</td>
<td>7,500</td>
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</table>

Life Comparisons Hrs

<table>
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<tr>
<th>Haul Truck</th>
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<th>Makuri Liner Coverage</th>
<th>Nett Loss / Gain Kgs</th>
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<tr>
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<td>400</td>
</tr>
<tr>
<td></td>
<td>24%</td>
<td>100%</td>
<td>7,500</td>
</tr>
</tbody>
</table>
1G - Basic Liner Set with Standard Guarantee

Standard Guarantee – Full refund on any liner if it fails from faulty workmanship or materials within a period of installation of 1 month or 650 hrs whichever comes first.

2G - Basic Liner Set with Pro-Rata Guarantee

The 2G package includes the Standard 1G Guarantee plus these liners are offered with our propriety, patent pending, Makuri Technology installation process. This ensures 100% support under the liners to prevent failure from fatigue cracking of the installation welds. This greatly extends the service life of the liners and also reduces field maintenance.

Pro-Rata Guarantee

For any part of the liners system that does not reach the guaranteed minimum life and requires the machine to be taken out of service for a lined component change, a pro-rata credit will be paid based on the % of hours not achieved. i.e. if the guarantee is 4,000 hrs and the life achieved for a floor plate is only 3,600 hrs, or 90%, then 10% of the value of the failed liner will be issued as a credit note.

3G - Complete Liner Set with Lowest Cost / Tonne Guarantee

The 3G package includes the 1G & 2G guarantees, plus additional matched liners are also designed to cover the lack of protection offered by the standard OEM designs. This complete liner system will deliver the lowest cost / tonne or lowest operating cost / hour of any other liner system when using the full “cost to use” formula.

Lowest Cost / Tonne

We guarantee that the liners will also be the lowest cost / tonne, or operating hours based on total cost to use formula. If it can be shown that our liners systems cost more than any competitors liners a full refund of the cost difference will be issued as a credit note.

Cost To Use Formula

To determine the full cost of using any liner system a calculation has to be made in addition to simply looking at the “Cost to Buy”. The minimum that should be used to calculate “Cost to Use” is as follows:

1. Landed price (including shipping and taxes) +
2. Installation cost +
3. Maintenance costs +
4. Downtime costs (if associated with liners only) = Total Cost
5. Lifetime in hours or tonnes must be known
6. Cost to use = Total cost / operating hours or tonnes = cost / tonne or hour
WA HardRock Liners

Welding Alloys Group, the global hardfacing and cladding specialist has an extensive range of WA HardRock Liners - exotic clad alloy plates, available with matching hardfacing wires and electrodes for easy installation.

The HardRock range consists of:

- HardRock Chrome A - an advanced Chrome Carbide plate for high abrasion and moderate impact
- HardRock Chrome X - an advanced Chrome Carbide plate for extreme abrasion and moderate impact
- HardRock Titanium Plus - Titanium-based alloy for applications of combined high impact and high abrasion
- HardRock Max Impact - Manganese-based alloy for extreme impact and high abrasion
- HardRock Ultra Alloy - Next-generation carbide alloy for extreme abrasion and high impact

<table>
<thead>
<tr>
<th>Chrome A</th>
<th>Chrome X</th>
<th>Titanium Plus</th>
<th>Max Impact</th>
<th>Ultra Alloy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced</td>
<td>Xtreme</td>
<td>Titanium+ complex carbides</td>
<td>20% Manganese</td>
<td>Complete complex carbides</td>
</tr>
<tr>
<td>Chromium carbides</td>
<td>Chromium carbides</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-62 HRC</td>
<td>67-68 HRC</td>
<td>56-58 HRC</td>
<td>Work hardened ~550 BHN</td>
<td>62-64 HRC</td>
</tr>
</tbody>
</table>

When used with the Makuri Design + Installation methods, WA HardRock Liners can greatly extend liner life and in most cases, allow for reduced liner weight.
Makuri designs include the use of MAK-Bloks—an extreme abrasion resistant, high chrome & moly, cast alloy steel, vacuum brazed to a hardened construction steel backing plate. Many standard and unique custom designs available to specially address wear issues – see the Makuri Technology website www.makuri.asia

<table>
<thead>
<tr>
<th>WA Designation</th>
<th>Base Thickness</th>
<th>Clad Deposit Thickness</th>
<th>Clad Plate Size</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 + 2</td>
<td>2</td>
<td>2</td>
<td>950 x 1950</td>
<td>Chrome X</td>
</tr>
<tr>
<td>3 + 3</td>
<td>3</td>
<td>3</td>
<td>950 x 1950</td>
<td>Chrome X</td>
</tr>
<tr>
<td>3 + 3</td>
<td>3</td>
<td>3</td>
<td>1400 x 2900</td>
<td>Chrome A</td>
</tr>
<tr>
<td>6 + 6</td>
<td>6</td>
<td>6</td>
<td>1400 x 2900</td>
<td>Chrome A, Titanium+, Ultra Alloy</td>
</tr>
<tr>
<td>9 + 9</td>
<td>9</td>
<td>9</td>
<td>1400 x 2900</td>
<td>Chrome A, Titanium+, Ultra Alloy &amp; Max Impact</td>
</tr>
</tbody>
</table>
Our Technical ‘Spark’ Solves Your Industrial Challenges

WA Consumables
The go-to provider of advanced welding consumables

WA Machines
The go-to provider of automated equipment for wear protection

WA Integra™
The go-to provider of engineered wear protection solutions

A worldwide presence

www.welding-alloys.com

Makuri I+M+D
Advanced Liner Systems
for Large Mobile Mining Equipment

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Makuri Technology + WA HardRock Wear Plates are changing the mining world with technically better wear liner solutions

About Welding Alloys
Since its foundation in 1965, the Welding Alloys Group has become the global specialist in the development of low and high alloyed cored wires, tubular electrodes, automated welding equipment for surfacing and joining applications and through its Integra™ specialized fabrication division it now offers an advanced liner system for large mobile mining equipment using Makuri iM+O Technology.

About Makuri
The Makuri name and logo is taken from the ancient Japanese art of making Samurai swords with soft cores and hard outer steel bands for extreme impact and abrasion and is representative of the technology being used.

About Makuri iM+O
A fully integrated process that multiplies the power of:
1. a unique patented INSTALLATION method,
2. with advanced MATERIALS science, and
3. computer aided flow DESIGNS

What are the results?
- The Makuri iM+O Technology creates outstanding results far in excess of what any one or two changes can do on their own, and
- Makuri iM+O Technology sets a new benchmark, achieving both longer liner life and lower weight liner systems, which can also greatly increase the life of the components they are fitted to.

Applications
The Makuri iM+O Technology is specifically designed for the following equipment operating in hard rock and in extreme wear applications:
- Excavator Shovel Claws
- Excavator Buckets > 10m³
- Fork Trucks > 100 tons payload

Monitoring and Feedback
Technical Site Survey and Inspection

Maximum life Adding Process
Optional Instalation by WA personnel

Supply Template Clip Kit, Ready to install