

CERAMIC LAGGING TILE LOSS – CAUSES AND PREVENTION



Ceramic lagging is chosen for pulleys where a long trouble free service life is required to ensure that the conveyor is operational when required and to avoid unplanned conveyor shutdowns. This is a critical for mining companies where conveyor down time costs run into thousands of dollars per minute. While ceramic lagging is considered expensive compared to other lagging options the cost is insignificant when compared to the cost of lost production, or the cost of a pulley change out when lagging failure occurs.

A key factor in the longer service life expected from ceramic lagging is the ceramic tiles that are bonded to the rubber backing. These tiles are made from Aluminium Oxide – an extremely hard ceramic material that provides exceptional wear and abrasion resistance. It is critical to the performance of the ceramic lagging that the ceramic tiles remain in place in the

rubber backing and are not removed during service. This is a very demanding dynamic application where the tiles are loaded and unloaded every time the pulley rotates – this constant flexing will quickly find out any area of weakness in the tile/rubber adhesion.

Unfortunately loss of ceramic tiles from ceramic lagging is an all too common mode of failure. This tile loss can occur for two basic reasons:

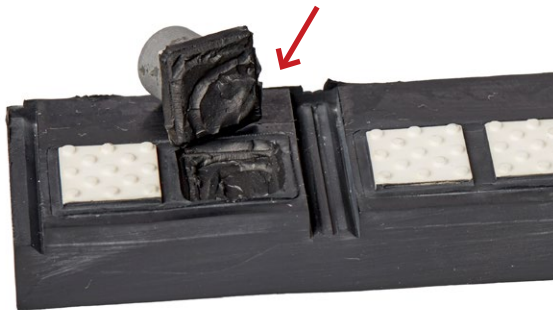
- Debonding of the tiles from the rubber backing
- Physical damage where the tiles are torn from the rubber backing

Both these failure modes for ceramic tile loss can be eliminated.

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1.) DEBONDING

In order for the aluminium oxide tiles to adhere to the rubber backing the ceramic tiles must be treated with chemical adhesion promoters or adhesives. There is a multitude of these adhesives available from different manufacturers and most if applied correctly will provide a strong “initial” bond between the ceramic tile and the rubber. This is easily tested by holding the lagging in a fixed position and applying a load to the tile. A good bond has been achieved when the load applied to the tile eventually is high enough to tear the tile out of the rubber with a layer of rubber over all the tile surface that were in contact with the rubber (see photos#1) – this is called a **100% rubber tear bond**.



Photo#1

The adhesion of the ceramic tile relies on a chemical reaction between the tile and the adhesive and the adhesive and the rubber backing.

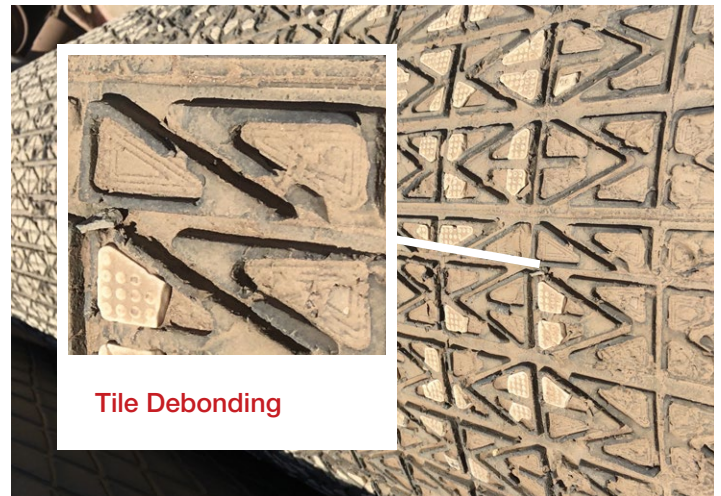
Ceramic tile loss due to debonding occurs when these chemical reactions breakdown and stop working effectively. This breakdown can be caused by many factors including outdoor exposure, UV, moisture, sub zero temperatures, prolonged service above 25C, and contact with chemicals such as acids, bases and oils. It is critical that extensive adhesion testing is carried out under the full range of conditions that the ceramic lagging will be subjected to in service to ensure that the tile/rubber bonds remain effective. Unfortunately very few ceramic lagging manufacturers do this testing.

Tile debonding is very easy to identify as the recesses in the rubber backing where the tiles are missing, are smooth, and have a detailed imprint of the back of the tile – often this can be seen as ribs or marks in the rubber surface (see photos #2 #3 and #4).



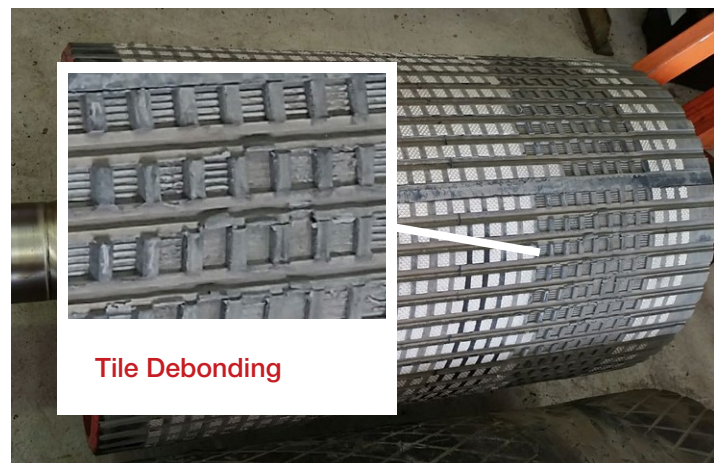
Tile Debonding

Photo#2



Tile Debonding

Photo#3



Tile Debonding

Photo#4

Causes of tile loss due to debonding include:

Manufacturing: Poor process control (there are many areas where the ceramic lagging production process can result in defective tile bonding if not controlled properly)

Operation: Adhesive not suitable for outdoor service - **the wrong adhesive has been used by the lagging manufacturer.**

- Adhesive not suitable for use at maximum and minimum service temperatures
- Adhesive not suitable for contact with liquids (water, acid, bases, oil)
- Adhesive not suitable for exposure to sunlight.

Ceramic tile loss due to debonding is always a production fault and is the lagging manufacturers responsibility.

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2.) PHYSICAL DAMAGE

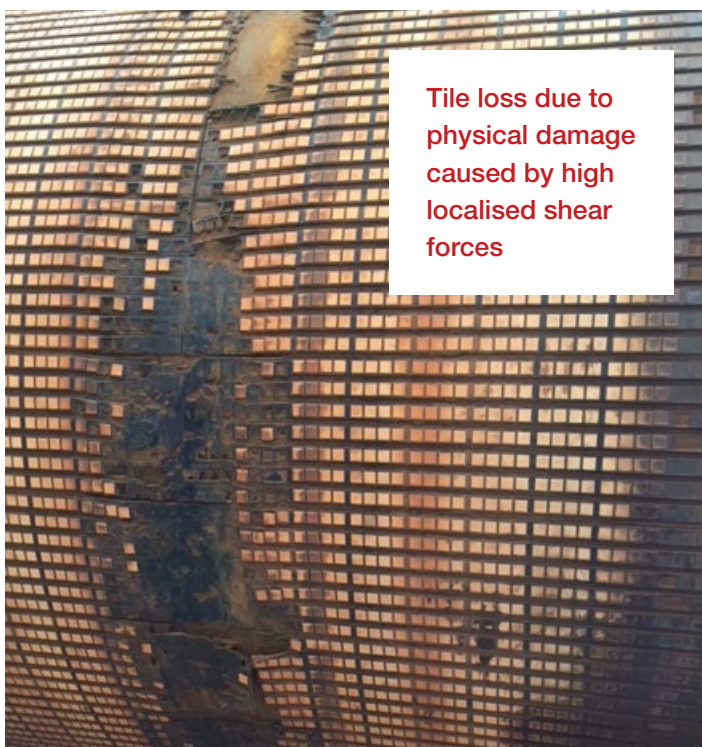
This form of tile loss occurs when the load applied to the tiles in service exceeds the strength of the rubber backing layer and results in the tiles being torn out of the rubber backing – the tiles are removed with a layer of rubber bonded to the tile on all surfaces that were in contact with the rubber (Photo# 5).



Photo#5 Tile loss due to physical damage.

Somewhat surprisingly this is more often seen on Non Drive pulleys and rarely on Drive pulleys. In particular high tension non drive pulleys subject to high localised shear stresses such as:

- Head pulleys with short transitions



Photo#6 High tension bend pulley.

- Bend pulleys in contact with the dirty side of the belt and subject to carry back. On these pulleys when the system is new lagging performance can be okay but as the centre of the belt wears the localised shear stress in the centre of belt increases dramatically and eventually will result in the tiles being torn from the lagging (see Photos 6).
- The presence of carry back on the uneven belt surface can accelerate this failure.
- Bend pulleys receiving carry back can suffer from severe tile breakage and tile loss. In these circumstances many of the remaining tiles will be broken and the recesses where tiles are missing will have rough surface.



Photo#7

Photo#7 shows a non drive pulley with Elastotec Hot Vulcanised Ceramic Lagging that has been in contact with the dirty side of the belt and with continuous exposure to carry back. Although all the tiles have been cracked, none have debonded and none are missing. This pulley remained in service until a bearing failure necessitated a pulley change out.

Consultation with conveyor maintenance personnel and careful evaluation of all operating requirements is required before selecting the best lagging for each application – Ceramic lagging is not the cure all solution for all forms of lagging failure. Ceramic lagging failures that occur due high localised shear forces, and/or the presence of carry back causing tiles loss due to physical damage, require a different type of lagging. Elastotec has a number of high performance laggings designed specifically for these difficult applications.

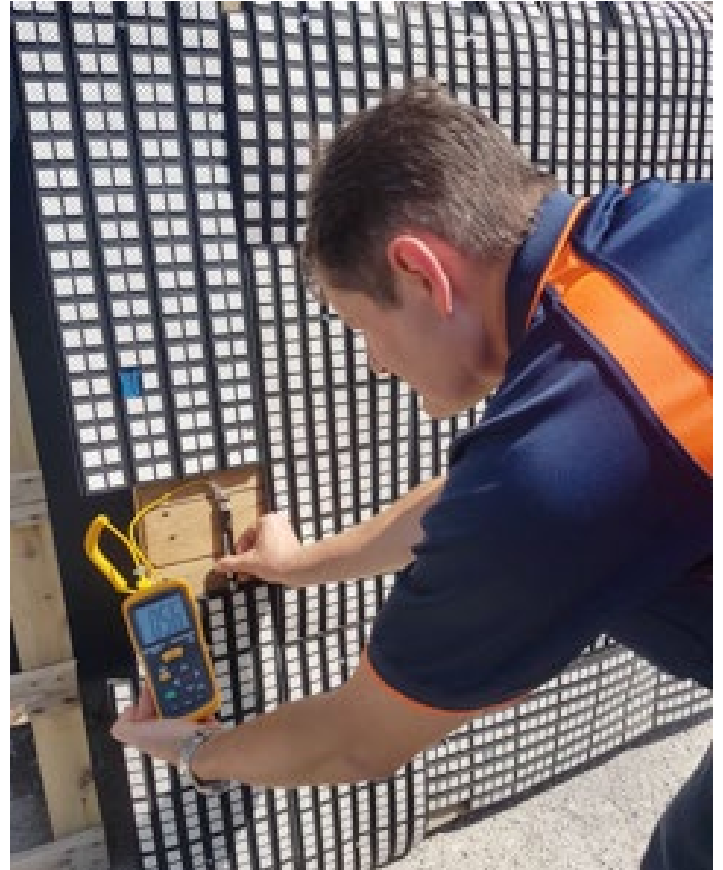
Ceramic tile loss due to physical damage is a result of incorrect lagging selection/specification and can be eliminated.

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ELASTOTEC GUARANTEE

Elastotec has spent the past seven years studying the various causes of tile loss and failure and has put in place a range of measures to eliminate tile debonding and to minimise tile loss due to physical damage.

Based on eight years of out door ageing adhesion data, extensive adhesion testing in temperatures from -40C to +60 C and detailed records for more than 700 pulleys installed internationally with trouble free operation, Elastotec guarantees no tile loss due to debonding from our ceramic lagging. A copy of our written warranty for Elastotec Ceramic Lagging is available on request.



Elastotec conducts extensive outdoor aging tests to check the ceramic tile adhesion and has seven years of test data with no tile debonding.

For more information please contact:

David Molesworth
Sales Director Elastotec
Mobile: +61 423 200 178
Email: david@elastotec.com.au

Mariana Ballestrin
International Business Development
Mobile: +61 425 318 580
WhatsApp: +61 425 318 580
Email: mariana@elastotec.com.au